

Urban Business Models

Creating collective value in European urban environments

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1. Introduction

In recent years, environmental degradation, climate change, and sustainability have been a topic of major global concern in societies as well as in business (Parmesan and Yohe, 2003; Held and Soden, 2006; Trenberth et al., 2011; Robèrt et al., 2015). Combine this with the fact that the world population growth rates are increasing exponentially (Van Bavel, 2013) and that urbanization rates are also growing, with 66 percent of the world's population expected to live in cities by 2050 (UNDESA, 2015), and you can see the grounds of an upcoming change towards a more sustainable society, in which people and communities in urban environments could have a unique role to play. Sustainability is a very broad topic that comprises different environmental, ecological, economical, and social factors. There are a growing number of tools, principles and concepts that address the sustainability challenge, which all have different characteristics and qualities while at the same time showing similarities (Robèrt et al., 2015). The global sustainability challenge requires strategic thinking and acting as well as a systematic approach in which ecological, social and financial factors are essential for the transition towards a sustainable society (Broman and Robèrt, 2015).

One of the concepts that has emerged out of the challenge of addressing sustainability issues is the Circular Economy. The circular economy is a relatively new school of thought in sustainable development (Murray et al., 2015), although its origins lead back to the 1970s. Since the late 70s, the concept has started to gain momentum (Ellen MacArthur Foundation, 2013), and it is currently trending among both practitioners and scholars, as seen by the increase in and rapid growth of articles being published on the Circular Economy (Geissdoerfer et al., 2017). The circular economy strives toward the maximum reuse of products, parts and raw materials within an economic system (Jonker et al., 2016), and focuses on the redesign of processes and products in order to *“maximize the value of resources through the economy with the ambition to decouple economic growth and resource use”* (Ghisellini et al., 2016, p. 15). The definition of the circular economy given by the Ellen MacArthur Foundation (2012, p. 7) reads: *“an industrial system that is restorative or regenerative by intention and design. It replaces the ‘end-of-life’ concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models.”* The circular economy attempts to integrate environmental wellbeing with economic activity in a sustainable way (Murray et al., 2015) and the idea of this has been adopted by numerous organizations, governments and

cities (Murray et al., 2015; Rodriguez-Coello and Carrillo-Hermosilla, 2017; Prendeville et al., 2017).

Considering the prospect that urbanization rates will continue to grow and that the population living in cities in 2050 will be 66 percent (UNDESA, 2015), it is interesting to look at the circular economy in cities. The growing amount of people that are living in cities is leading to an increased demand for resources, and even though cities only take up a small amount of the land surface of the earth, they are consuming 75 percent of all natural resources (UNEP, 2013). With this in mind, cities are now facing different pressures regarding this growth and its possible environmental impact, and they have to find a way to move from conventional strategies used for planning and managing towards those that cover the needs of sustainable cities (Lindner et al., 2017). Traditionally, the circular economy is most often used in the industrial sector and in the designing of products, but as can be seen from what is stated above, the circular economy provides a big opportunity for cities. Cities can make use of the concept for a combination of both sustainability and economic ambitions, and in trying to achieve resource efficiency (Lindner et al., 2017). According to the Ellen MacArthur Foundation (2017), in the coming years, cities will find themselves in the unique position of being able to drive a global transition from a linear to a circular economy. This unique position that cities find themselves in is further emphasized by the emerging of ‘Urban Business Models’, a new, upcoming trend connected to cities and the circular economy, as well as there being political pressure on cities from governmental organizations and other institutions. The circular economy is also becoming increasingly important on the agendas of policy makers (Blomsma & Brennan, 2017), as can be seen from different programmes and action plans issued by the European Commission, for example the ‘European Circular Economy package’ (European Commission, 2016). The circular economy taking hold in cities has not only led to there being a lot of interesting opportunities for cities, it has also come with a lot of unclarity and ambiguity, as well as a lot of gaps in research regarding circular cities and their business models (Achterberg et al., 2016; Lindner et al., 2017; Prendeville et al., 2017; Rodriguez-Coello and Carrillo-Hermosilla, 2017). This thesis aims to clarify the concept of urban business models by looking into circular economy projects happening in cities and identifying how and in what way these cities are addressing and using the possibilities of the circular economy in order to collectively create value, and how they are aided and enabled to create this value collectively, through the use of business models in. It

will add an international aspect into that by making an analysis of projects cases from different cities across Europe.

1.1: Background: The Circular Economy

In order to better understand the theories on circular cities and circular business models that are to be discussed in the upcoming two theoretical chapters, we will first take a more extensive look at the concept behind these theories, which was briefly discussed in the introduction of this chapter, that being the circular economy.

Although the phenomenon of urban business models is a new and upcoming trend, and the circular economy concept behind it also having become a trending topic in recent years, the circular economy itself is not considered new and has existed in some way for a long time. An early theory of the circular economy is presented by Boulding (1966). Although he did not actually use the term circular economy, he talked about a cyclical system that is regenerative and has zero waste, recycles finite resources, and optimizes their value (Boulding, 1966). Walter Stahel, an architect and industrial analyst, provided the insight in the 70s that the linear economy was not sustainable, and if people were to continue to consume as they did, it could lead to a lot of problems in the future (Arcadis, 2016). The ‘Limits to Growth’ report by the Club of Rome (1972) shared the same notion, as they warned that resource depletion could eventually bring down the global economy. Stahel, together with Genevieve Reday, wrote a research report for the European Commission in 1976, in which they pitched the idea of reforming the economy, by closing the material cycles and creating an economy in loops, which eventually resulted in the concept of the circular economy (Arcadis, 2016). Other research marking the beginnings of the circular economy concept include Pearce and Turner (1990), who are among the first to actually use the term circular economy. There are several authors who credit the introduction of the circular economy concept to Pearce and Turner (1990), as they investigated the linear and open-ended characteristics of the present-day economic systems and how natural resources that provide inputs for consumption and production as well as creating waste influence the economy (Geissdoerfer et al., 2017). The concept has evolved and developed since these early beginnings, and in recent years has become increasingly relevant, as can be seen from the steep increase in articles published, which were over a 100 in 2016, where there were only around 30 articles on the topic in 2014 (Geissdoerfer et al., 2017).

As this topic is often spoken and written about these days, there consequently are different definitions of what a circular economy is and what it entails, most of them showing

similarities but also ones that take different aspects into account. The vastness of this concept is further illustrated in an article published by Kirchherr, Reike and Heggert in 2017, who in said article have made an analysis of 114 different definitions of the circular economy, which they labelled and put into 17 different dimensions. In this article, the authors aimed to provide more conceptual clarity, as they believe that due to the amount of attention that the circular economy has attracted from both scholars and practitioners, the concept has started to diffuse in its meaning and has become blurry (Kirchherr et al., 2017). This is further illustrated by Geissdoerfer et al. (2017), who state that *'there is great room for improvement in terms of conceptual development'* (Geissdoerfer et al., p. 760), and Lieder and Rashid (2016) who say that *'there are various possibilities for defining [the Circular Economy]'* (Lieder and Rashid, 2016., p. 37). The definition given by Geissdoerfer et al. (2017), which they based on different contributions by authors who published on the concept in the past, says the circular economy is *'a regenerative system in which resource input and waste, emission, and energy leakage are minimised by slowing, closing, and narrowing material and energy loops. This can be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling'* (Geissdoerfer et al., 2017, p. 759). Circle Economy (2015) define the circular economy as *'a concept in which growth and prosperity are decoupled from natural resource consumption and ecosystem degradation. By refraining from throwing away used products, components and materials, instead re-routing them into the right value chains, we can create a society with a healthy economy, inspired on and in balance with nature'*. This definition differs from the definition given by Geissdoerfer et al., (2017) in that it takes the society and also nature into account, which not many definitions found on the circular economy do. Kirchherr et al., (2017) affirm this as they mention in their article that there is a negligence of consumers in circular economy definitions, and that regarding the consumer perspective and consumers' willingness to participate in the circular economy, a research gap still exists (Kirchherr et al., 2017). After analysing many different definitions, Kirchherr et al., (2017) stated that their definition of the circular economy is *'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., 2017, p. 224/225). This definition also adds another aspect to the circular economy compared

to the definitions previously stated, by saying that the system is based on business models. They consequently state that the circular economy *'is enabled by novel business models and responsible consumers'* (Kirchherr et al., 2017, p. 229). It also divides it into three different levels of where the circular economy can take place. The three definitions given are similar in their meaning but each of them names different important aspects that are relevant to consider. The understanding of a concept like the circular economy is complex and, as Kirchherr et al. (2017, p. 222) state, *'the understanding of a concept may be broader than the written definition presented'*.

Getting a better understanding of the circular economy thus requires moving beyond the many definitions of the circular economy. The Ellen MacArthur Foundation (2012), looks at the circular economy in terms of three principles that they believe it is based on. The first is to design out waste. This refers to the cycles or loops that are present in the various definitions given. The goal is for waste not to exist, meaning that products and components are designed to enable disassembling, reassembling and thus reusing (Ellen MacArthur Foundation, 2012) The second principle is to keep components and materials at their highest value in use, making a differentiation between durable and consumable products. Consumables are seen as the products or materials that are non-toxic and were made from biological ingredients that *'can be safely returned to the earth'* (Ellen MacArthur Foundation, 2012, p. 7), and durables are made out of materials like plastic, which is considered unsuitable for the biosphere and thus *'are designed from the start for reuse'* (Ellen MacArthur Foundation, 2012, p.7). The third and last principle is regenerating natural systems, where it is stated that *'the energy required to fuel this cycle should be renewable by nature, again to decrease resource dependence and increase system resilience'* (Ellen MacArthur Foundation, 2012, p.7). The linear economic system that is currently in place in most industries, a system that follows the 'take-make-dispose' pattern, has its limits and shortcomings compared to the circular economy, which is a system that is restorative and regenerative by design, and replaces the 'end-of-life' concept that is present within the linear economy (Ellen MacArthur Foundation, 2012).

Even though the circular economy is receiving more and more attention, the mindset of most people is still set within the ideas of the linear economy. A shift towards the circular economy *'must be understood as a fundamental systemic change instead of a bit of twisting of the status quo to ensure its impact'* (Kirchherr et al., 2017, p. 229). To make that shift happen successfully, and for the circular economy to become a mainstream way of thinking and

acting, it requires different things from different actors. Consumers, businesses, institutions like governments and policy makers all play a very important role. The circular economy is currently being held back due to consumers not being 'ready' yet. The consumer plays a very central and important role in the shift towards the circular economy. It requires them being more aware of the concept itself in the first place, as well as a collective change in attitude, as consumers are the most important enabler of the circular economy (Gallaud and Laperche, 2016). On the other hand, we have businesses and organizations, who need to change their ways of working starting from the creation of new business models suited to the circular economy, as well as changes in use of materials, responsibilities, and structures of ownership (Arcadis, 2016). Lastly there are the institutions such as governmental organizations, who play a huge part in enabling the circular economy but are currently still hindering it with unsuitable institutional frameworks and regulations, as well as the prevailing accountancy and financing rules (Jonker et al., 2016). Despite this, governments and business leaders are more often starting to acknowledge that in order to create and maintain value in the long-term, a new economic model like the circular economy, which is clearly an opportunity for value creation, is needed (Ellen MacArthur Foundation, 2017). The rationale of both the economy as well as the society for moving towards the circular economy is continuously increasing, awareness of the limits of the linear economy are growing (Arcadis, 2016), and the time has come for both businesses and society to '*embrace the new standard: the Circular Economy*' (Arcadis, 2016, p. 5).

1.2: Problem formulation

To the background of the facts that were given in the first part of the introduction, about the ongoing population growth, urbanization, and sustainability challenge, as well as the theory written about one of the tools that can tackle this sustainability issue, that being the circular economy, it has become clear that this is an interesting and currently very relevant area of research. From the definition given by Geissdoerfer et al. (2017) it was made clear that the circular economy can be operated at different levels, micro, which includes consumers and companies, meso, for example eco-industrial parks, and macro, which are cities, regions and nations (Geissdoerfer et al., 2017). In this research, the decision was made to look at cities. Currently, a research gap exists on the implementation and outcomes of the circular economy in cities, whereas consumers and especially businesses and organizations are often researched (Geissdoerfer et al., 2017; Lindner et al., 2017; Prendeville et al.). On the other hand, sustainability in cities is also being researched, for example by van Berkel et al. (2009) who

researched ‘eco-cities’, Renz (2015) who researched the ‘creative city’, as well as research on ‘smart cities’ (Caragliu et al., 2011; Mulligan, 2014; Navidi and Hashemi, 2016). Cities can clearly play an important role in tackling sustainability issues, but making a change within a city requires new forms of policy and regulations that help break down barriers and unsustainable practices, and thus requires new strategies of urban governance (Wittmayer and Loorbach, 2016). At the city level, tackling the issues of climate change and sustainable development requires a high level of involvement from the urban authorities (Lindner et al., 2017), as well as the fact that all actors need to take the long-term objectives into account (Predeville et al., 2017). The actors in cities include institutions and citizens as well as businesses. From this, it can be seen that cities and sustainability put together come with complexity regarding all that is involved, but at least there has been a lot of research into this. Regarding cities and the circular economy, this is not the case. Predeville et al. (2017, p. 5) state that there is: *‘a lack of attention to the subject in the literature so far’*, and that the research has been dominated by a focus on business and competitive advantage (Predeville et al., 2017). This doesn’t mean that the circular economy in cities has been ignored completely by scholars, it has just not been the main focus. In their article, Predeville et al., (2017) list numerous publications of research into circular cities, such as City of Amsterdam, 2013; Metabolic et al., 2015; Glasgow Chamber of Commerce et al., 2016. Other research that can be found on the Circular Economy in a city context includes Ghisellini et al., 2016; Rodriguez-Coello and Carrillo-Hermosilla, 2017; and Lindner et al., 2017. Predeville et al. (2017) also highlight that there is research that has developed frameworks for the circular economy on micro and meso level, but not on the macro level, as well as that there is a need for more empirical data on the circular city topic (Predeville et al., 2017).

Despite the lack of research and publications on the circular economy in cities, the circular economy is in fact taking form at regional and municipal level, as there are groups of citizens that are undertaking circular initiatives in several kinds of ways (RLI, 2015). The circular economy is gaining momentum in cities, which also leads to a more pressing need to identify and fill the research gaps that come with this. One of the gaps identified states that there is a lack of insight into the current reality of the circular economy in cities (Lindner et al., 2017). A shortcoming of current research on circular economy in cities is identified by Predeville et al., (2015), who say that currently a lot of the research has taken a Chinese viewpoint, but that an understanding of local context is also of importance, and therefore there is a need for research on the circular economy in cities that takes a European perspective.

Secondly, the circular economy requires new and innovative business models for production that can be used as an enabling tool for the circular economy (Lindner et al., 2017), and thus also for the circular economy in cities. In order to create value in a city context through the circular economy, those new and innovative business models are required (Jonker, 2018).

Having identified the research gaps and shortcomings of the current literature on the circular economy in cities, and the need for new and innovative business models for cities and the circular economy, a more specific focus can be made as to what the research in this thesis will entail. The background provided on the circular economy has made it clear that the concept is broad, and from there, the decision to focus on the macro level, cities, was made. Regarding cities and the circular economy, several research gaps were identified, including the need for research from a European perspective as well as the need for a better understanding of what the current reality of the circular economy in cities is. The decision was made to look at the circular economy in cities in terms of the new business models that are needed for the circular economy to become successful in cities. Consequently, the objective of this master thesis research has been formulated as follows:

The objective of this research is to gain an insight into how different types of urban business models are currently taking form in circular economy projects in cities across Europe that are collectively creating value within those cities, in order to contribute to the theory on the circular economy, as well as making practical recommendations for such projects regarding the use of business models.

The main research question following the objective of the research is:

How are constituents in an urban environment collectively creating value through the use urban business models?

To be able to answer this question, the following sub-questions were determined that will help answer the main research question:

- What current themes can be identified with regards to the circular economy in European cities?

- How do the business models that are found within European cities relate to the typology of urban business models?

The research will be exploratory and have a qualitative nature. To answer the sub-questions and the main research question, a document analysis will be done. This thesis will look into

circular economy projects happening in cities or in city-like environments, and as said will add an international aspect to that, by looking at projects in different cities across Europe. The outcome of this will be a typology of urban business models, that will contribute to the theory of the circular economy and is connected to the theory on value creation within cities.

1.3: Outline of the thesis

The structure of this thesis will be as follows: in chapter 2, the theories and perspectives on circular cities and urban business models will be discussed, followed by chapter 3 which will focus on the underlying theory of value creation that is a key component of this research, and will present the proposed typology of urban business models that follows from the discussed theory. Chapter 4 will be the methodology, where it will be stated what methods are used and why, what data will be used and how the analysis will be done. In this chapter, the research ethics will be discussed as well. Chapter 5 then follows with the analysis and results. The final chapter will be chapter 6, in which the conclusion will be given as well as the discussion on the research, including the limitations, practical implications and theoretical recommendations, and the methodological reflection will be discussed.

2. Circular cities and business models

In this chapter, the various key concepts that are relevant for this research will be discussed, and the definitions and different theories regarding these key concepts will be further elaborated on.

2.1: Circular Cities

In developing sustainable cities, favouring the circular economy is identified as one of the priorities (GDF SUEZ, 2013). Prendeville et al., (2015) define a circular city as: *“a city that practices CE principles to close resource loops, in partnership with the city’s stakeholders (citizens, community, business and knowledge stakeholders), to realize its vision of a future-proof city”* (Prendeville et al., 2015, p. 17). The Ellen MacArthur Foundation (2017) state that: *“a circular city embeds the principles of a circular economy across all its functions, establishing an urban system that is regenerative, accessible and abundant by design”* (Ellen MacArthur Foundation, 2017, p. 7). Rodriguez-Coello and Carrillo-Hermosilla (2017) argue that looking at the circular economy from an urban perspective is necessary and say that reasons for this are the growing population density and resource consumption, the possibilities of collaboration within cities due to geographic proximity, as well as that the change of socioeconomic systems towards the circular economy requires strategies of urban government and the participation of urban authorities (Rodriguez-Coello & Carrillo-Hermosilla, 2017). Cities are not only the drivers of innovation and the economy, but cities and urban areas are also currently housing over 70 percent of the European population, a number that is still growing (European Commission, 2018a). An example of this is the city of Amsterdam, whose population grows with around 10000 new inhabitants annually. The rapid growth is straining the city’s resources, along with a greater demand for products and services and an increase in material and energy consumption. This development bodes opportunities for the circular economy in this city, to achieve a higher quality of life in the city in a sustainable way, for example through the innovation of new productive models that are less resource intensive (Circular Amsterdam, 2016). Cities are thus in a unique position to play an important role in the transition towards the circular economy, which is further illustrated by the Ellen MacArthur Foundation (2017), who say that there are a number of factors that enable the unique position of cities as drivers of the transition, while at the same time greatly benefitting themselves from said transition. One of these factors is the abilities that local governments in cities have in shaping urban planning and policies, through which they can play an active role in adopting circular economy principles into their policies. On the other hand, cities have a high concentration of resources and talent in their citizens within a small

geographic area, which can be effectively used by those citizens in local circular economy initiatives (Ellen MacArthur Foundation, 2017). Another benefit that cities enjoy is that local governments can operate quicker compared to their national or international counterparts (Ellen MacArthur Foundation, 2015).

It is clear why cities are an interesting environment, where the circular economy could flourish and aid in cities becoming more sustainable in the future. Nevertheless, there are also some difficulties underlying circular cities which will be looked at later on. Within the agenda of the European Union, urban policy has become increasingly important recently (Olejnik, 2017). This is why it is also important to look at the actions that Europe is undertaking regarding the European policies on the circular economy in general, as well as what they are doing regarding circular cities and urban policies. The next paragraphs will look at the elements of circular cities, the actors in cities, and the influence of the European Union and its policies on the development of circular cities throughout Europe.

2.1.1: Elements of Circular Cities

The definition by the Ellen MacArthur Foundation (2017) given in the beginning of this chapter stated that circular cities embed principles of a circular economy across all its functions, resulting in a regenerative, accessible and abundant urban system. The goal of a circular city would be to generate prosperity, increase liveability, and improve the city's flexibility, ultimately leading to value creation (Ellen MacArthur Foundation, 2017). In order for a city to become circular, there are different elements that can be included. The Ellen MacArthur Foundation identifies five elements in their vision for a circular city, which are the built environment, energy systems, urban mobility systems, the urban bio economy, and production systems. These five elements will be explained below and are further illustrated by examples from cities that have already incorporated these elements into their action plans in becoming a circular city.

The built environment is important to circular cities, because they not only have a high environmental impact but also present opportunities with regards to for example energy use and waste production (Pomponi and Moncaster, 2017). Cities are obviously full of buildings, and the construction sector is the world's largest consumer of raw materials (WEF, 2016), but despite many attempts, the environmental impact of buildings still remains a difficult issue to tackle (Pomponi and Moncaster, 2017). The Ellen MacArthur Foundation (2017) suggests that in a circular city, the built environment should be designed in a flexible and modular manner and minimize the use of new materials. They state that efficient construction techniques

should be used when building, buildings should be shared, and components of buildings are to be maintained and renewed when necessary (Ellen MacArthur Foundation, 2017). An example of this can be found in the action plan of ‘Circular Amsterdam’, in which it is proposed to demolish older, unused or irrecoverable buildings intelligently so that the materials can be reused. Another proposal includes the intelligent design of buildings in a way that they can be adapted whenever there is a change in use of the building, based on modular design and reused materials (Circular Amsterdam, 2016). Another project in Austria has developed a building-passport concept with regards to the built environment element. The passport is part of a building material information systems and connects actors such as architects and suppliers. The aim of this project is to enable reuse and recycling of building materials at their highest quality, and with this the prevention of waste in the construction sector (European Environment Agency, 2015).

The element ‘energy systems’ means that energy systems within cities are to be made in a way that will allow for effective use of energy and cost reduction all while have a positive impact on the environment (Ellen MacArthur Foundation, 2017). The city of Glasgow is running a project that makes use of the residual heat that is generated within bakeries, where the baking process accounts for around 80 percent of the energy consumed. The residual heat is used for other purposes, for example water heating and the heating of other areas (GCC, 2016). The city of Balma, in France, has adopted a solution for collective heating, in which a power plant consisting of a wood boiler and high-temperature solar collectors is supplying to a network and covers more than 80 percent heating and hot water needs in the neighbourhood connected to it (GDF SUEZ, 2013).

The urban mobility system should be accessible, affordable, and effective, meaning that transportation for example should be electric powered and shared, the infrastructure is adapted to the needs of the citizens, and lastly air pollution and congestion should be eliminated as much as possible (Ellen MacArthur Foundation, 2017). In Dijon, France, the urban mobility system element of circular cities can be seen in a project that has developed an electrical streetcar system that is solar powered and provides for both the citizens and visitors of the city of Dijon (GDF SUEZ, 2013). Another circular travel solution is found in Denmark, where the so-called ‘GoMore’ platform was founded, where drivers can invite others onto their ride on a journey that was already planned, making the trip more efficient, reducing the number of cars on the street, and in doing so benefiting the environment (State of Green, 2016).

Regarding the urban bio economy, the Ellen MacArthur Foundation says that *‘nutrients will be returned to the soil in an appropriate manner, while generating value and minimising food waste’* (Ellen MacArthur Foundation, 2017, p. 8). Next to that, they describe the concept of ‘urban farming’, which means creating closed and local loops to produce foods such as fruit and vegetables, and reusing food to eliminate as much waste as possible, through which the city can partly provide its own food and capitalize on both the materials and nutrients already in use (Ellen MacArthur Foundation, 2017). In the ‘Circle Amsterdam’ action plan an example of this can be found under the pillar of ‘nutrient recovery’, where the aim is to recover nutrients from human biological waste. This waste is made up out of high value nutrients and can be used for the generation of for example compost or fertilizer (Circular Amsterdam, 2016). The action plan for circularity in Glasgow describes another example of the urban bio economy element, with what they call a ‘high-value cascade’. The project entails interaction between bakers and beer companies. Bakers can make use of the grains that are left as waste from the beer production process in making bread or other pastries. Through this project, a 50 percent reduction of flour needed for bread making can be achieved while at the same time reducing waste from the beer production (GCC, 2016).

The production systems are aimed at the creation of so-called ‘local value loops’, meaning more local production as well as increased exchanges of value in the local economies (Ellen MacArthur Foundation, 2017). In the city of Peterborough in England, a collaborative project can be found where local SMEs work together in constructing an economic model that is viable and sustainable. It has led to the ‘Fengate business cluster’, which helps improve efficiency of resources and provides shared solutions for the local companies involved in it (Rodriguez-Coello and Carrillo-Hermosilla, 2015).

2.1.2: Top-down and bottom-up actors in Circular Cities

From the definitions of circular cities as well as the hereabove identified elements of such cities, it could be argued that in circular cities many different actors are important, with the three key actors being the local government, businesses, and the citizens. Prendeville et al. (2015) have developed a conceptual framework through which they provide an understanding of the ways that the circular economy could be used within cities. In this framework, a distinction is made between bottom-up and top-down changes. Top-down changes in cities moving towards circularity are changes that are institution driven, which for cities would be initiated from the local government. Bottom-up changes towards circular cities are initiated from small groups of individuals, and are thus run by civil society, but can also mean

businesses, communities or NGOs (Prendeville et al., 2015). The distinction between top-down and bottom-up initiatives in cities becoming circular is an important one to make, though they are often complementary with each other too, as small, local, bottom-up initiatives can be stimulated and supported by the local government's involvement. Cities can thus become circular through bottom-up or top-down initiatives, or a combination of both.

Regarding the top-down interventions that can be used by the policymakers of a local government, the Ellen MacArthur Foundation (2015) has developed a 'Toolkit for Policymakers', in which there are six types of policy interventions that are outlined, and can be used by policymakers trying to implement the circular economy. There appears to be a need for a toolkit such as this one, because even though many local governments are willing to include the circular economy within their agendas, it is often unclear to policymakers what a circular city means in practice, which leads to a hard time implementing it, as well as policymakers often depending on businesses to implement the circular economy rather than the government (Prendeville et al., 2015). The framework presented by the Ellen MacArthur Foundation (2015) suggests that a transition towards a circular economy is dependent on the actions of policymakers within national or local governments, and aims to aid such a transition through the framework they have created for policymakers. The six types are education, information and awareness, collaboration platforms, business support schemes, public procurement and infrastructure, regulatory frameworks, and fiscal frameworks. The implementation of policy on the circular economy within local governments in cities presents an interesting topic of research, but in this thesis the decision was made to focus on the business models that have emerged from the circular economy in cities, rather than the top-down actions of the government regarding policies that can lie behind it. Nevertheless, it is important to acknowledge that in the distinction between top-down and bottom-up changes, the top-down changes are mostly in the hands of policymakers.

The changes in society coming from the bottom-up are in the hands of citizens and the community, and as said earlier, businesses and NGOs are also considered to be in the bottom-up category. Within the topic of sustainability in cities, which is underlying to the concept of circular cities, there is a big role to play for the citizens and communities that want to lead a sustainable lifestyle and create a vision for the future within their own environment (Prendeville et al., 2015). These citizens and communities can band together to create innovative solutions for sustainability which are suited to their own local scenarios (Prendeville et al., 2015). Local communities in cities that are undertaking action are a

powerful tool when it comes to the circular economy taking hold in cities, as the locals are likely to be strongly connected to their own living environment, and also know the opportunities and possibilities that their own environment have to offer. However, though research acknowledges this important role of the citizens as stakeholders, they are often not included enough in building a circular city vision, because there is often a bigger emphasis on the major stakeholders within an urban environment, rather than the ‘smaller’ local citizens (Prendeville et al., 2015).

Though the power of citizens is undisputable, bottom-up actions are often found to be constrained by barriers regarding politics, regulations, and infrastructure (Bergman et al., 2010). In order for cities to successfully become circular, the changes coming from the bottom-up as well as from the top-down need to be in sync with each other, meaning that policymakers should not only think about making policies, but should also play an active role in stimulating the citizens and communities that are undertaking action from the bottom-up (Prendeville et al., 2015). Cities are in a great position because local governments are often able to act quicker than their national and international counterparts with regards to developing and implementing policies (Ellen MacArthur Foundation, 2015), however, local governments are often enthusiastic about the ideas of the circular economy but lack understanding of what to actually do to become a circular city (Prendeville et al., 2015).

2.1.3: Europe’s influence on Circular Cities

To provide a background to the international approach that this thesis adopts in looking at the circular economy, this paragraph will look at how Europe has adopted the circular economy into its plans and policies and how they are supporting and stimulating circular economy initiatives throughout Europe. From the distinction made in the previous paragraph, the European Union can be seen as a top-down actor, as it is the biggest overarching influence in Europe. This means that Europe could play a defining role in the success of the circular economy in Europe and thus, it is important to look at this actor.

The circular economy concept can be found in many different projects and action plans of the European Commission. An example in the Horizon 2020 programme, which is Europe’s biggest research and innovation programme ever, and will invest almost one billion of its budgets into the financing of projects and initiatives on the circular economy, as well as into research and innovation (European Commission, 2017). The European Commission has also issued an action plan for the circular economy named ‘Closing the Loop’, in which they set out that their aim is to make sure that the correct regulatory framework will be

implemented, and to remove the obstacles that stem from European legislation, in order to make room for favourable conditions for the circular economy to flourish in Europe (European Commission, 2015). This action plan focuses on different priority areas in the specific challenges regarding the circular economy, such as plastics, food waste, critical raw materials, and bio-based products (European Commission, 2015). From the recent actions that the Europe has taken, and the plans that they have drawn up for the future, it is clear that there is a place for the circular economy on Europe's agenda.

There is a need for action at a European level because the present model of value creation in the European economy is notably wasteful, and the European economy is still mostly using a take-make-dispose system (Ellen MacArthur Foundation, 2015). If Europe takes leadership in the shift towards a circular economy, they can not only drive innovation and create job opportunities, but also could secure first mover advantages in the global economy (European Environment Agency, 2015). The Ellen MacArthur Foundation (2015) suggests that if Europe wants to accelerate this shift, they first need to acknowledge the systemic nature of the change, meaning that coordinated and aligned actions are required, and that all policy domains and sectors will be affected. Interventions regarding policy would be needed at the European level in the member states, and those need to be complementary to national policies. Therein lies one of the major sources of difficulty, as it is challenging for Europe to create an overarching policy regarding the circular economy that will be complementary to the national policies, which will likely have differences between themselves. Besides that, it is recognized that there is a need for circular initiatives at the European, national, and city levels to be able to fully benefit from the opportunities that the circular economy brings (Ellen MacArthur Foundation, 2015). Again, both cooperation and coordination between these different levels could prove to be difficult due to the differences that are inherent to the many levels. Even though the European Union is the most powerful top-down actor that Europe has, it does not necessarily mean that this power will or can be used in the right way, and perhaps the shift towards a circular economy in Europe is better off coming from bottom-up, with only the necessary, complementary regulations and policies coming from above.

One of Europe's action plans that will be highlighted here, because it is specific to the context of circular cities, is the 'Urban Agenda for the EU', in which they acknowledge that cities are essential to the development of the circular economy. The agenda focuses on twelve priority themes divided over three pillars, which are Better Regulation, Better Funding, and

Better Knowledge. Each of the themes is connected to a partnership that will bring together cities, European member states, and European institutions (European Commission, 2018a). The plan presents concrete actions in order to *‘realise a city where residents and entrepreneurs do not think in terms of waste, but in terms of resources with permanent economic and social value’* (European Commission, 2018a, p. 10). The plan is very concrete and, on each pillar, presents the different themes with the specific problem, how existing EU policies, legislations and instruments contribute to it, what concrete actions are needed, with which partners, and on which timeline. The first pillar is ‘Better Regulations’, which is focused on the future design and revision of existing regulations, in order for them to be better suited to the needs, practices and responsibilities of the urban environment. An example of one of the themes that falls under this pillar is waste legislation, where they are looking to support the transition from waste management to resource management by setting up a new regulatory framework that is better suited to the needs of resource management within a circular economy context (European Commission, 2018a). The pillar ‘Better Funding’ is focused on trying to improve the opportunities for the funding of urban authorities across Europe’s policies and instruments, in order to better support those urban authorities regarding their circular economy initiatives. An example of one of the plans under this pillar is the preparation of the so-called ‘Circular City Funding Guide’, which is aimed at helping cities gain access to funding for circular economy projects. Cities can use their own projects to promote the circular economy but could also support projects brought about by local businesses or citizens. Both of these require funding to succeed as they often lack budget, and this action plan aims to create more awareness on existing sources of funding as well as guidance for cities on how to set up funding programmes for circular economy projects themselves (European Commission, 2018a). The pillar ‘Better Knowledge’ is aimed at enhancing the knowledge base on issues of an urban nature and creating a platform for the exchange of best practices and knowledge regarding the development of the circular economy in an urban context. Under this pillar, the plan for a ‘Circular City Portal’ is elaborated on, which is a web-based tool that was made to provide information and resources on the development of the circular economy and sharing practical know-how on different subjects. It aims at both guiding and inspiring cities through an openly shared knowledge platform, as many cities lack knowledge on the circular economy and its complementary business models, as well as often lacking a coherent plan, strategy or roadmap when it comes to becoming a circular city (European Commission, 2018a). As said earlier, the actions that the EU Urban Agenda proposes are very concrete and are likely to improve regulations, funding and

knowledge on the circular economy in many ways. Still, due to the underlying difficulties that were previously discussed, it is unsure how the agenda will contribute to the shift to a circular economy in Europe in the end.

The difficulties that were touched upon earlier in this paragraph are further illustrated in an article by Repo, Anttonen, Mykkänen and Lammi published in 2018, in which they explore the lack of congruence between citizens expectations and Europe's policies regarding the circular economy. They argue that even though consumers or citizens are obviously part of the economy, their role is not prominent throughout most European policies (Repo et al., 2018). Many articles in general note the importance of the consumer or, in the case of cities, citizens in achieving a successful shift to a circular economy, yet it is often unclear what the meaning of citizens could actually be for the circular economy. The ignorance of or lack of attention to citizens could prove detrimental for the realization of a circular economy in Europe. The lack of congruence that Repo et al. (2018) find regarding European policies and citizen perspectives on the circular economy confirms that Europe should pay more attention to the possibilities that stem from Europe's citizens' ideas and initiatives regarding the circular economy. Not only does the lack of congruence give a signal that perhaps the policies should be revised, it also suggests that in the case that congruence is accomplished, it would provide momentum to the actual achievement of the set policy goals (Repo et al., 2018). The article also pays attention to the difficulties when it comes to creating overarching policies at the European level that are complementary to the national or city levels, even though the national and city levels are likely quite a lot different between countries. The areas that Europe has prioritised in its policies so far may not be of the same importance for all the European member states, and even though at European level the identified priority areas make sense, they may not transfer to the needs of countries or cities (Repo et al., 2018).

The EU's European Commission has developed a monitoring framework to monitor the implementation of their own circular economy action plans, which, even though they acknowledge it as a challenging task, they say is needed in order to assess the progress towards a circular economy in Europe (European Commission, 2018b). From all that is discussed above it has become clear that Europe is serious about creating a circular economy in Europe and has set plans in motion to be able to accommodate a shift to the circular economy, but they are also faced with many challenges such as the complementarity of the European policies to national and city-level needs, as well as the potential lack of congruence between European policies and the citizen perspective, which could hamper the success of the

policies' implementation and outcomes. These views and findings are important to take into account in creating the typology of urban business models, as they may have implications and are underlying to the success of these new business models in the circular economy.

2.2: Business models in the Circular Economy

This paragraph will focus on business models in the circular economy, but not yet specifically focused on business models in cities. Before looking at the concept of urban business models, it is important to get an idea of business models in the circular economy in general. Circular business models are important to take into account, because the circular economy not only depends on policymakers like the European Commission, but also on the introduction of circularity into business models (Lewandowski, 2016). Planing (2015) argues that the transition towards a circular economy is dependent on four building blocks, of which 'new business models' is the second one. Linder and Williander (2017, p.2) define a circular business model as: *'a business model in which the conceptual logic for value creation is based on utilizing the economic value retained in products after use in the production of new offerings'*. The circularity of a business model is determined by the amount of new products that have come from used products, and always involves processes such as for example reusing, remanufacturing, and recycling (Linder and Williander, 2017).

A core component of circular business models is the value proposition. Osterwalder and Pigneur (2010, p. 5) state that *'business model innovation is about creating value, for companies, customers, and society'*, which applies to the creation of new business models in the circular economy. Value creation is in fact seen as the core of business models, not necessarily only in circular business models, but in business models in all economies. A business model is a description of how different parties within a certain context and with certain resources organize the creation of value (Jonker et al., 2016). The value proposition of the circular economy offers a product, product-related service, or a pure service, and allows the consumer to do what is needed while at the same time providing additional benefits (Lewandowski, 2016). It is important to keep the underlying aspect that is the value creation in mind for now, as it is inherently connected to circular business models and thus also to urban business models. The concept itself will be further elaborated on in chapter 3.

As the circular economy is becoming increasingly important and popular, circular business models are also often written about in literature, which has led to many different business model types and categorizations that can be identified. Jonker et al (2016) identify three characteristics and five building blocks of circular business models. The three

characteristics are the closing of loops, servitization replacing ownership, and more intensive use of functionality. The closing of loops being an element of circular business models is obvious, as it is the central idea of the circular economy. Servitization replacing ownership is related to the shift from products to service that comes with the shift to the circular economy. The lifespan of products is expanded through presenting them as a service, for example in the form of leasing or renting products (Jonker et al., 2016). The last element is the more intensive use of functionality, which in name speaks for itself; if the function of products is made use of more intensively, aiming at optimal use, then creation of value is achieved through efficient use of products and materials (Jonker et al., 2016). From these elements, the authors name the five building blocks that they believe are essential to circular business models, which are: the realization of loops, the pursuit of value creation, choosing a fitting strategy, shaping an organization that fits organizing between-parties, and developing revenue models.

‘The realization of loops’ is again connected to the core of the circular economy. An organization has to aim at the closing of loops within all its core activities, otherwise they will never be able to work according to a circular business model (Jonker et al., 2016). ‘The pursuit of value creation’ has to do with value creation as the underlying principle to the circular economy. Business models based on circular economy principles are aimed at more than financial value creation, they aim to create social and ecological value as well. Jonker et al. (2016) state with regards to this building block that organizations that are closing loops but are not booking sustainability profit are not working according to circular business models, as they are neglecting the creation of multiple value (Jonker et al., 2016). The building block ‘choosing a fitting strategy’ states that doing business in a circular way needs a clear strategy, because in organizations working according to circular economy principles, the main focus is no longer on selling products to create value, but on creating value through for example adding value to the lifespan of a product (Jonker et al., 2016). ‘Shaping an organization that fits organizing between-parties’ is an important building block, because the authors state that no organization would be able to operate in a circular way by itself, as cooperation as well as cohesion between organizations in creating multiple values is a prerequisite to circular business models (Jonker et al., 2016). The last building block, ‘developing revenue models’ is focused on the need for the revenue models to change and redevelop to fit the needs of circularity (Jonker et al., 2016). These five building blocks clearly state what is needed for developing circular business models and how organizations can create business models aimed

at working in a circular way. The prerequisites to the creation of circular business models have thus become apparent from these building blocks. The building blocks will now be used to analyse some existing types of business models below.

Accenture (2015) distinguishes five types of circular business models, which are Circular Supplies, Resource Recovery, Product Life Extension, Sharing Platforms, and Product as a Service. The ‘Circular Supplies’ business model is based on replacing linear resource approaches while removing inefficiencies and cutting waste, which for example means *‘providing renewable energy, bio based- or fully recyclable input material to replace single-lifecycle inputs’* (Accenture, 2015, p. 13). The ‘Resource Recovery’ business model is aimed at the recovery of the embedded value of a product that is at the end of its lifecycle and using it for another product, transforming waste into value by doing so (Accenture, 2015). The ‘Product Life extension’ business model uses for example the repairing and upgrading of products, and in doing so assures that *‘values that would otherwise be lost through wasted materials are instead maintained or even improved by repairing, upgrading, remanufacturing or remarketing products’* (Accenture, 2015, p. 14). The ‘Sharing Platforms’ business model is about collaboration among the users of products, aiming to increase the utilization rate of products through making it possible that people are able to share the use, access or ownership of those products (Accenture, 2015). The last business model, ‘Products as a Service’, *‘provides an alternative to the traditional model of “buy and own.”’* (Accenture, 2015, p.14) and enables the uses of products through a pay-for-use or lease arrangement. The building blocks of creating loops and pursuing value creation are clearly shown within these business models. Choosing a fitting strategy, organizing between-parties and the development of revenue models are less clearly shown throughout these five types of circular business models, though generating new revenue is mentioned throughout the models and could thus be seen as an underlying aspect to these five types of business models. Furthermore, it could be argued that ‘choosing a fitting strategy’ is what this publication by Accenture (2015) is trying to help companies and organizations do, as it is aimed at raising awareness on how adopting the circular economy as a company’s strategy could create many advantages, and that strategy is mentioned as one of the ‘core capability shifts’ for the adoption of circular business models. The block that seems to be missing is ‘shaping an organization that fits organizing between-parties’, which is not mentioned within the five types of circular business models or the surrounding information that the publication provides. There is mention of cooperation with consumers, suppliers, manufactures and retailers within collaborative

circular networks but the true importance of cooperation, because as said before no organization would be able to operate in a circular way by itself, is found to be missing from these circular business models that Accenture (2015) has developed.

Bocken et al., (2016) discuss potential circular business model strategies in their article. They state that the difficulty in moving towards a circular economy and the use of circular business models is that it is a radical change that requires new ways of thinking and doing business (Bocken et al., 2016). The business models they describe are aimed at slowing resource loops, which has resulted in four models: access and performance, extending product value, classic long life, and sufficiency, and aimed at closing loops, which leads to two models: extending resource value and industrial symbiosis (Bocken et al., 2016). The models are explained through the value proposition of each model, how value is created through the models, and how the value is captured. The first model, 'access and performance', involves *'providing the capability or services to satisfy user needs without needing to own physical products'* (Bocken et al., 2016, p. 313). The value proposition is the delivery of a service, which provides access to and performance of a certain product, instead of the product being owned by the consumer. Value in this model is created due to the fact that the company takes over the service and maintenance of the product while the user can enjoy the benefits (Bocken et al., 2016). The second model, 'extending product value', looks to exploit *'residual value of products, from manufacture, to consumers, and then back to manufacturing'* (Bocken et al., p. 313). It is thus mostly concerned with remanufacturing, with the value proposition being the exploitation of the residual value leading to an affordable 'new' product through the process of repair or remanufacturing. Value is created through take-back systems and collaborations that enable the return of products, and the value is then captured by for example the reduction of material costs, which in turn can lower overall costs (Bocken et al., 2016). The 'classic, long-life' model is focused on *'delivering long-product life, supported by design for durability and repair'* (Bocken et al., 2016, p. 313). Products are designed to be more durable and easily repaired, with the value proposition being products of high quality that will last longer. Value is created through this durable product design, accompanied by high customer service levels with regards to for example repair, and then captured through the product having a premium price that covers its quality level and the service included over the products' lifetime (Bocken et al., 2016). The fourth model aimed at slowing the loops, 'sufficiency', is similar to the third one and aimed at long-lasting products, but differs in that it takes a 'non-consumerist' approach, meaning that there are no sales commissions and the

focus is on reducing end-user consumption. The value proposition is the same as in the last business model, aimed at high quality products that are durable, with high service levels. The value is created in the non-consumerist approach, through fewer, but high-end sales, and value is then captured similar to the last model again, through a premium price (Bocken et al., 2016). The first model aimed at closing the loops, ‘extended resource value’, exploits the residual value of resources, through the *‘collection and sourcing of otherwise “wasted” materials or resources to turn these into new forms of value’* (Bocken et al., 2016, p. 313). The value proposition is reducing material costs and the product price overall, through making use of the residual value of resources. Value is created similarly to the ‘extending product value’ model, through take-back systems and collaborations in order to collect materials and is then captured through using these materials that would otherwise be wasted. The second model, ‘industrial symbiosis’ is a more process-oriented solution, which concerns *‘using residual outputs from one process as feedstock for another process’* (Bocken et al., 2016). It is similar to the first model in the way that it turns waste from one process into something usable for another process, but the difference is that ‘extending resource value’ happens more at the product level, while ‘industrial symbiosis’ at the process and manufacturing level, in business within close proximity of each other, creating a business network. The value proposition in this business network is to reduce the overall operating costs. Value is created through collaborations and is aimed at reducing operating costs through for example sharing communal services (Bocken et al., 2016). Value is then captured through *‘joint cost reductions and the potential creation of new business lines based on former waste streams’* (Bocken et al., 2016, p. 317). The business models proposed by Bocken et al., (2016) do not differ much from those of Accenture (2015) in their underlying ideas of servitizing and sharing products, waste reduction, product-life extension and reuse of products and materials. Regarding the building blocks for circular business models created by Jonker et al., (2016), all five blocks appear to be present in the business models created by Bocken et al., (2016), as they have a clear focus seen through the value proposition, value creation and value capturing presented in each model, which can be seen in the blocks ‘pursuit of value creation’ and ‘developing revenue models’. The realization of cycles is also present throughout the models, as well as there being a need for a clear strategy. The fourth building block, ‘organizing between-parties’ is more clearly seen throughout these models than in the Accenture (2015) models, as there is a focus collaboration and cooperation between organizations that can be seen throughout the six models.

Lewandowski et al., in their 2016 article, created an overview of circular business models from a literature review aimed at identifying and classifying circular business models. The classification is made based on the 'ReSOLVE' framework created by the Ellen MacArthur Foundation (2015). ReSOLVE stands for regenerate, share, optimize, loop, virtualise, and exchange, and is a framework made to emphasize these six areas where businesses or countries wanting to move towards the circular economy could undertake action. Regenerate regards the shift to renewable materials and energy, to retain and restore the health of ecosystems and return biological resources to the biosphere. Share is logically aimed at sharing assets among users, reusing products and prolonging life through for example durability in product design, and maintenance. Optimize is aimed at increasing the performance of a product, removing waste in both the production process and in the supply chain. Loop actions are aimed at keeping materials and components in the closed loops that are characteristic to the basic idea of the circular economy. Virtualise actions are aimed at delivering utility of a product virtually instead of materially, done through dematerializing either directly, for example CDs or DVDs, or indirectly, for example through online shopping. Exchange is aimed at new technologies such as 3D printing and new products or services, meaning replacing old materials with more advanced, non-renewable materials (Ellen MacArthur Foundation, 2015). Based on these six categories, Lewandowski et al., (2016) have classified many different circular business models into a clear overview. From this overview it becomes apparent that many authors create their circular business models from the same base idea, taking the value proposition and value creation into account, and building on the main ideas of the circular economy which is the loops or cycles, extending product life, reusing and remanufacturing, and in addition to that adopting the circular economy into the strategy of a company. From this it would seem that most circular business models that are currently out there are in accordance with the five building blocks by Jonker et al., (2016), though as said earlier, the importance or the fourth block regarding organizations having to work together cohesively in order to be successful in the circular economy is an element that is not always present.

From this, the base idea underlying circular business models has become clear, as well as circular business models having been further illustrated by the examples above. On a critical note, even though there were many models and examples named, it could be argued that there is still a certain lack of clarity regarding the circular business models, due to the vastness of the concept. The models explained above show overlap yet also have minor

differences that can create ambiguity. An overview like the one Lewandowski et al., (2016) present aids in providing a bit more clarity, as well as the building blocks by Jonker et al., (2016) that provide a base to circular business models which the models need to comply to in order to successfully work within a circular economy. Furthermore, van Renswoude et al., (2015, p. 2) say that, even though there are successful examples of circular business models to be found, *'100% circular business models do not exist (yet). Not creating any waste at all is difficult to achieve for physical and practical reasons'*. There are many circular business model tools, scans, frameworks, and analyses that can be found (Achterberg et al., 2016; Antikainen and Valkokari, 2016; Linder and Williander, 2017), that further illustrate the inherent uncertainties behind business model innovation in the circular economy. It is easy to get lost and this could thus also be the case for companies looking to adopt the circular economy into their strategies and use circular business models, as well as for countries or cities looking to do the same. From this part on circular business models in general, the next paragraph will look at circular business models specific to the context of cities.

2.3: Business models in cities

The first paragraph of chapter two made clear that cities are uniquely positioned to drive a transition towards the circular economy due to different factors, and that circular cities have many different actors that are important. The second paragraph of chapter two shed light on business models in the circular economy. This paragraph will look at how circular business models manifest in cities, resulting in 'urban business models'

2.3.1: The potential of cities in the Circular Economy

Cities provide opportunities for circular business models to flourish. What makes the urban environment unique in the context of the circular economy is the high concentration of resources, capital, talent and data within cities, which allows for opportunities to be created more easily for business models based on sharing and reusing, which can for example be done within a neighbourhood (Ellen MacArthur Foundation, 2017). Moreover, the Ellen MacArthur Foundation, (2017, p. 10) states that: *'new circular economy business models are more likely to emerge and succeed in the presence of both a large and varied supply of materials, and a high potential market demand for the goods and services derived from them'*, to which they add that both these conditions are likely to be met within cities. Within Europe, the percentage of the population living in urban environments is continuing to grow (European Commission, 2018a). As was said earlier, it is argued that this ever-growing population percentage within cities is a strain on cities' resources as well as a cause of greater demand, which makes

looking at the circular economy from an urban perspective necessary (Rodriguez-Coello and Carrillo-Hermosilla, 2015). Given these facts, the circular economy presents an opportunity through the stimulation of the development of new, innovative business models and accompanying innovations aimed at reduction of the consumption of resources, to improve the quality of life within cities (Rodriguez-Coello and Carrillo-Hermosilla, 2015). The changes happening in society in general that are enabling a shift towards a circular economy are another area where cities provide opportunities. Jonker (2018) describes that the balance between citizens, businesses and city governments is shifting regarding the roles, relationships and tasks within cities, as citizens are seen to be partly taking over tasks from the city governments, and businesses are having to be more and more aware of their impact on and involvement with society. This development has led to new ways of collaboration among citizens or between citizens, businesses and city governments in the form of local circular economy initiatives and projects (Jonker, 2018). The potential of cities is further illustrated by the World Economic Forum (2018, p. 9), who state that '*cities are key to going circular*', accompanied by the fact that cities generate more than 80 percent of the global GDP. Next to that, they also emphasize the collaboration between the three main city actors, the citizens, businesses, and the city government, who together can start innovative projects that address the challenges of linear economic models, and create new, urban circular business models in the process.

Given the information stated above, it would seem that cities provide the perfect conditions for circular business models to emerge, develop and prosper. The next paragraph will look at what these urban business models are and how they have developed up till now.

2.3.2: Urban Business Models

Urban business models can be defined as '*the conscious organizing of multiple value creation between different parties within an urban context*' (Jonker, 2018, p. 2). The central idea behind this is that citizens within an urban context invest in urban business models with their time, money and competences and through collaboration aimed at generating profit for their own environment, creating value in the process (Jonker, 2018). Citizens are not the only constituents operating in the urban context, businesses and institutions such as the local government are also important actors that are involved. In these urban business models, the constituents often pursue a combination of different goals, which for example includes themes like food, housing, education and healthcare. All these goals are representing certain values, and combining multiple goals in a smart way creates multiple values, which provides added

value. The value is captured by means of the mix of financial, social and ecological benefits that are gained within projects or initiatives in an urban context (Jonker, 2018). Such projects or initiatives are aimed at making efficient use of competences in the own environment of the constituents involved. These initiatives are arising more often in urban contexts recently, and are seen to come from citizens, businesses and city governments, which means the initiatives are starting both top-down and bottom-up, and involve a high amount of collaboration between the actors (Jonker, 2018). The constituents are collectively organizing their own environment through urban business models, for which there are many different possibilities that are also highly dependent on the opportunities that the environment has to offer

Within urban business models, there is a distinction that can be made between three groups, those being platform, community based, and circular business models. Platform models are based on the unused capacity within a city, which for example results from tickets that weren't sold out, trains that aren't full or food that is being thrown away, and can also be unused spaces. The platform models are aimed at detecting this idle-capacity and using it in a more efficient way (Jonker, 2018). Community-based business models aim at building a community based on the needs and competences within that community and the potential to realize those. These models are more service than product related. The third group is circular business models, aimed specifically at the loops of the circular economy and thus at making use of the material flows regarding waste, energy and products (Jonker, 2018). Furthermore, there are three principles that are underlying to the urban business models, which are sustainable, inclusive, and circular. Constituents in an urban environment have the ambition to create a sustainable living environment for themselves and others, and are actively and consciously involved in creating this environment. Urban business models do not only concern the material side of the circular economy like the previously described circular business models do, but are also heavily involved with the social side, which is an aspect that is specific to the urban context. From the potential opportunities and overvalues that are found within the constituents' living environment there are initiatives that are shaped according to a business model, resulting in the creation of social, ecological and financial value, thus multiple value creation (Jonker, 2018).

The potential within an urban environment comes from the overvalues that are found within that environment. Jonker (2018) identifies different five types of overvalues, though they are often intertwined and overlapping within the urban circular initiatives. The five types are material, spatial, social, institutional, and financial overvalue. Material overvalue includes

for example forms of waste, like paper or plastic, and can also be leftover meals. Spatial overvalue includes unused buildings or other spaces like rooftops which could be used for solar panels. Social overvalue is about citizens that have certain skills and competences which they can put to use, for example for sharing purposes. Institutional overvalue can be tickets that aren't sold out or buses that aren't always full. Lastly, financial overvalue is about money that people have and want to invest in initiatives like urban farming, energy solutions, or mobility.

From this, it has become clear how urban business models have come to be and what is involved with these models, which in the next chapter will help with making them concrete and creating the typology of urban business models. Urban business models are new and upcoming, which can be seen from the fact that Jonker (2018) is the only source of information that specifically writes on circular business models in an urban context. Though other authors mention the circular economy in an urban context (Rodriguez-Coello and Carrillo-Hermosilla, 2015; Pomponi and Moncaster, 2017; Ellen MacArthur Foundation, 2017) they do not mention specific ideas for urban business models, or are more focused on the top-down side of the circular economy in cities, looking at policy and the city governments (Prendeville et al., 2015; WEF, 2017). In the next chapter, the above elaborated theories on circular cities, circular business models and urban business models will be expanded with the theory on the continuously intertwined concept of value creation, which was mentioned before as being the underlying principle to the circular economy. From this deepening on the theory value creation that underlies the circular economy together with the theories in this chapter, a conceptual model in the form of a typology of urban business models will be created.

3. Value Creation

In this chapter, the underlying concept of value creation will be elaborated on. Value creation is a key part of the circular economy and thus also connected to circular cities and urban business models.

Value creation is a broad concept that is studied by scholars from many different disciplines. Hence, different definitions of what value is and what value creation is can be found. Windsor (2017) states that value as a construct lacks both theoretical precision and empirical verification. He defines value as *'a surplus or gain in someone's welfare relative to a previous condition'* (Windsor, 2017, p. 76). Haksever, Chaganti and Cook (2004, p. 292) define value as *'the capacity of a good, service or activity to satisfy a need or provide a benefit to a person or legal entity'*. Value creation is defined as *'the generation of a surplus (gain) from trade, other transaction, investment, or relationship'* (Windsor, 2017, p. 76). Another definition reads that *'value creation is essentially a theory of how to manage a business, or more broadly any organization'* (Brandenburger & Nalebuff, 1997). From these definitions and most general articles on value and value creation, the focus seems to be mostly on value creation within businesses or firms. Nevertheless, value is created intersubjectively by human actors, and originates from human actions that are aimed at for example self-realization (Kraaijenbrink, 2011). The next paragraph will look at value creation in the context of the circular economy and circular cities, where value is created collectively by different actors within an urban context, which adds a new dimension to value creation compared to the business or economic realm that value creation is normally seen within.

3.1: Collective value creation in a Circular Economy

Porter and Kramer (2011) in their theory go beyond the perspective of the firm when it comes to value creation, by connecting business progress with social progress. This is called *'creating shared value'*, which means a firm generates economic value while at the same time addressing social issues, which in turn creates social value. Moore (1995) creates a similar concept in what he calls *'creating public value'*, in which public value means the value that a firm provides to society. Bryson et al. (2017) add to this theory by saying that nowadays, there is a wider range of actors involved in the process of public value creation, calling today's society a multi-sector, multi-level and multi-actor place characterized by complexity and dynamism. These actors work together in a shared effort to create and manage public value strategically through different configurations (Bryson et al., 2017), which the urban business models in the circular economy could be an example of. Value creation, whether

called shared or public value creation, is the key underlying principle that the circular economy is built on. It is aimed at value retention within the material and goods chains, and the redesign of those chains leads to recycling and reusing patterns that will lead to value creation (Jonker et al., 2016). Heshmati (2015) states that within the circular economy, resources are used to generate value, and the activities within the economy support and create a healthy society. Within society, more specifically within urban environments, citizens, businesses and local governments are seen to be collaborating in circular economy initiatives as of recently (Jonker, 2018). Such ‘collaborative networks’ have a high potential as drivers of value creation (Camarinha-Matos and Afsarmanesh, 2006). A collaborative network is defined as *‘a network consisting of a variety of entities (e.g. organizations and people) that are largely autonomous, geographically distributed, and heterogeneous in terms of their operating environment, culture, social capital and goals, but that collaborate to better achieve common or compatible goals, and whose interactions are supported by computer network’* (Camarinha-Matos and Afsarmanesh, 2006, p. 4). They argue that the goal of such a network is to maximize some component of its value system, and that these networks can be a very strong instrument within society (Camarinha-Matos and Afsarmanesh, 2006). These networks are characterized by complex interactions among its participants, who are collaborating in order to achieve certain common social and economic goals (Figueiredo and Scaraboto, 2016), hence why these networks are becoming increasingly relevant nowadays, especially within the context of the circular economy. Collaborative networks have the potential to create value because within the networks there are things such as shared identity, shared consciousness, and a sense of obligation to the community, and the actions they are collectively undertaking can reinforce these aspects, which in turn can aid in the process of value creation (Figueiredo and Scaraboto, 2016). The impact that a collaborative network can have on society is known as the ‘collective impact’, which stems from the idea that *‘social problems arise from and persist because of a complex combination of actions and omissions by players in all sectors—and therefore can be solved only by the coordinated efforts of those players, from businesses to government agencies, charitable organizations, and members of affected populations’* (Kramer and Pfitzer, 2016, p. 84). Again, the multi-actor perspective comes forward as an important part of collective impact, just as in collaborative networks and in urban business models. One of the five building blocks of circular business models which was underexposed in many existing models was the organizing between parties, which in an urban environment, where the circular initiatives organized through urban business models are likely to come from collaborative networks, seems to be one of the most important blocks.

In creating value in an urban environment through collaborative networks using urban business models, the triangle between the three actors, which are citizens, businesses, and local governments, and the cooperation between the three is a vital part. Kramer and Pfitzer (2016) state that in the process of shared value creation, businesses do not act alone because they exist in an ecosystem characterized by for example societal restrictions, cultural norms, and government policies. Such conditions are outside of the control of one single actor, and require cooperation in order to advance shared value efforts, as there is a clear connection between social progress and business success. (Kramer and Pfitzer, 2016). From this, it becomes clear that value creation in the circular economy is a complex concept, which is further emphasized by Figueiredo and Scaraboto (2016, p. 509-510), who state that '*current approaches to value creation have not yet explained how value is created in loosely organized, dynamic, and heterogeneous collectives*', meaning within collaborative networks, which becomes much more important when the circular economy is approached from the perspective of urban environments. The next paragraph will look at how value creation is embedded within urban business models.

3.1.1: Collective value creation in Urban Business Models

Within urban business models, the importance of the cooperation between the three actors, citizens, businesses, and city governments, has been stressed numerous times. These actors, especially the citizens who are relatively new players within the realm of circular initiatives, find themselves in changing roles as a result of the changes in society and the beginnings of a shift towards the circular economy within cities. These changing roles lead to the need to re-design existing value networks and the business models related to that (Antikainen and Valkokari, 2015). This need for a new generation of business models that are based on cooperation and value creation between parties in different networks emphasizes the importance of collaboration or, within cities, collaborative networks, because the circular economy in its essence is based on cooperative value creation (Jonker et al., 2016). Value creation in the circular economy is not solely up to organizations, but is in the hands of the networks or communities that are found within cities, which makes value creation a shared task of different actors. Value creation is the core of business models, as business models describe the way value creation is organized between parties given a certain context and available resources (Jonker et al., 2016). The redesign of business models results in new value propositions, which is one of the core components of urban business models (Lewandowski, 2016). The value proposition in circular or urban business models offers a product, service or

product-related service which allows the user to do what is needed while reducing inconveniences and providing additional benefits (Lewandowski, 2016). Value is then created by the maintenance of products and services, dematerialization through offering services instead of products, the lifetime extension of products, cascades based on new combinations of resources, and the reusing of resources and materials (van Renswoude et al., 2015). Within the urban context this leads to smart combinations that create value out of the overvalues that can exist in an urban environment, which in many cases leads to multiple value creation due to the overlapping overvalues that are found within an urban environment. Multiple value creation within urban business models is created through the interaction between multiple actors that aim to reach multiple goals simultaneously within the possibilities of their own environment (Jonker, 2018).

3.2: Typology of Urban Business Models

The above-mentioned theory on value creation as well as the theories explained in chapter two on circular cities and circular and urban business models lead to the creation of a typology of urban business models. A typology is defined as '*a classification according to general type*' (Oxford Dictionaries, 2018). Creating a typology helps to form and refine concepts, draws out underlying dimensions, and creates categories for classification and measurement (Collier, LaPorte and Seawright, 2012). There are two different approaches to classification, which are a typology and a taxonomy (Smith, 2002). Typologies create a useful heuristic and a systematic basis for comparison due to the fact that the dimensions of a typology represent concepts and not empirical cases, but comes with the drawbacks that the categories aren't exhaustive or mutually exclusive and are descriptive (Smith, 2002). The other approach is a taxonomy, which differs from a typology in that they classify items on the basis of empirically observable and measurable characteristics (Bailey, 1994, p. 6), making taxonomies more systematic, and having the exhaustive and mutually exclusive categories that a typology does not have. In this case, a typology was chosen, because it allows for the urban business model concept to be represented in the dimension, and will help identify the relationships between variables that share common features within this concept. In the current literature on circular business models there is a wide variety of types of models that can be found, many of which are overlapping and showing similarities, but often still slightly different. This can create haziness and ambiguity. With regards to urban business models, it was found that there are not many business models in the circular economy specific to the urban context that can be found. The purpose of creating this typology is thus to address the

gap there is with regards to the lack of urban circular business models, as well as providing more clarity in the multitude of circular business models that are out there. In this chapter, the proposed typology of Urban Business Models will be elaborated on and it will be substantiated how the typology has come to be.

In chapter two, different circular as well as urban business models were discussed. Accenture (2015) identifies five models, which are Circular Supplies, Resource Recovery, Product Life Extension, Sharing Platforms, and Product as a Service. Bocken et al. (2016) name six models: Access and Performance, Extending Product Value, Classic Long Life, Sufficiency, Extending Resource Value, and Industrial Symbiosis. These existing models and their characteristics have been examined and were subsequently composed into three new types of models. The typology of urban business models that was created is thus essentially a composition of existing business models into three new types of urban business models. Categorizing these models into the three new types of urban business models was done by identifying the general characteristics of each model, such as if they are making use of processes like reusing and remanufacturing, if they are concerned with the material side of things or more related to the shift from ownership to servitization, and other characteristics that are found in the business models, like for example waste reduction and take-back systems. After these characteristics were identified for each of the business models, the next step taken was to look at the models again through the ReSOLVE framework created by the Ellen MacArthur Foundation (2015). ReSOLVE stands for regenerate, share, optimize, loop, virtualise, and exchange, and the framework was explained earlier on in chapter 2.2. Thirdly, it was looked at how these circular business models fit into the three groups of urban business models as created by Jonker (2018), which are platform, community, and circular based models. The choice was made to look at circular business models from different authors, as well as using different authors' angles to look at said models in order to be able to look at the material from different angles of approach, by different authors, and with that hopefully create the most complete typology. The three new models have been named 'Product and Resource Optimizing' model, 'Product and Resource Looping' model, and 'Urban Circular Community' model. The names have been created from the main features within the models, with the first two being characterized by 'Optimizing' and 'Looping', and the third model being the most specific to the urban context and really taking the community part into account.

The first model, the ‘Product and Resource Optimizing’ model, is made up of the Circular Supplies model by Accenture (2015), and the Classic Long Life and Sufficiency models by Bocken et al. (2016). Table 1 shows how these three models fit together based on their general characteristics, ReSOLVE characteristics, and what Urban Business Models group they fit into.

Table 1 Business Models that fall under the type ‘Product and Resource Optimizing Model’		
Circular Business Model:	Description of the model:	Labels:
Circular Supplies (Accenture, 2015)	The Circular Supplies model is based on replacing linear resource approaches while removing inefficiencies and cutting waste, which for example means <i>‘providing renewable energy, bio based- or fully recyclable input material to replace single-lifecycle inputs’</i> (Accenture, 2015, p. 13).	General: Waste reduction, Renewable energy, Bio-based materials, Raw materials, Input materials, Recycling
		ReSOLVE: Regenerate, Optimize
		UBM Group: Circular based, Platform based
Classic Long Life (Bocken et al., 2016)	The Classic Long Life model is focused on <i>‘delivering long-product life, supported by design for durability and repair’</i> (Bocken et al., 2016, p. 313). Products are designed to be more durable and easily repaired, leading to products of high quality that will last longer. This durable product design is accompanied by high customer service levels with regards to for example repair, the product having a premium price and the service included over the products’ lifetime (Bocken et al., 2016).	General: Raw materials, Input materials, Durability of products, Repair
		ReSOLVE: Optimize
		UBM Group: Circular based, Platform based
Sufficiency (Bocken et al., 2016)	The Sufficiency model is similar to Classic Long Life and aimed at long-lasting products, but it takes a ‘non-consumerist’ approach, meaning that there are no sales commissions and the focus is on reducing end-user consumption. The value proposition is the same as in the last business model, aimed at high quality products that are durable, with high service levels. (Bocken et al., 2016)	General: Raw materials, Input materials, Durability of products, Repair
		ReSOLVE: Optimize
		UBM Group: Circular based, Platform based

As seen from the table, the main characteristics these models have in common is that they are aimed at optimization, and that they have to do with the materials or resources that are used for products and the subsequent product durability. The new urban business model type that then follows out of these three models has been named the ‘Product and Resource Optimizing’ model. It can be described as being aimed at the optimization of products and resources through for example the replacement of linear resource approaches in order to remove inefficiencies and to cut waste, and designing products for long product-life, making them more durable and easier to repair. This can for example means the use of renewable energy and bio-based or other recyclable input materials.

The second model, the ‘Product and Resource Looping’ model combines the Resource Recovery and Product Life Extension models from Accenture (2015) with the Extending Product Value and Extending Resource Value model from Bocken et al. (2016). Table 2 shows how these four models fit together.

Table 2 Business Models that fall under the type ‘Product and Resource Looping Model’		
Circular Business Model:	Description of the model:	Labels:
Resource Recovery (Accenture, 2015)	The Resource Recovery model is aimed at the recovery of the embedded value of a product that is at the end of its lifecycle and uses it for another product, transforming waste into value by doing so (Accenture, 2015).	General: Waste reduction, Reusing, Recycling
		ReSOLVE: Loop
		UBM Group: Circular based, Platform based
Product Life Extension (Accenture, 2015)	The Product Life Extension models uses for example the repairing and upgrading of products, and in doing so assures that <i>‘values that would otherwise be lost through wasted materials are instead maintained or even improved by repairing, upgrading, remanufacturing or remarketing products’</i> (Accenture, 2015, p. 14).	General: Reusing, Repair, Recycling, Remanufacturing, Waste reduction
		ReSOLVE: Loop
		UBM group: Circular based, Platform based
Extending Resource Value (Bocken et al., 2016)	The Extending Resource Value model exploits the residual value of resources, through the <i>‘collection and sourcing of otherwise “wasted” materials or resources to turn these into new forms of value’</i> (Bocken et al., 2016, p. 313). It reduces material costs and the product price overall, through making use of the residual value of resources. It uses take-back systems and collaborations in order to collect materials.	General: Reusing, Remanufacturing, Waste reduction, Take-back systems
		ReSOLVE: Loop, Optimize
		UBM Group: Circular based, Platform based
Extending Product Value (Bocken et al., 2016)	The Extending Product Value model looks to exploit <i>‘residual value of products, from manufacturer, to consumers, and then back to manufacturing’</i> (Bocken et al., p. 313). It is thus mostly concerned with remanufacturing, with the exploitation of the residual value leading to an affordable ‘new’ product through the process of repair or remanufacturing. It again uses take-back systems and collaborations that enable the return of products (Bocken et al., 2016)	General: Remanufacturing, Repair, Take-back systems
		ReSOLVE: Loop
		UBM Group: Circular based, Platform based

Looking at this table it can be seen that the main characteristics these four models have in common are that they are aimed at looping and mainly use processes such as reusing and remanufacturing. The new urban business model type that then follows out of these four models has been named the ‘Product and Resource Looping’ model. It can be described as being aimed at creating value out of waste. Processes of recycling, reusing, repairing, and remanufacturing are central to the model. The residual value of both products and resources is

exploited, transforming products and materials that would otherwise be wasted into something valuable.

The third model, the ‘Urban Circular Community’ model is made up of the Sharing Platforms and Products as a Service models from Accenture (2015) and the Access and Performance and Industrial Symbiosis model from Bocken et al. (2016). Table 3 shows how these four models were categorized.

Table 3 Business Models that fall under the type ‘Urban Circular Community Model’		
Circular Business Model:	Description of the model:	Labels:
Sharing Platforms (Accenture, 2015)	The Sharing Platforms models uses collaboration among the users of products, aiming to increase the utilization rate of products through making it possible that people are able to share the use, access or ownership of those products (Accenture, 2015).	General: Cooperation, Sharing, Servitization, Increase functionality of products, Reusing
		ReSOLVE: Loop, Exchange, Share
		UBM Group: Community based, Platform based
Products as a Service (Accenture, 2015)	The Products as a Service model <i>‘provides an alternative to the traditional model of “buy and own.”’</i> (Accenture, 2015, p.14). Products are used by multiple customers through for example lease or pay-for-use arrangements.	General: Servitization, Cooperation, Sharing, Increase of functionality of products, Reusing
		ReSOLVE: Loop, Exchange, Share
		UBM Group: Community based, Platform based
Access and Performance (Bocken et al., 2016)	The Access and Performance model involves <i>‘providing the capability or services to satisfy user needs without needing to own physical products’</i> (Bocken et al., 2016, p. 313). It delivers a service, which provides the access to and performance of a certain product, instead of the product being owned by the consumer. The company takes over the service and maintenance of the product while the user can enjoy the benefits (Bocken et al., 2016)	General: Servitization, Sharing, Reusing, Increase of functionality of products, Cooperation
		ReSOLVE: Loop, Exchange, Share
		UBM Group: Community based, Platform based
Industrial Symbiosis (Bocken et al., 2016)	The Industrial Symbiosis model is a more process-oriented solution, which concerns <i>‘using residual outputs from one process as feedstock for another process’</i> (Bocken et al., 2016). It turns the waste from one process into something usable for another process, and happens at the process and manufacturing level, in businesses within close proximity of each other, creating a business network. Within this business network, the businesses collaborate and aim at reducing operating costs through for example sharing communal services, leading to <i>‘joint cost reductions and the potential creation of new business lines based on former waste streams’</i> (Bocken et al., 2016, p. 317).	General: Cooperation, Sharing, Reusing, Waste reduction, Remanufacturing
		ReSOLVE: Loop, Exchange, Optimize, Share
		UBM Group: Community based, Platform based

From this table it can be seen that these models have multiple characteristics in common with those in the previous tables, such as looping and optimizing, as well as reusing products or resources. What is new in this table are the processes of cooperation and servitization, and the sharing and exchanging characteristics. These four business models are also the first that are seen to fall within the community based group of urban business models, whereas the previous ones were in the circular based group. The new urban business model type that then follows out of the four models has been named the ‘Urban Circular Community’ model. Out of the three urban business models created, this one is the most specific to the urban context, as it uses the power of the urban community at the product level in order to optimize the functionality of products through servitization and sharing platforms, as well as at the process and manufacturing level with organizations sharing and reusing raw materials and creating business networks. The community factor is key within this model, with the process of collaboration between citizens, between organizations and between citizens and organizations being the main feature.

As was said earlier, the three models were grouped based on how they fit into the platform, circular, or community based groups of urban business models as suggested by Jonker (2018). As can be seen from the labels in all three tables, all of the business models are seen to be in the platform group. The platform model is about making a number of things possible at the same time and the better use and exploitation of that what is already available within a city (Jonker, 2018). The platform model can thus come in many forms within a city or urban environment, and is ever present throughout the urban environment. The opportunities that arise from the idle-capacity in an urban environment are used by citizens, local governments, businesses, or a cooperation between these three actors. All circular business models that emerge within an urban environment can be seen as being somehow based on the idle capacity within that environment, and thus on the platform model. The business models that the Product and Resource Optimizing model was composed of use for example the creation of products that are durable and easily repaired, and use the products and resources so optimally and to be best of their capabilities, and thus use the input materials most efficiently. The business models that the Product and Resource Looping model was composed of for example collect used products or materials through take-back systems in order to remanufacture them into new products. The use of the platform model and idle-capacity is most clear in the last model, the Urban Circular Community model, as it is based on sharing and reusing products among people. The Product and Resource Optimizing model

and the Product and Resource Looping model are also in the circular based group, as they are making use of material flows regarding waste, energy, and products and are specifically aimed at the main principle of the circular economy which is creating loops. The last model, the Urban Circular Community model, is logically in the community-based group, as it relies on networks and depends on the urban community and the potential they have to realize a Circular Economy within their own environment. This model is one that is very specific to the urban context, whereas the other two models are in a way a little more generic, and can thrive in other environments than solely an urban environment. The community-based aspect that comes with the Urban Circular Community business model is key to its success. As was discussed in chapter 2.3.1, on the potential of cities in a circular economy, the urban environment provides unique opportunities through its high concentration of resources, capital, talent and data that allow for opportunities for sharing and reusing which are both part of the Urban Circular Community model (Ellen MacArthur Foundation, 2017), as well as the potential for collaboration between citizens or between citizens, businesses and governments within cities. All three models take the opportunities that the urban environment offers in using the idle capacity within that environment, but the Urban Circular Community model is most dependent on the unique opportunities arising from the city as a community and the collaboration possibilities that follow.

The figure below shows the typology of urban business models that results from the three new business models created. It shows how the models fit into the three groups of business models, with a short description of the models and their main characteristics:

Figure 1. Proposed typology of Urban Business Models		
	Platform based	
Circular based	<i>Product and Resource Optimizing model</i>	<i>Product and Resource Looping model</i>
	Optimizing products and resources through replacement of linear resource approaches and designing products for durability and repair. The main characteristic of this model is optimization of both products and resources, making optimal use of the materials and resources available within the urban environment and using its capacities most efficiently.	Exploiting the residual value of both products and materials, creating value out of something that would otherwise be waste. The main characteristics of this model is creating loops through processes such as recycling, reusing, repairing and remanufacturing and with that reducing waste within the urban environment.
Community based	<i>Urban Circular Community model</i>	
	The power of the urban community is used, at the product level in order to optimize the functionality of products through servitization and sharing platforms, and at the process and manufacturing level with organizations sharing and reusing raw materials and creating business networks. The main characteristic of this model is the collaboration between citizens, businesses, and local governments who together are engaging in circular economy initiatives within their own urban environment.	

The creation of this typology resulted from the different theories on the circular economy, circular cities, and circular and urban business models that were described in chapters two and three. The typology forms the base for the rest of the research, and in the next chapters will be used in the analysis of the circular economy projects and thus eventually will be used in the answering of the research question of this thesis.

4. Methodology

In this chapter the methods used in this thesis will be explained. As discussed in the first chapter, this research will be exploratory and have a qualitative nature. Exploratory research is suited to this thesis as looks into a concept which is fairly new and thus not yet clearly defined or extensively researched, that being collective value creation in cities through the use of urban business models. Doing an exploratory research means that there will not necessarily be final and conclusive answers, but it provides a basis for further research on a certain topic (Dudovskiy, 2016). Exploratory research thus *“tends to tackle new problems on which little or no previous research has been done”* (Brown, 2006, p. 43). Whilst the circular economy itself has been extensively researched, mainly throughout the last few years, the particular urban aspect of it has not, which is why exploratory research is suited here.

In the following paragraphs the data collection will be discussed, followed by the research methods, the operationalisation of the theory, and lastly the limitations of the research as well as the research ethics will be discussed.

4.1: Data collection

For this research, the data that will be used is derived from an already existing database on circular economy projects in cities. The data analysed is thus secondary data. This data is part of a previous research on ‘Circular City Governance’, an explorative research into the barriers and governance practices in circular cities across Europe. 31 countries were part of this research, of which 27 were EU member states, and 4 were not. The 27 member states included in the research are Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, the Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden, and the United Kingdom. The four non-EU European countries were Iceland, Norway, Switzerland, and Ukraine. The project case studies that were the focus of this research are all focused on the urban circular economy, and the project case studies were either provided by the EU’s Urban Agenda Partnership on circular economy, or found through internet research. The database is limited by the fact that only English written documents were collected and analysed. The database consists of 337 project case studies throughout Europe, of which 40 cases will be used and analysed in this research, because these cases were classified as being specifically addressed to the circular economy in cities, and thus most suited for this particular research. From this database, the necessary data to conduct a document analysis is available. The project cases will be analysed with the main focus being

the themes and underlying business models present within the projects. From the analysis, the projects will be clustered by theme in order to be able to identify the themes that are currently playing in the circular economy in Europe.

As said, there were 40 cases selected from the existing database, based on these cases being classified in the database as being most specifically addressed to the circular economy in cities. Through the selection of the 40 cases from the database, the number of European countries being included in this research goes down to 19, the countries included being: Austria, Belgium, Denmark, Estonia, Finland, France, Germany, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Slovenia, Spain, Sweden, Switzerland, and the United Kingdom. The database provides general information on the cases such as their country and location, website and other contact information, and when the project started, as well as more specific information on each case, such as what the project is about and what themes are involved. Based on the information that is provided in the database on these 40 selected cases, the cases have been reformatted, pulling the most useful information from the database into a more structured description per case, suited to this particular research. The format of how the cases were reformatted to suit this research can be found in appendix 1. The format first looks at characteristics such as the project's name, the country and city it takes place in, a short description of what the project is and what the central theme is. Then, it is looked at which actors are involved in the projects, mainly looking to identify whether the project was initiated by a local government, business, or citizens, or perhaps by a collaboration between multiple actors. Next, it is looked at whether an urban business model is used by the projects, and if so, it is identified which model is used. In order to identify the model type used, the proposed typology of urban business models that was created in chapter 3 will be used. Lastly, value creation within the project is looked at. Though value creation is hard to define or specify, there are some aspects of value creation in the urban environment that are identified, such as the interaction or cooperation between parties in a network leading to multiple value creation, in which the value is created out of the overvalues that can exist in an urban environment.

Reformatting the cases will provide a better basis for conducting the document analysis that is to be done, as the multitude of information from the database will be structured specifically to what is being researched in this thesis. The next paragraph will look at the methods that will be used to do the analysis on the cases.

4.2: Methods

The method that will be used for conducting this part of the research is a document analysis on the 40 case studies. The content of the cases in the documents will be coded, in order to identify themes and patterns within and between the cases. The codes have been formulated in the operationalization of the typology of urban business models. The operationalization can be found in the next paragraph, as well as in appendix 3.

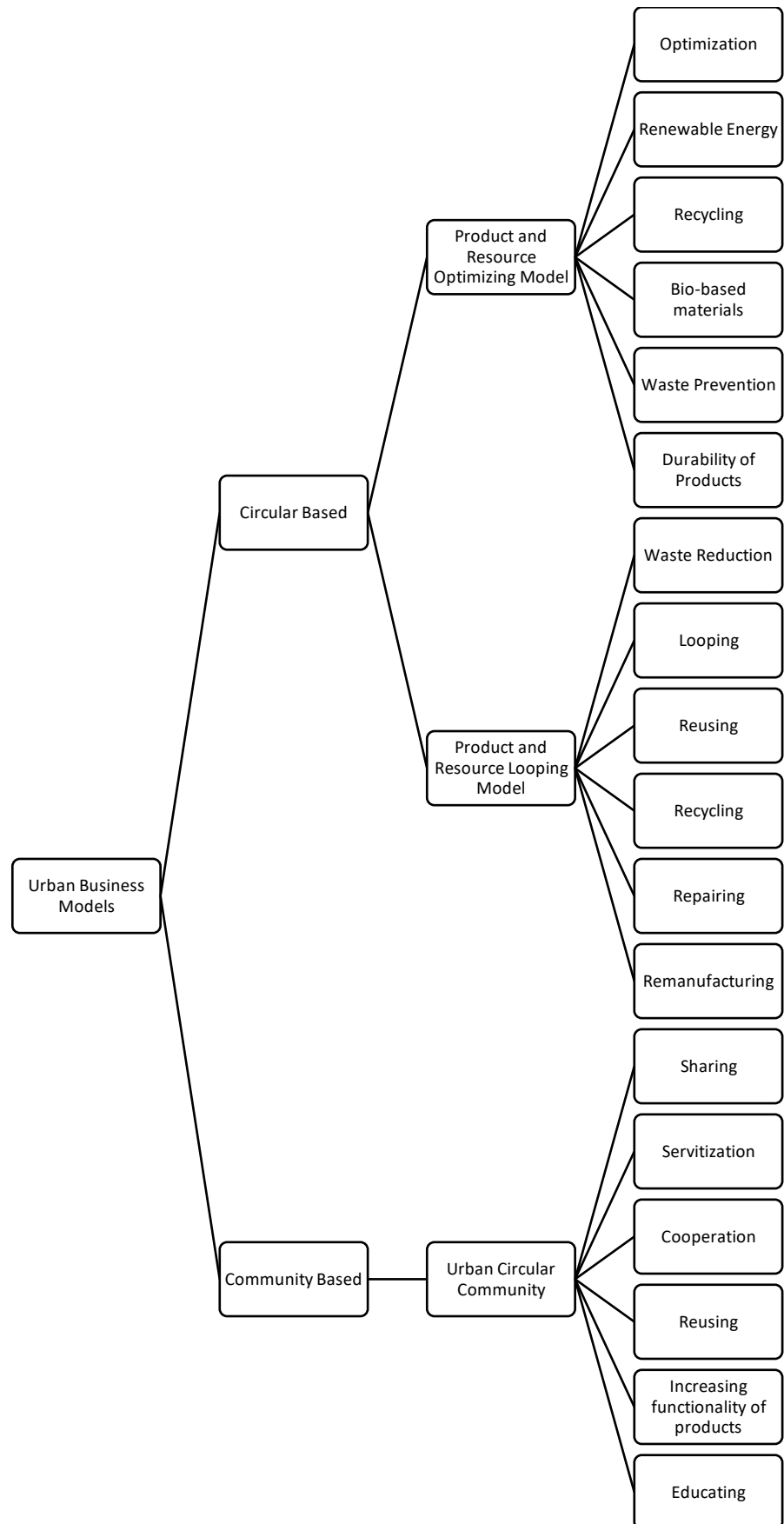
The document analysis will help in getting an insight into the current state of the circular economy in Europe. The benefit of using a data analysis in this case is that it provides an easy access to a widespread amount of countries, allowing for many European countries to be included in this research, which would have been more difficult with for example a field research and taking interviews, which would likely have limited the amount of countries that could have been included in the research. Through the accessed textual information in the database it has been made possible to include project cases from 19 European countries. Through the coding of the project case descriptions, it will be possible to create frequency tables that will help identify the central themes that are currently occurring in urban circular economy initiatives throughout Europe. Next to that, the document analysis will help identify the urban business models, that are found in the proposed typology, within the cases analysed. The document analysis is thus used to identify whether the cases are clearly making use of an urban business model within their projects, and if so which of the three types of urban business models is being used, and what central theme the projects have.

The steps that will be taken in the document analysis are as follows: First, the case descriptions will be examined, after which they will be systematically searched through for all actions or key words that are identified as being within the realm of the circular economy in urban environments. Next, codes will be allocated to the identified key words or actions. For the coding, the indicators created in the operationalization of the typology of urban business models will be used as the codes. After allocating the codes, it will be looked at which urban business models the actions fall under, as well as in which dimension they are, that being circular based or community based models. Subsequently, the frequencies of the codes will be analysed, in order to identify themes around the actions, as well as the frequencies of what urban business model type the project in the cases makes use of. From the analysis of the frequencies of the codes as well as the frequencies of the urban business model types, there will be clusters formed out of the 40 cases according to the themes found. The coded text in the case description, the frequency tables, and the created clusters will aid in answering the

first and second sub-questions of the research and eventually aid in answering the main research question.

4.3 Operationalisation of the typology

This paragraph shows the operationalisation of the proposed typology of urban business models that was created in chapter 3.2. The operationalisation starts from the key concept of the typology of urban business models, which was created in chapter 3.2 and was compiled from different aspects of the general theory on the circular economy and the potential of the circular economy in cities, as well as the theory on value creation which is an underlying aspect to the circular economy in cities. From this key concept follow the dimensions, circular based and community based models, which are two categories used in the typology of urban business models, which then leads into the three urban business models. Subsequently, the indicators attached to these models can be found. The indicators have been derived from the tables that are found in chapter 3.2, where we find three tables with the three types of urban business models. The tables show which general circular business models that currently exist in theory have been used to create a new, overlapping business model suited to the specific urban context. In these tables, we find labels in the third column, which are theory based labels from the ReSOLVE theory by the Ellen MacArthur Foundation (2015) and the theory on urban business models by Jonker (2018), as well as general labels which are more emergent, and are derived from the themes identified within the business models. The labels created in the tables in chapter 3.2 provide the basis for the indicators in the operationalisation, and the indicators created will be used as the codes in the document analysis that is to be conducted. The operationalization is shown on the next page.



4.4: Limitations

The research method applied comes with certain limitations. The limitation of the methodology used lies first of all in the fact that when using a document analysis, the documents are not created with this specific research in mind, which could cause coding difficulties as well as potential gaps in the data (Bowen, 2009). There may also be differences between the project cases with regards to the amount of useful data they provide, as for some cases it may have been easier to find more extensive information than others. This has been tried to be prevented, as instead of using the information directly from the database the project case information has been reformatted in order to be more suited to this particular research, as was discussed previously. However, this will still not fully prevent the limitation of possible coding difficulties and potential data gaps. Another limitation is that document analysis is a covert method which has consequences for the ethical principles, which will further be discussed in the next paragraph. Next to that, a limitation of document analysis is that there may be biases, both from the researcher as well as in the documents itself, which calls for a thorough investigation and evaluation of the documents and their subjectivity and the researchers understanding of the data in order for the credibility of the research to be preserved (Bowen, 2009).

Besides that, it is important to consider the validity and reliability, which are two important measures when assessing the quality of a research (Bleijsen, 2013). Validity is divided into internal and external validity, internal meaning whether the research was done right, and external having to do with the generalizability of the results to a bigger population. The reliability has to do with the fact that the findings of the research should not be biased by random errors.

The reliability of this research could perhaps be impacted by the choice to use secondary data. The documents may have incomplete information and thus have missing data. This makes them more prone to random errors and bias. In order to eliminate this as much as possibly, the database was carefully and extensively looked into prior to selecting the 40 cases that the research will be done on, attempting to select the most complete and useful cases for this particular research. The documents following the database were carefully compiled to be as wholesome and extensive as possible.

External validity as said has to do with results being generalizable to a bigger population. The external validity in this research will be improved by the fact that the chosen method, a document analysis from secondary data, allows for both a large number of cases as

well as a large number of countries to be included in the research. This would have been more complicated had the chosen method been interviews for example, and not as many countries and cases would have been included in the research. The larger number of countries and cases included will hopefully allow for a better generalizable result of the research. Both quality criteria will further be discussed at the end of the research, in the methodological reflection.

4.5 Research ethics

Research ethics is an important element of doing research, and conducting research in an ethically sound manner is a fundamental principle of scientific research (Kjellström et al., 2010). The research ethics have been taken into account in doing this research, in trying to conduct the research in an honest and objective way, striving for integrity and the critical and careful assessment of the work that has been done in this research. As this research is conducted through a document analysis, there is no direct contact with the actors in the project cases, as the information has come from an already existing database. The database was accessed and used with permission of the researchers who created it. The names and contact information of the actors involved with each project case was chosen to be kept out of the documents, and all information was treated confidentially. It has been tried to be transparent with the research goals of this research, as well as being open about the results and potential implications of the research.

5. Analysis & Results

In this chapter, the results of the conducted document analysis and survey will be discussed. The document analysis was done on 40 project cases that were selected out of the 337 cases in the database. These 40 cases were most specifically addressed to the circular economy within an urban context, and thus most suited for this research. The list of project names and the country and city they took place in can be found in appendix 2. The document analysis is seen in appendix 4. From the document analysis, it became clear that there were four common themes throughout the projects, which will be discussed in paragraphs below. Next to that it, was found that within the 40 cases, the different types of business models could clearly be linked to the projects that are happening around Europe. What was seen is that many a times when there was an Urban Circular Community model found, it simultaneously took place with another model such as Looping or Optimization. Meaning there were instances where there for example was clearly a community model in use that also had some type of looping process going on. Below is a frequency table that shows how the many times the models or model combinations were found within the projects. In the following three paragraphs, the findings with regards to the three models will be discussed as well as the combinations that were found. This leads to the fourth paragraph, in which the adaptations to the typology of urban business models that follow from the results will be discussed. Lastly, there were some other findings which were not necessarily relevant to this specific research, but interesting enough to be discussed, which are found in paragraph five.

Table 7. Frequency of UBMs in the cases	
Urban Business Model type:	Frequency:
Combination of UCC & PRL	9
Product and Resource Looping	8
Combination of UCC+PRL+PRO	8
Urban Circular Community	6
Combination of UCC & PRO	4
Product and Resource Optimizing	3
Combination of PRL & PRO	2

5.1: Urban Circular Community model

This paragraph discusses the findings with regards to the Urban Circular Community model. Below is a frequency table that shows the indicators with regards to this model.

Table 4. Urban Circular Community	
Indicator:	Frequency:
Cooperation	26
Sharing	22
Education	12
Reusing	12
Increasing functionality of products	8
Servitization	5

As can be seen from the frequency table, the most frequent code found within this type was ‘Cooperation’, followed by ‘Sharing’. ‘Education’ and ‘Reusing’ both have 12 counts. Cooperation and Sharing being the most frequent themes found within the Urban Circular Community model type is a logical and expected outcome, as within this type the opportunities that the community in an urban environment provide are central. The main feature of the Urban Circular Community model is, as described in chapter 3, the process of collaboration between citizens, businesses and the local government within an urban environment. Nevertheless, there was still a distinction found that can be made between the Cooperation theme and the Sharing theme that was found in the cases that are within the Urban Circular Community type.

Cooperation was found to be most present in the cases that had a combination of multiple actors, and was also mostly found in projects that had a combination of the Urban Circular Community type with one or both of the other models, Product and Resource Looping and Product and Resource Optimizing. Next to that, Cooperation was most prevalent in projects that were building or creating neighbourhoods or other types of communities in which they were combining multiple circular initiatives. Sharing was also found within these neighbourhoods or communities, but different from the Cooperation theme was that Sharing was mostly used in projects with initiatives like car or bike sharing, and the Sharing action was more related to servitizing products and creating a platform where things can be shared, rather than creating a community as the Cooperation theme is doing. For this reason, when creating the clusters out of the 40 cases, there was a separation made between the Urban Circular Community model type projects, with one of the clusters being ‘Circular Neighbourhoods’ and the other ‘Sharing models’. The Circular Neighbourhoods cluster consists of the projects with the Cooperation theme, and the ‘Sharing models’ cluster consists of the projects with the Sharing theme. As said earlier on in the theory chapters, cities provide opportunities for circular business models to flourish, due to the urban environment and its

high concentration of resources, capital, talent and data being unique in the context of the circular economy within cities (Ellen MacArthur Foundation, 2017). What was found here with regards to the sharing and cooperation initiatives that use the unique urban environment context for the circular economy, is that currently in Europe, these opportunities are being used in two different ways. In some cities we find complete neighbourhoods dedicated to the circular economy, combining multiple circular initiatives and actively stimulating the citizens within the community to participate. An example of this is ‘Eco-Viikki’ in Helsinki, Finland, or ‘De Nieuwe Dokken’ in Ghent, Belgium. Both projects exploit the opportunities their living environment has to offer as much as possible, through for example the use of natural resources, waste reduction, rainwater reusing, and sharing possibilities among residents. Below is an excerpt of data from the ‘De Nieuwe Dokken’ project that further illustrates this.

implemented several circular initiatives with regards to heating, waste, water and mobility, with the aim to make de Nieuwe Dokken a climate-neutral neighbourhood. There is an energy network, the wastewater is collected and reused by a local business, waste is turned into for example fertilizer and biogas, and	Waste Reduction	Product and Resource Looping	Circular Based models
	Renewable Energy	Product and Resource Optimizing	
	Reusing		
	Waste reduction		

The example clearly shows a multitude of circular actions being present within this circular neighbourhood.

The projects in the Circular Neighbourhoods cluster are striving to create multiple values through cooperation between citizens, local businesses and the local government. This rhymes with the theory on multiple and shared value creation as well as what Jonker et al. (2016) say about cooperation and cohesion in creating multiple values being a prerequisite to circular business models, and about the need for a new generation of business models that are based on cooperation and value creation between parties in different networks, as the circular economy in its essence is based on cooperative value creation, which in urban environments is made possible through collaborative networks. Accenture (2015) also stress the importance of cooperation between multiple actors in collaborative circular networks. The document analysis clearly shows that there are currently cities throughout Europe doing such a thing, with 9 out of 40 cases being in the Neighbourhoods cluster.

With regards to the Sharing theme, it is seen that sharing is being used as a part of circular neighbourhoods, but more frequently being used as a separate action within a city, for example through a sharing platform. The difference thus is that this solely offers a sharing platform within a city, for one separate purpose, instead of bringing multiple actions and actors together, as was discussed in the previous part on the Circular Neighbourhoods cluster. Due to sharing being present in both clusters but there also being a clear distinction between ‘standalone’ sharing projects and sharing actions within projects that combine multiple actions, the decision was made to create a separate cluster, that being ‘Sharing models’. An example of this is the ‘SwapFiets’ project, which is providing bikes to people in multiple Dutch cities, and ‘La Charte Main Verte’ in Paris, France, which has made communal gardens available for people to grow plants and vegetables on. 7 out of 40 cases fall within the Sharing models cluster.

As seen from the frequency table in the introductory part of this chapter, the Urban Circular Community model was quite often found within the project cases, either on its own or in a combination with another model. This is logical on the one hand, as the urban and community aspects that are part of that business model are inherently connected to ongoing processes in cities and thus likely to be found throughout the projects in the cities. The circular economy getting a foothold in cities will not only be a result of the high concentration of resources, capital, talent and data being present in cities, as was discussed in the theory chapters (Ellen MacArthur Foundation, 2017), but the community aspect can also provide a lot of power to the circular initiatives in cities, because it brings opportunities, in bringing multiple actors together and creating something extra compared to a ‘normal’ circular business model. To further illustrate this we will look at an example from the data analysis. The following example comes from the ‘Waste to energy plant’ project in Malmö, Sweden.

<p>This project has changed the way the city collects waste, instead of letting trucks drive through the street to pick it up, citizens drop it in underground containers. From the collected waste, the organic waste is burnt and converted into biofuel and biofertilizer. The other types of waste are burnt and recycled into electricity and district heating. Through the district heating the project provides over 60% of the heating to Malmö and neighbouring city Burlöv. The</p>	Waste Reduction	Product and Resource Looping	Circular Based Models
	Looping		
	Recycling Renewable Energy Sharing	Urban Circular Community	Community Based models
	Cooperation		

In this project, multiple actors are being brought together. Citizens are dropping their waste in underground containers, saving trucks from having to drive through all the streets and pick up garbage bags, now instead only having to collect it at several points. The collected waste is subsequently efficiently used, creating biofuel and electricity among others. A district heating system then makes it possible to ‘give back’ to the citizens, who set the whole process in motion through their own waste, getting heating in return. The project in the example clearly used the opportunities and advantages it has seen in citizens’ waste, eventually letting the circle become full by returning the waste back to the citizens in the form of heating.

5.2: Product and Resource Looping model

This paragraph discusses the findings with regards to the Product and Resource Looping. Below is a frequency table that shows the indicators with regards to this model

Table 5. Product and Resource Looping	
Indicator:	Frequency:
Waste Reduction	24
Looping	17
Reusing	12
Recycling	7
Repairing	4
Remanufacturing	4

For the Product and Resource Looping model type, the most frequent indicator found was ‘Waste Reduction’. ‘Looping’ and ‘Reusing’ were the following two most frequent. Waste Reduction and Looping being common themes found throughout the projects in Europe is logical outcome, as they are two processes that are at the base of the idea of the circular economy. As seen from the definitions of the Ellen MacArthur Foundation (2012, p. 7), which states that the Circular Economy ‘*aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models*’ and of Geissdoerfer et al. (2016) who say that the circular economy is ‘*a regenerative system in which resource input and waste, emission, and energy leakage are minimised by slowing, closing, and narrowing material and energy loops*’. Waste reduction or elimination is central to the idea of the circular economy and thus it is no surprise that they were frequently found throughout the projects. The cluster that was created from these projects was thus called ‘Waste Reduction’, and out of the 40 projects, 11 are in this cluster. Within the cluster, the projects are all focused on creating loops and reducing waste in doing so, but there are many variations between what type of waste is being targeted. Subthemes within the Waste Reduction theme that were found are construction and demolition waste, food waste, textile waste, and ‘product’ waste, that being projects where citizens have a place to bring their unused or broken products and have them be repaired or reused. Next to that, there were cases, such as ‘*CircWaste*’ in Jyväskylä, Finland, ‘*Movimento Legge Rifiuti Zero per l'Economia Circolare*’ in multiple cities throughout Italy, and ‘*Zero Waste*’ in Ljubljana, Slovenia that were more focused on informing and educating people about the idea of waste reduction and how it can be achieved, as well as promoting the idea and giving citizens incentives to reduce waste. It is thus clear that Waste Reduction is a common theme throughout Europe currently with regards to the circular economy, and that it comes in many forms of waste reduction, ranging from different types of waste being reduced to educating people on the idea of waste reduction. This could also possibly be due to the fact that waste legislation and waste management are prevalent throughout the action plans of the European Commission which were discussed in chapter 2.1.3, as well as the Ellen MacArthur Foundation (2015) saying that there is a need for action at a European level with regards to waste, as the present model of value creation in the European economy is notably wasteful, with the European economy still mostly using a take-make-dispose system (Ellen MacArthur Foundation, 2015). The trend that is seen with regards to waste reduction being a common theme throughout Europe could thus be a

combination of the fact that Europe needs to change their approach to handling waste and the European Commission promoting this, as well as waste reduction being central to the idea of the circular economy in general.

The Product and Resource Looping model was most often found in combination with the Urban Circular Community model. This particular combination is found to be a smart way of using the urban business models within cities, as it combines opportunities from for example waste reduction, which is a Product and Resource Looping related theme, with the community aspect and its possibilities that the Urban Circular Community model brings. An example of this is given below.

Next to this, the project also operates in wastewater treatment and uses the residual heat to deliver district heating and cooling.	Waste Reduction	Urban Circular Community	Community Based models
	Sharing		

The following excerpt comes from the ‘Linköping biogas plant’ project in Sweden. The project does several things with regards to waste management, they collect food waste and convert it into biogas, and as can be seen above they treat wastewater, which generates residual heat. This particular project has really thought about the opportunities in their own urban environment, and instead of using the residual heat for other purposes, they in a sense ‘give it back’ to the citizens living in the surrounding areas of where the plant is located, through a district heating and cooling system. This makes it that this project case, which through its primal processes can clearly be seen as using a Product and Resource Looping business model, is also labelled with ‘sharing’, seen in the data excerpt above, and thus also being within the realm of the Urban Circular Community model.

The following example comes from the Austria ‘Wiener Tafel’ project.

The Wiener Tafel project has businesses donate food that would otherwise be thrown away, and the Wiener Tafel distributes this food to people in need.	Waste Reduction	Product and Resource Looping, Urban Circular Community	Circular based models, Community based models
	Sharing		

In the data excerpt above, we see that in this project there is a combination of the labels ‘Waste Reduction’ and ‘Sharing’ that has led to the combination of the model Urban Circular Community and Product and Resource Looping being identified. Here, the project smartly uses the overvalues available in the urban environment, in the form of leftover food, and combines in with the community aspect through sharing the leftover foods with citizens in need.

<p>The mall is divided into different, smaller stores run by entrepreneurs and supported by the local government. The citizens can drop off their used items at the mall.</p>	<p>Cooperation Sharing</p>	<p>Resource Looping Urban Circular Community</p>	<p>Community based models</p>
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This example is a data excerpt from the ‘ReTuna’ project in the city of Eskilstuna, Sweden. The project in its essence is simply a second hand store, in the form of a shopping mall divided into smaller stores selling reused and repaired products. Based on this, the business model behind the project is clearly Product and Resource Looping. However, the project combines this with the Urban Circular Community model, as can be seen in the data excerpt above. The mall combines all three actors, by letting citizens bring in their used items, by having the project supported by the local government, and by entrepreneurs being able to able to start a business within the shopping mall, because as said the mall is not a single second hand store, but smaller stores within the mall. The project thus makes use of the available overvalues within their city. Material overvalue is the used items that citizens bring in, social overvalue through the entrepreneurs that now have a space available to them to open up a store to repair and sell reused products, and perhaps financial overvalue through the local government’s involvement.

The Product and Resource Looping model is not only found in combination with the Urban Circular Community model, but is also found on its own eight times. Below is an excerpt of data from the project ‘BauKarussell’ in Vienna, Austria.

BauKarussell		Product and Resource Looping	Circular based models
The BauKarussell project aims to reuse building materials of demolished buildings in newly built buildings in Vienna. This reduces waste from the demolished buildings and allows it to be reused in new buildings. The central theme is waste reduction and urban	Reusing		
	Waste Reduction		
	Looping		

The excerpt shows that this project is aimed at waste reduction of construction and demolition waste through reusing and looping of building materials. The Product and Resource Looping model does not necessarily find its power from the community or urban aspects and is able to be used by more example a single company, and will still work detached from the specific urban context, whereas the Urban Circular Community model will not. The example above clearly shows that, as it is a project of a company within a city that operates independently and is not depended on for example citizens' waste like the examples discussed previously often were. This is thus an interesting finding, because Product and Resource Looping model is found in combination with the Urban Circular Community nine times, and on its own eight times. So where some projects that are engaging in circular initiatives with regards to the Product and Resource Looping model are adding an extra dimension through the urban community aspect and the Urban Circular Community model, there are also many projects that are operating within the urban context solely based on the Product and Resource Looping model. Next to this finding it is also seen that the Product and Resource Looping models in the projects are most often related to waste reduction, which is quite logical as waste is an important area which has previously been indicated as an area that Europe needs to change its approach to.

5.3: Product and Resource Optimization model

This paragraph discusses the findings with regards to the Product and Resource Optimization. Below is a frequency table that shows the indicators with regards to this model

Table 6. Product and Resource Optimization	
Indicator:	Frequency:
Renewable Energy	18
Optimization	9
Waste Prevention	9
Bio-based materials	3
Recycling	2
Durability of products	0

For the Product and Resource Optimization model type, the most frequent indicator found by far was ‘Renewable Energy’. ‘Optimization’ and ‘Waste Prevention’ followed, both being found nine times across the 40 cases. Durability of products was identified zero times. What was found that durability of products was often underlying to processes happening within the projects labelled with the Product and Resource Optimization model, but was not necessarily found independently, more often being intertwined with the recycling or optimization label, but not strongly enough to be solely labelled on ‘durability of products’. Perhaps using this indicator was not the right choice as it was often seen in falls within the optimization label. Renewable Energy being a common theme throughout the circular economy in European cities is presumably to do with the fact that the linear economic system that is currently in place throughout most of the world has its limits and shortcomings (Ellen MacArthur Foundation, 2012) and the fact that the rationale of both the economy as well as the society for moving towards the circular economy is continuously increasing, awareness of the limits of the linear economy are growing (Arcadis, 2016). Next to this, cities’ populations are rapidly growing due to urbanization (UNDESA, 2015) and this comes with a strain on cities’ resources and an increased resource and energy consumption. The Ellen MacArthur Foundation (2017) stress that there is a need for energy systems within cities to be made in a way that will allow for effective use of energy and cost reduction all while have a positive impact on the environment, as well as including a *‘shift towards the use of renewable energy’* (Ellen MacArthur Foundation, 2012, p. 7) in their definition of the circular economy. Out of all of this it logically follows that renewable energy is a theme that is found throughout the projects in Europe. The cluster that was formed was thus called Renewable Energy Systems, and out of the 40 cases, 13 are in this cluster. The subthemes within the Renewable Energy Systems cluster range from providing heating, in different ways such as the *‘Fortum biomass plant’* in Jelgava, Latvia using waste to generate heat, the *‘Sandvik Plant, Växjö Energi AB’* projects in Växjö, Sweden burning wood to generate heat, the *‘Waste to Energy plant’*

projects in Malmö, Sweden burning and converting citizens waste into biofuel and biofertilizer, and the ‘*Linköping biogas plant*’ projects in Linköping, Sweden using food waste from both citizens and local canteens and restaurants and converting it into biogas. There are also projects within this cluster that are focused on educating citizens on renewable energy and providing incentives to citizens that are making use of renewable energy, and projects that are focused on innovating new ways of creating renewable energy. Next to the fact that all the projects are making use of renewable energy in some way, most of them are simultaneously involved in the process of waste prevention. Waste Prevention was the second most common theme found, as can be seen from the frequency table. Waste Prevention is found in one of the three principles of the circular economy as stated by the Ellen MacArthur Foundation (2012), which is to design out waste. The goal is for waste not to exist, meaning that products and components are designed to enable disassembling, reassembling and thus reusing (Ellen MacArthur Foundation, 2012). The projects in the Renewable Energy Systems cluster are mostly making use of different types of waste to generate a type of renewable energy, and thus preventing waste in the process.

The excerpt of data below comes from the ‘Pakri Science Park’ project in Estonia.

Pakri is a privately owned science and industrial park that is focused on things such as renewable energy, energy efficiency, energy storing, and electrical vehicles.	Renewable Energy	Product and Resource Optimizing	Circular Based models
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The project is not necessarily undertaking action but is more aimed at researching and developing renewable energy solutions among others, with the aim to use energy and find energy solutions that work as optimally as possible. Another project where such energy solutions are already in effect is found in Ljubljana, Slovenia.

<p>The main aim of this project is to improve the energy consumption in rental apartments in Ljubljana, both through the adaptation of existing housing and by building new low energy housing. They use innovative renewable energy systems for both the refurbishment of existing houses and the construction of new houses.</p>	Renewable Energy	Product and Resource	Circular Based models
	Optimization	Optimizing	
	Renewable Energy		

This project is not only changing currently existing apartments throughout the city to be more energy efficient but also implementing the use of innovative renewable energy systems when building new houses, aiming to make both new and existing houses be as optimally efficient as possible with regards to energy consumption. The fact that renewable energy is a common trend throughout Europe could come down to what was discussed above with regards to there being a need for renewable energy systems within cities due to the strain on the resources and the increased demand that the ongoing urbanization comes with, as well as the fact that waste prevention is an agenda point of the European Commission, as was previously discussed for the Waste Reduction cluster.

5.4: Adaptation of the Typology

From the three paragraphs above it can be seen that there are not only clear themes throughout Europe with regards to the circular economy, but the three urban business models in the proposed typology are also clearly seen throughout the data. The four clusters that were formed based on the general themes and the models being used with regards to those themes are Renewable Energy Systems, Waste Reduction, Circular Neighbourhoods, and Sharing Models. Next to that, the results in the paragraphs above also show that several types of combinations of models are also quite often used within the models. The examples and data excerpts in the paragraphs above tell us that there is possibly an overlap between the Product and Resource Looping and Urban Circular Community models in the typology. There could be a need to adapt the typology in order to better fit and better specify when Product and Resource Looping actions are specific to an Urban Circular Community model context, and what it means when they are separate. Same goes for the combination of all three models within the urban community context, where the overlap between the three models can cause blurriness and ambiguity within the typology. The need for adaptation of the typology will

become more clear from the next part, where the distribution of the urban business models within the four clusters will be looked at.

Table 8. Frequency of UBMs per cluster, cluster 1	
Cluster 1: Renewable Energy Systems	Frequency
Combination of UCC & PRL	5
Product and Resource Optimization	3
Product and Resource Looping	2
Combination of UCC & PRO	2
Combination of PRL & PRO	1
Combination of UCC+PRL+PRO	0
Urban Circular Community	0

In the first cluster, Renewable Energy Systems, we see that the combination of the Urban Circular Community model and Product and Resource Looping is the most frequent, and that the combination of all three models as well as the Urban Circular Community model on its own were not found. This can be explained by the fact that the Urban Circular Community model does not necessarily fit specifically to the Renewable Energy Systems theme, a company can start a business with for example a biogas plant and does not have to involve the city's community in this to be successful. However, most frequent was the combination of Product and Resource Looping with the Urban Circular Community, where in most cases there were companies that did use the specific power and possibilities of their city or community, which was already seen in the examples from the data excerpts explained previously, where businesses not only smartly use the overvalues from their own environment, which can for example be wastewater like in the 'Linköping biogas plant' project, in order to create renewable energy, but then also give back to the community through a district heating network. A district network is often seen within this cluster when some type of combination model involving the Urban Circular Community model is used.

Table 9. Frequency of UBMs per cluster, cluster 2	
Cluster 2: Waste Reduction	Frequency:
Product and Resource Looping	6
Combination of UCC & PRL	5
Combination of UCC+PRL+PRO	0
Urban Circular Community	0
Combination of UCC & PRO	0
Product and Resource Optimization	0
Combination of PRL & PRO	0

In the cluster of Waste Reduction we see that Product Resource Looping and the combination of Product and Resource Looping with Urban Circular Community were the models that were found most often. The other models were not found at all within this cluster. This outcome is likely a result of the fact that waste reduction is a theme that is central to the Product and Resource Looping model. In five of the cases the Product and Resource Looping model went together with the Urban Circular Community model, which was often found to be used in a similar way to the previous cluster, where businesses are using overvalues within their local area or city and using these to both their own and the cities advantage in a waste reduction process, such as the previously discussed examples of the ‘Wiener Tafel’ and ‘ReTuna’ projects. Next to that there were also projects promoting waste reduction and informing and education citizens on waste management, such as the ‘Zero Waste’ project in Ljubljana, Slovenia, the ‘*Movimento Legge Rifiuti Zero per l'Economia Circolare*’ project which is spread throughout multiple Italian cities, and the ‘CircWaste’ project in Jyväskylä, Finland. The following excerpts of the data analysis are from these projects.

<p>The Zero Waste project in Ljubljana wants to redesign society into thinking differently about waste, to see it as a resource, to change peoples' lifestyles and consumption patterns in general and to make them think circular.</p>	<p>Waste Reduction</p> <p>Educating</p>	<p>Product and Resource Looping</p> <p>Urban Circular Community</p>	<p>Circular Based models</p> <p>Community Based Models</p>
<p>The project is a movement creating awareness and providing education</p>	<p>Educating</p> <p>Waste Reduction</p>	<p>Urban Circular Community</p>	<p>Community Based models</p>
<p>as generating new information on these processes in order to better understand and develop waste management in the future.</p>	<p>Educating</p>	<p>Urban Circular Community</p>	<p>Community Based models</p>

From all three excerpts it becomes clear that educating the community on waste reduction possibilities is the main goal, with the ‘Zero Waste’ projects even having the aim to redesign the society’s way of thinking and in doing so changing peoples’ lifestyles. The education

aspect is not clearly present within the typology of urban business models but from these findings it seems that is perhaps should be more present.

Table 10.	
Frequency of UBMs per cluster, cluster 3	
Cluster 3: Circular Neighbourhoods	Frequency:
Combination of UCC+PRL+PRO	8
Urban Circular Community	1
Combination of UCC & PRO	0
Product and Resource Optimization	0
Combination of PRL & PRO	0
Combination of UCC & PRL	0
Product and Resource Looping	0

The third cluster, Circular Neighbourhoods, sees most logically the combination of all three models as the most frequent, next to one count of the Urban Circular Community model on its own. The other models are not found within this cluster. The projects within the Circular Neighbourhoods cluster are perfect examples of cities trying to seize as many circular opportunities as possible within the urban environment, combining the different aspects and themes found within all three models and using them to the neighbourhood's advantage. Table 3 in Appendix 6 shows multiple examples of Circular Neighbourhoods throughout several European cities. Within the Urban Circular Model type in the typology it should perhaps be made more clear that the Product and Resource Looping and Product and Resource Optimizing model aspects are integrated parts of the Urban Circular Community model, as the table clearly shows that the Circular Neighbourhoods are almost always a combination of the three models.

Table 11.	
Frequency of UBMs per cluster, cluster 3	
Cluster 4: Sharing Models	Frequency:
Urban Circular Community	4
Combination of UCC & PRL	1
Combination of UCC+PRL+PRO	1
Combination of UCC & PRO	1
Product and Resource Looping	0
Product and Resource Optimization	0
Combination of PRL & PRO	0

The last cluster, Sharing Models, saw the Urban Circular Community as the most frequent model, with the combinations of Urban Circular Community and Product and Resource

Looping, Urban Circular Community and Product and Resource Optimizing, and the combination of all three all being found once. This is likely because the sharing aspect is a part of the Urban Circular Community model within the typology, however, in this case it was found that the Sharing Models are mostly found as standalone projects within cities that are simply providing a sharing platform to individuals, rather than there being an actual community aspect to it, which is the reason why two separate clusters were made. An example is ‘Swapfiets’ which is a Dutch bike sharing project.

24 hours. The project makes sure no bikes are thrown away unless absolutely necessary. They reuse and repair bikes. The SwapFiets bikes are currently available in 16 cities across the Netherlands.	Increasing functionality of products Servitization Reusing Repairing Sharing	Urban Circular Community	Community Based models
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The data excerpt above shows that the core of the ‘Swapfiets’ project is to reuse and repair bikes, making sure they aren’t thrown away, and providing the bikes to people throughout several Dutch cities. The business and citizens are completely separate, with the business providing a platform for the bikes to be shared and taking care of the repairs, and the citizens simply using and paying for the bikes. It is thus more of a sharing platform than a community that is being created, however, with the typology as it is now these projects do fall under the Urban Circular Community model category, as is the case for all the projects in the fourth cluster. Perhaps an adaptation to the typology is needed through this outcome. A separate model type suited to the projects in the Sharing Models category would be the most logical adaptation following the research. Sharing is a theme that can take place as an integrated process within an Urban Circular Community type model, but can also be a standalone model where for example a company provides a platform within a city where bikes or cars are being shared between citizens, but there is no real community aspect to it. More on the adaptations to and creation of the final typology will be discussed in the next subparagraph.

5.4.1: Final Typology of Urban Business Models

Before we look at how the above presented results with regards to the three urban business model types that were in the proposed typology have led to a need for adaptation of

the typology, we will first quickly look back at what the proposed typology looks like, and how it came to be.

The proposed typology was created out of the circular business models by Accenture (2015) and Bocken et al. (2016), which were labelled based on their general characteristics, how they fit into the ReSOLVE framework (Ellen MacArthur Foundation, 2015), and what urban business model group (Jonker, 2018) they were based on. This led to three model types, which were Product and Resource Looping, Product and Resource Optimizing, and Urban Circular Business models. The proposed typology of urban business models can be seen below in Figure 1.

Figure 1. Proposed typology of Urban Business Models		
	Platform based	
Circular based	<i>Product and Resource Optimizing model</i>	<i>Product and Resource Looping model</i>
	Optimizing products and resources through replacement of linear resource approaches and designing products for durability and repair. The main characteristic of this model is optimization of both products and resources, making optimal use of the materials and resources available within the urban environment and using its capacities most efficiently.	Exploiting the residual value of both products and materials, creating value out of something that would otherwise be waste. The main characteristics of this model is creating loops through processes such as recycling, reusing, repairing and remanufacturing and with that reducing waste within the urban environment.
Community based	<i>Urban Circular Community model</i>	
	The power of the urban community is used, at the product level in order to optimize the functionality of products through servitization and sharing platforms, and at the process and manufacturing level with organizations sharing and reusing raw materials and creating business networks. The main characteristic of this model is the collaboration between citizens, businesses, and local governments who together are engaging in circular economy initiatives within their own urban environment.	

From the model type descriptions, it can be seen that the Product and Resource Optimizing model is aimed at making optimal use of the products, materials, and resource within the urban environment, the Product and Resource Looping model is aimed creating product, material and resource loops and with that reducing waste within the urban environment, and the Urban Circular Community also uses both optimizing and looping within the urban environment but adds the community aspect through processes such as sharing and servitization of products, and in having the three different actors within the urban context, citizens, businesses, and local governments cooperate.

From the previous four paragraphs with the results of the data analysis it has become clear that there are several adaptations that should be made to the typology in order for it to be more specific, complete, and usable. First of all, it has become clear that there should be a fourth model created, aimed at sharing platforms in urban environments that provides citizens with a product or service, and is not necessarily part of creating a community. Next to that, the Urban Circular Community model should be more specifically aimed at creating a community through many circular initiatives combined. Aspects of both the Product and Resource Looping and Product and Resource Optimizing should be more integrated within the model, as the research clearly showed that within circular neighbourhoods, these two models and the themes involved in them went together with the Urban Circular Community model. Lastly, both the Product and Resource Looping and Product and Resource Optimizing models need to have the urban aspect more clearly integrated within the model. The research showed that these two models often are used in projects started by businesses that involve the citizens and the overvalues in their cities to both their own and the citizens benefit in some way. The two types as they are in the proposed typology are too general and could simply be circular business models, so the urban aspect needs to be more integrated for them to truly be seen as urban business models. Most projects that use one of these two model types were seen to somehow include and use the citizens, and in doing so they were not necessarily using the Urban Circular Community model or creating a community as such, but the cooperation between the businesses and citizens that operate and live within the same urban proximity and environment clearly showed from the research, and thus should be made more clear in the model types. With the model types as they currently are, the question could be asked: are they really specific to the urban context, or can the models be used in a standalone project that just happens to be taking place in an urban environment? To really be called an urban business model, the model types should be specific to the opportunities in the urban environment, and thus the Product and Resource Optimizing and Product and Resource Looping model types should be adapted as such. As was said earlier on in the theory chapter, urban business models do not only concern the material side of the circular economy, but are also heavily involved with the social side, which is an aspect that is specific to the urban context. This aspect being present within urban business models was clearly shown through the outcomes explained above. The adapted typology can be seen in figure 2 below.

Figure 2.
Typology of Urban Business Models

	Circular based	
Community based	<i>Product and Resource Optimizing model</i>	<i>Product and Resource Looping model</i>
	Optimizing products and resources through replacement of linear resource approaches, making use of renewable energy sources, and designing products for durability and repair. The urban environment is optimally used through for example the use of regional waste as input for renewable energy, and cooperation between different actors in the urban environment allowing for the created energy to be locally used within said environment.	Exploiting the residual value of both products and materials, creating value out of something that would otherwise be waste. The main characteristics of this model is creating loops through processes such as recycling, reusing, repairing and remanufacturing, leading to waste reduction. The creation of loops is done within the urban environment through different processes of cooperation and mutually dependent relationships between citizens, businesses and the local government, who are engaging in different processes and trying to close the loops together.
	<i>Urban Sharing Platforms model</i>	<i>Urban Circular Community model</i>
	The servitization of products through providing a platform for sharing within a city or urban environment. The sharing platforms provide a place where different actors are brought together in order to make use of a certain service or product, without there being a collaborative aspect to it as there is in the Urban Circular Community model. Examples of sharing platforms within urban environments can be shared gardens and bike or carsharing and other mobility solutions.	Combining different circular possibilities and initiatives and multiple actors within the urban environment in order to together create a collaborative circular network leading to a wholesome urban circular community in which different themes and processes from all three other models are combined, as well as adding an education aspect to it, as within the community there can be different ways of informing and educating other actors on circular ways of living within a city. This can for example be in the form of a circular neighbourhood.

The adapted and final typology shows four model types, Product and Resource Optimizing, Product and Resource Looping, Urban Sharing Platforms, and Urban Circular Community. The name for the new model type was chosen to be Urban Sharing Platforms, as in this model businesses or local governments are providing a sharing platform to citizens within their own urban environment. The names of the other three models remain unchanged, as the names still represent what the models are about, only the description and meaning of the model was made more specific, in line with the findings of the research.

5.5 Other findings

Next to the findings with regards to the sub questions there were other general but important findings that came forward from the research, that were not necessarily important to the typology and its adaptation, but were still interesting findings which will be discussed below.

One of the findings is that there is a lot of variety between the projects regarding the actors that are carrying out the projects. Some are one actor initiatives by citizens, local

governments, or businesses, some are combinations of the two and some are all three actors combined. Almost half of the projects had all three actors involved, mainly in projects that are in the Circular Neighbourhoods cluster but also in projects such as the German 'City2Share' projects, where the three actor involvement comes from the project, which is focused on urban electromobility, being initiated from the local government in order to try and reduce traffic and emission, with help of businesses that are developing and creating smart, circular solution in order to be able to achieve that reduction, and the project is subsequently dependent on the citizens actually understanding and using the mobility solutions for it to be successful. The three actor combination is most frequent with 18 out of 40 cases. Other combinations of two actors or single actors in projects are pretty evenly distributed, with only the local government as a single actor not being found, and the citizens as a single actor being found only once. The frequency table can be found in appendix 5. Another notable finding was that when there was a combination of the two actors business and citizens, which was present in 9 of the projects, the nature of the projects was always that a business had business plan based on circular principles, but is dependent on citizens in a certain way for it to be successful. Examples are the 'Closing the Loop' project in Spain, which creates new clothes out of textile waste, but is largely dependent on citizens bringing in their old clothing in order to have textile to work with, and 'Kungsbroskuset' in Sweden which uses the body heat from commuters to heat the central station building, and is thus dependent on citizens traveling by train.

The geographical distribution of the projects is also interesting to look at. As said in the methodology chapter, the database of the project cases consisted of 337 projects spread throughout 31 European countries. The 40 cases that were eventually selected to be used in this project were spread throughout 19 countries, most of which were Western European countries. The country with the most amount of cases was Sweden, as well as Scandinavia in general being well represented among the cases. Less represented were the more Eastern countries in Europe, where only Slovenia and the three Baltic states had project cases.

With regards to the general themes that were found in the cases related to their geographical location, it can be seen that Swedish projects tend to have a focus on renewable energy systems, with five out of six Swedish projects consisting of initiatives that use some type of waste in order to generate renewable energy. Same goes for Austria, with all of the four Austrian projects being in the Waste Reduction cluster there seems to be a certain trend going on in the country. This could possibly also be related to the fact that waste reduction is

a popular theme throughout the European projects in general, which in turn could be a result of the waste management theme being present throughout the European Union's plans with regards to the circular economy in Europe and the waste legislation and regulations that have followed out of those plans. Other than Austria and Sweden seemingly having a clear theme preference going on within their projects, the themes are pretty evenly spread throughout the different project cases in Europe.

6. Conclusion & Discussion

In this chapter, the final conclusion of the research will be given, as well as a discussion including the limitations of the research, recommendations for practice as well as further research, and a reflection on the research.

6.1: Conclusion

This thesis studied what is currently happening with regards to the circular economy in urban environment throughout Europe. The current literature identified research gaps with regards to the present reality of the circular economy in European cities and a need for research from a European perspective, as well as the fact that the circular economy in an urban context specifically asks for new and innovative business models. The objective of the research was to *‘gain an insight into how different types of urban business models are currently taking form in circular economy projects in cities across Europe that are collectively creating value within those cities, in order to contribute to the theory on the circular economy, as well as making practical recommendations for such projects regarding the use of business models’*. The main research question following the research objective was: *‘How are constituents in an urban environment collectively creating value through the use of urban business models?’*, which was accompanied by sub-questions focusing on identifying the circular economy themes that are currently favoured throughout Europe, and how the business models found throughout the European cities relate to the typology of urban business models. Said typology was created out of the theory as a proposed typology, and was adapted into the final typology following the research outcomes.

In order to answer the main research question, a qualitative research was done in which project case descriptions were created out of an already existing database on circular economy projects throughout Europe, out of which the 40 best suitable cases were selected. The project case descriptions were coded and analysed in order to be able to identify themes and business models used, and with that be able to find out how constituents in the European urban environment are taking on and carrying out circular economy projects, aided by urban business models and ultimately leading to value creation.

From the results of the research it became clear that waste reduction, renewable energy, cooperation, and sharing are currently the biggest themes throughout Europe. The 40 project cases that were analysed were grouped into clusters according to the findings with regards to the current themes playing in Europe, leading to four clusters: Renewable Energy Systems, Waste Reduction, Circular Neighbourhoods, and Sharing Models. The fact that

renewable energy and waste reduction are popular themes in Europe is in accordance with the theory that was discussed in chapter 2. Waste legislation and waste management are frequent themes throughout the action plans of the European Commission, which were discussed in chapter 2.1.3, as well as the Ellen MacArthur Foundation (2015) saying that there is a need for action at a European level with regards to waste, as the present model of value creation in the European economy is notably wasteful, with the European economy still mostly using a take-make-dispose system (Ellen MacArthur Foundation, 2015). The outcome that cities throughout Europe are commonly focusing on waste themes within their projects is thus supported by the theory stating a change with regards to waste is required for Europe. The results showed that many cities are currently already undertaking action with regards to waste. The renewable energy theme is related to the waste reduction theme as the project cases showed for example food waste, wastewater, or other forms of regional waste being used and processed into some type of renewable energy. The cooperation and sharing themes were also identified as being prevalent throughout Europe. Theory states that cities provide opportunities for circular business models to flourish, due to the urban environment and its high concentration of resources, capital, talent and data being unique in the context of the circular economy within cities (Ellen MacArthur Foundation, 2017). Many projects were seen to attempt to seize the unique opportunities that the urban environment has to offer with regards to the circular economy, for example in the projects that were building circular neighbourhoods in which they integrated and combined multiple circular initiatives and themes while at the same time actively stimulating and educating the citizens on the circular economy's possibilities, creating a community in doing so.

With regards to how the model types in the proposed typology related to what was found in the analysis of the project cases, it was found that a fourth model needed to be created, named Urban Sharing Platforms, as it was seen that sharing platforms within the urban environment were both found integrated within circular communities executing several circular actions, but also simply as a sharing platform within a city, offering for example bike sharing to citizens. Next to that, it was found that the three remaining model types needed to be adapted in order to be more suited to the specific urban context. Both Product and Resource Looping and Product and Resource Optimizing could in their old form function as normal circular business models, but from the analysis it was seen that this was often not the case, as within cities the projects were seen to combine their own objectives with the opportunities in the urban environment they are operating in, for example with the use of

citizens' waste as a resource, processing it into renewable energy that is eventually given back to those citizens through a district heating system. The Urban Circular Community model was adapted because it was found that it needed to be more clear that this model combines aspects of all three remaining models, for example in the form of a circular neighbourhood.

The results showed that the circular economy is taking place throughout Europe in different forms. In most of the project cases there was a cooperation between two or more actors, which are citizens, businesses, and the local government. They are often seen to be working together and collectively taking action, thus collectively creating value in doing so. In a few projects there were single actors and no collective action. Though theory states that the urban environment provides unique opportunities and many projects were seen to be seizing those opportunities, there were also project cases which did not necessarily fully use their cities potential, but were simply standalone project that just happened to take place in an urban environment. This perhaps shows that while the general idea of the circular economy is becoming more widespread and businesses are integrating its principles into their business models and ways of working, more could be achieved if they are able to fully understand and subsequently use the possibilities of the circular economy within their city or urban environment, cooperating with both citizens and the local government in a more integrative collaborative network benefitting all actors. Yet, the circular economy in European cities generally mostly seems to have a collective nature. The collective actions that constituents in the urban environment are undertaking do not have one specific direction or theme, but are divided over the four themes and subsequently formed clusters which were discussed above. This undertaking of collective action in order to create multiple values within a project, neighbourhood, or city, is in accordance with the theory on multiple and shared value creation discussed in chapter 3.1, which said that different actors work together in a shared effort to create and manage public value strategically through different configurations (Bryson et al., 2017), which is effectively what is happening is the circular economy initiatives that were part of this research, as well as Accenture (2015), who also stress the importance of cooperation between multiple actors in collaborative circular networks. Jonker et al. (2016) addressed a need for a new generation of business models that are based on cooperation and value creation between parties in different networks, as the circular economy in its essence is based on cooperative value creation, which in urban environments is made possible through collaborative networks. The four model types found in the typology created in this research are examples of such models. The business models that the constituents in the project cases

are using in their circular initiatives in order to create value were seen to be divided over the four model types that were created in the typology of urban business models, which were Urban Circular Community, Urban Sharing Platforms, Product and Resource Looping, and Product and Resource Optimizing. The constituents in the European urban environment were thus found to be clearly undertaking collective action when it comes to the circular economy, and with that it is clearly seen that collaborative networks have a great amount of power when it comes to the circular economy in cities, as well as these collaborative networks clearly being the drivers of value creation in the circular initiatives within those cities. What these findings mean for both the theory on the circular economy as well as practical implications will be discussed in the next paragraph.

6.2: Discussion

This paragraph will look at the strong and weak sides of the research, where the limitations of the research will be indicated, the meaning of the findings for the theory on the circular economy will be discussed with the theoretical recommendations, as well as the practical implications of the research. Next to that there will be a methodological reflection on the research.

6.2.1: Limitations

The research was conducted as a document analysis on 40 project cases found throughout Europe. The research was limited by the fact that the documents may not provide all complete and necessary information, meaning there were potential gaps in the data. By choosing to use a document analysis instead of for example interviews, the data used may thus have had some gaps that could potentially have influenced the research. Next to that, one of the findings was that the locations of the cities in which the projects took place was not evenly distributed across Europe. There was a clear lack of project cases in Eastern Europe, with most of the project cases being found in Western Europe. This could be due to the fact that in the initial database there already was a smaller amount of Eastern European countries, potentially due to the fact that the level of English could be inadequate, making it difficult to communicate and receive full and coherent information from projects in such countries. The language barrier could thus be a reason for the small amount of Eastern European project cases. Another reason could be that the circular economy simply hasn't gained a lot of ground yet in this area of Europe, hence why there are hardly any circular economy initiatives to be found.

6.2.2: Theoretical recommendations

With the outcomes of the research there are a few theoretical recommendations that could be made. With the final typology that was created in the research there are now four general model types of urban business models, those being Product and Resource Looping, Product and Resource Optimizing, Urban Sharing Platforms, and Urban Circular Community. The research showed that all four models were seen to be present throughout the 40 European project cases, but there are still inherent differences between the business models used in the projects. It could be interesting for further research to zoom in deeper on the urban business models, through the comparison of cases that are using a business model that is within the same model type, as well as comparing cases that use business models that are in different urban business model types, but still show similarity in the actions they are undertaking. This could lead to an even more defined description of the four model types, as well as creating more specific and usable model that could guide newly started projects. Besides this, an interesting point that was an outcome of the research was that many projects are already seizing urban environment-specific opportunities within their projects, seemingly having perfectly understood the unique possibilities of a city in combination with the circular economy. The collective nature of the projects throughout the European cities became clear, often times different actors were mutually dependent on each other in order for the project to succeed. Yet it was found that there is still a lot of variety between the 40 projects on which actor or which combination of actors is carrying out the project. It would be interesting for further research to focus on the actors involved in urban circular initiatives, what their roles are and how they relate to each other, and what the relationship between the different actors can mean for the circular economy in urban environments. Other possibilities for further research include the possible impact of the EU's plans, legislation and regulation on the implementation and success of the circular economy in Europe, as well as research on how the circular economy could be implemented strategically throughout Europe, as now there are a few projects in the research that are part of an overarching plan, but most of them are individual projects. Lastly, an interesting possibility for future research would be to research the circular economy in Eastern Europe, as this research did not include many cases from Eastern European countries, simply because there seemed to be little cases to be found in those countries. It would be interesting to find out why this is, and if the circular economy has not gained a lot of ground yet in Eastern Europe, or if the lack of cases is more a result of a possible language barrier.

6.2.3: Practical implications

The research has made clear that there are four currently popular themes with regards to the circular economy in Europe, with waste reduction being the most favoured theme. The themes could help guide newly started projects or projects in the making, providing them with a certain direction that they could take their project in. Besides that, the research showed that the circular economy in cities is most often done through a combination of actors within the urban environment collectively taking action and working together within a project while being mutually dependent on each other for the success of a project. This can be an interesting area for the European Commission, who have issued many action plans regarding the circular economy, which are most often focused on promoting certain themes on the circular economy, such as waste reduction. If the European Commission were to focus more on the aspects of collaborative networks and multiple value creation within cities rather than the general circular economy themes that can take place within cities, they may have more to gain. The power of the circular economy in cities is in seizing the unique opportunities the urban environment provides through the combination of multiple actors that are creating multiple values in and through collaborative networks. Rather than educating on general themes of the circular economy, the European Commission may have more to gain through making the importance and subsequent power of collective value creation within cities through use of the circular economy clear to its European citizens. This could also again help guide new projects, as it shows that circular economy projects can work as standalone projects, for example when done by a single company, but the urban environment offers a project an extra dimension, through the community aspect and other unique possibilities that come with a city. Next to that, the four model types that were created in the typology of urban business models could provide a base, both for newly started projects as well as already existing projects looking to seize more of the urban environment's possibilities. Lastly, the theory chapter revealed even though consumers or citizens are obviously part of the economy, their role is not prominent throughout most European policies (Repo et al., 2018). This research showed that the citizens play a vital part within most of the projects, mean that it could potentially be valuable for European policymakers to look at the citizens as a more prominent and important actor when it comes to their action plans regarding the circular economy in Europe.

6.2.4 Methodological reflection

This research was done through a document analysis. The method used provides the opportunity to examine cases from multiple countries and cities all over Europe, which could

have been more difficult through field research. The chosen method insured a higher amount of countries being able to be included in the research. The reliability of the research was perhaps compromised a bit with the chosen method, as documents could be incomplete and have missing data, as well as being prone to bias and random errors as a result of this. The documents were carefully put together out of the existing database, as well as having been extensively read and examined in order to attempt to eliminate the bias and random errors. Next to this there is the validity, in which mainly the external validity would be important for this particular research, meaning that the results have to be generalizable to a bigger population. The external validity was improved through the fact that the chosen method, as previously discussed, allowed for a larger number of cases as well as a bigger amount of countries to be included in the research. The fact that there was a low number of Eastern European countries and a high number of Western European countries may have impacted the external validity and generalizability of the research.

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Appendices

1. Case format

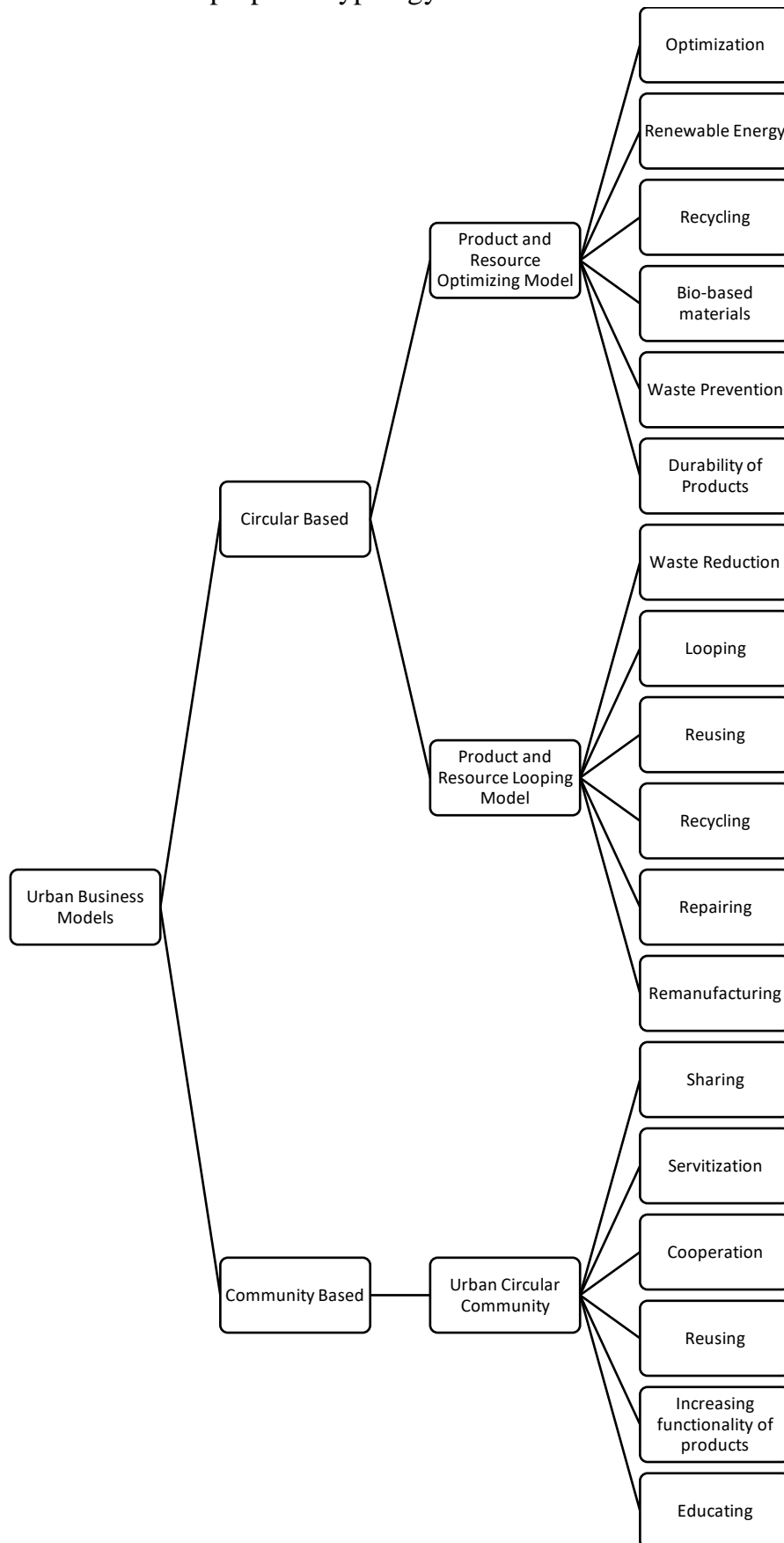
1: Country & City	
2: Project name	
3: Short description of the project <i>What is the project about? What is the central theme of the project?</i>	
4: Actors involved <i>Is the project initiated by citizens, does it come from businesses, or the local government? Is there a collaboration between either of these three actors?</i>	
5: Type of Urban Business Model identified <i>Does the project make use of a business model, and what type of Urban Business Model (Product and Resource Optimizing model, Product and Resource Looping model, Urban Circular Community model) does the model used fit best into?</i>	
6: How is value created? <i>In what ways does the project generate value within its city?</i>	

2. List of project cases used in the document analysis

1. Austria, Vienna, 'BauKarussell'
2. Austria, Vienna, 'Wiener Tafel'
3. Austria, Vienna, 'Energie & Reparaturcafe'
4. Austria, Retznei, 'GeoCycle Centre'
5. Belgium, Gent, 'De Nieuwe Dokken'
6. Denmark, Copenhagen, 'Keep your city cool/Keeping cool under the CO2 pressure'
7. Denmark, Copenhagen, 'Switch on district heating/Keeping the city warm efficiently'
8. Estonia, Paldiski, 'Pakri Science and Industrial Park'
9. Estonia, multiple cities, 'Estonian Smart City Cluster'
10. Finland, Jyväskylä, 'CircWaste'
11. Finland, Helsinki, 'Eco-Viikki'
12. France, Paris, 'La Métropole du Grand Paris'
13. France, Paris, 'La Charte Main Verte'
14. Germany, Hamburg and Munich, 'City2Share'
15. Germany, Munich, 'Civitas Eccentric'
16. Ireland, Cloughjordan, 'Cloughjordan Ecovillage'
17. Ireland, Dublin, 'Rediscovery Centre'
18. Italy, multiple cities, 'Movimento Legge Rifiuti Zero per l'Economia Circolare'
19. Latvia, Jelgava, 'Fortum biomass plant'
20. Lithuania, Vilnius, 'Danpower Vilnius'
21. Luxembourg, Ville de Luxembourg, 'Hollerich Village'
22. Netherlands, multiple cities, 'SwapFiets'
23. Netherlands, Amsterdam, 'Circulair Buiksloterham'
24. Netherlands, Hoofddorp, 'Park 20|20'
25. Netherlands, multiple cities, 'Cirkelstad'
26. Norway, Oslo, 'Losøter'
27. Slovenia, Ljubljana, 'Refurbish public buildings'
28. Slovenia, Ljubljana, 'Zero Waste'
29. Spain, A Coruña, 'Closing the Loop'
30. Spain, Valencia, 'FISSAC'
31. Sweden, Stockholm, 'Kungsbrohuset'
32. Sweden, Linköping, 'Linköping biogas plant'

33. Sweden, Helsingborg, 'Öresundsverket'
34. Sweden, Eskilstuna, 'ReTuna'
35. Sweden, Växjö, 'Sandvik Plant, Växjö Energi AB'
36. Sweden, Malmö, 'The Waste to Energy plant'
37. Switzerland, Zurich, '2000-Watt Society'
38. Switzerland, Zurich, 'Fernwärme'
39. Switzerland, Bern, 'Repair Café'
40. United Kingdom, Hackbridge, London, 'BedZED'

3. Operationalization of the proposed typology



4. Document Analysis

1: Country & City	Austria, Vienna	Indicator	UBM	Dimension
2: Project name	BauKarussell	Reusing Waste Reduction Looping Reusing Remanu-facturing, Looping	Product and Resource Looping	Circular based models
3: Short description of the project	The BauKarussell project aims to reuse building materials of demolished buildings in newly built buildings in Vienna. This reduces waste from the demolished buildings and allows it to be reused in new buildings . The central theme is waste reduction and urban mining.			
4: Actors involved	Businesses, local government			
5: Type of Urban Business Model identified	Product and Resource Looping			
6: How is value created?	Value is created from the waste of demolished buildings that is being reused in new buildings.			

1: Country & City	Austria, Vienna	Indicator	UBM	Dimension
2: Project name	Wiener Tafel	Waste Reduction Sharing Waste Prevention Waste Reduction Cooperation Sharing Waste Reduction Looping	Product and Resource Looping, Urban Circular Community	Circular based models, Community based models
3: Short description of the project	The Wiener Tafel project has businesses donate food that would otherwise be thrown away , and the Wiener Tafel distributes this food to people in need . They receive all types of food, whether it is overproduced foods, seasonal goods, food about to expire, or foods with damaged packaging, and with this provide the poor with perfectly good food that would've been thrown away otherwise. With this they prevent food waste and are thus reducing waste , as well as building social networks through the distributing of food . The central theme is waste reduction.			
4: Actors involved	Citizens, businesses			
5: Type of Urban Business Model identified	Urban Circular Community, Product and Resource Looping			
6: How is value created?	Value is created from waste in being able to feed people in need from food that would have been waste otherwise .			

1: Country & City	Austria, Vienna	Indicator	UBM	Dimension
2: Project name	Energie & Reparaturcafe	Educating	Urban Circular Community	Community based models
3: Short description of the project	The Energie & Reparaturcafe project hosts a gathering in a café during which both energy saving methods as well as repairing your own products/devices is discussed. The central theme is educating citizens on circular economy possibilities.			
4: Actors involved	Citizens			
5: Type of Urban Business Model identified	Urban Circular Community	Educating		
6: How is value created?	Value is created through the education of citizens on circular economy possibilities with regards to energy and repairing methods which they then hopefully use to the best of their abilities and in doing this are creating value through life-cycle prolongation of their products.			

1: Country & City	Austria, Retznei	Indicator	UBM	Dimension
2: Project name	GeoCycle Centre			
3: Short description of the project	The GeoCycle recycling centre processes construction and demolition waste , and every year processes 100000 tons of construction and demolition waste so it can be reused . For example, part of the waste is being reused in the cement production processes , and part is treated and sold as alternative materials . The central theme is waste reduction .	Waste Reduction Reusing Looping Waste Reduction	Product and Resource Looping	Circular Based models
4: Actors involved	Businesses			
5: Type of Urban Business Model identified	Product and Resource Looping			
6: How is value created?	Value is created from waste in using the construction and demolition waste for new building materials.	Looping, Remanufacturing		

1: Country & City	Belgium, Ghent	Indicator	UBM	Dimension
2: Project name	De Nieuwe Dokken	Cooperation Waste Reduction Renewable Energy Reusing Waste reduction Sharing Servitization Increasing functionality of products	Urban Circular Community Product and Resource Looping Product and Resource Optimizing	Community Based models Circular Based models
3: Short description of the project	<p>‘De Nieuwe Dokken’ is a residential area in the city of Gent, where a cooperation called ‘DuCoop’ has implemented several circular initiatives with regards to heating, waste, water and mobility, with the aim to make de Nieuwe Dokken a climate-neutral neighbourhood. There is an energy network, the wastewater is collected and reused by a local business, waste is turned into for example fertilizer and biogas, and there is charging stations available for electrical cars and bike throughout the neighbourhood, as well as electrical cars being available for citizens to share. There is not one but multiple central themes.</p>			
4: Actors involved	Citizens, businesses, local government			
5: Type of Urban Business Model identified	Product and Resource Looping, Product and Resource Optimizing, Urban Circular Community.			
6: How is value created?	<p>Value is created in many ways through the use of renewable energy, waste reduction and car sharing.</p> <p>Multiple value is created in this project as there is a lot of interaction and collaboration between the citizens, businesses, and local government.</p>			

1: Country & City	Denmark, Copenhagen	Indicator	UBM	Dimension
2: Project name	Keep your city cool/Keeping cool under the CO2 pressure	Cooperation Renewable Energy Sharing Reusing Waste Prevention Renewable Energy	Urban Circular Community Product and Resource Optimizing	Community Based models Circular Based models
3: Short description of the project	<p>This project states that the use of and demand for air-conditioning is leading to increased energy consumption. As a solution, the project has created two district cooling networks, in an effort to provide low carbon cooling. The cooling is generated from seawater abstraction and the surplus from the district heating network through absorption cooling and traditional compression coolers. The district cooling network is used to cool buildings in Copenhagen. They achieve a 70% reduction of CO2 emissions, and an 80% reduction of electricity consumption through this. Next to that, the resources can constantly be reused and there is almost no waste. The central theme is renewable energy sources.</p>			
4: Actors involved	Businesses, citizens, local government			
5: Type of Urban Business Model identified	Product and Resource Optimizing, Urban Circular Community through the district heating system.			
6: How is value created?	Value is created by the decrease in both CO2 consumption and electricity use, and the project providing buildings with air-conditioning that is generated through circular processes.			

1: Country & City	Denmark, Copenhagen	Indicator	UBM	Dimension
2: Project name	Switch on district heating/Keeping the city warm efficiently	Renewable Energy Bio-based materials Cooperation Reusing	Product and Resource Optimizing Urban Circular Community	Circular Based models Community Based models
3: Short description of the project	This project aims to reduce the city's dependence on fossil fuels, through the maximization of energy generation from waste, biomass and other fuel sources , which they then provide to the city through a district heating system . Currently, 98% of the heating in Copenhagen is supplied through this district heating grid. The central theme is reusing heat as well as using renewable energy sources.			
4: Actors involved	Businesses, citizens, local government			
5: Type of Urban Business Model identified	Product and Resource Optimizing, also Urban Circular Community through the district heating system.	Cooperation Sharing		
6: How is value created?	Value is created by the project leading to the almost the whole city of Copenhagen being supplied from the district heating , making them less dependent on fossil fuels.			

1: Country & City	Estonia, Paldiski	Indicator	UBM	Dimension
2: Project name	Pakri Science and Industrial Park	Renewable Energy	Product and Resource Optimizing	Circular Based models
3: Short description of the project	Pakri is a privately owned science and industrial park that is focused on things such as renewable energy, energy efficiency, energy storing, and electrical vehicles. The central theme is renewable energy.			
4: Actors involved	Businesses, local government			
5: Type of Urban Business Model identified	Product and Resource Optimizing	Educating	Urban Circular Community	Community Based models
6: How is value created?	Value is created in the sense that this project is developing and researching different circular solutions with regards to energy and can have a possible impact through this research and development			

1: Country & City	Estonia, multiple cities	Indicator	UBM	Dimension
2: Project name	Estonian Smart City Cluster	Cooperation Educating Sharing Cooperation	Urban Circular Community	Community Based models
3: Short description of the project	The Estonian Smart City Cluster is designed to create an innovative environment in cities which will boost the competitive ability of companies by bringing together businesses, citizens, public authorities, R&D institutes and structures that support innovation. The cluster focuses on the creation, development (including product development) and exporting of innovative solutions in different areas of urban life. There is not one clear theme, but a combination of multiple themes.			
4: Actors involved	Citizens, businesses, local government			
5: Type of Urban Business Model identified	Urban Circular Community			
6: How is value created?	Value is created through the sharing platform that is created with this Smart City Cluster which allows for different actors to come together, exchange ideas, and develop together, which will eventually lead to multiple value creation			

1: Country & City	Finland, Jyväskylä	Indicator	UBM	Dimension
2: Project name	CircWaste	Waste Prevention Waste Reduction Waste Reduction Recycling Waste Prevention Educating Waste Reduction Waste Prevention	Product and Resource Looping Product and Resource Optimizing Urban Circular Community	Circular Based models Community Based models
3: Short description of the project	<p>The CircWaste project promotes the efficient use of material flows, waste prevention, and new waste and resource management concepts. The project happens at the city level but is part of the national waste management plan that is directing Finland towards a circular economy. The project aims to decrease the amount of waste, increase the recycling of construction and demolition waste, improve material efficiency and waste prevention, as well as generating new information on these processes in order to better understand and develop waste management in the future. The central theme is waste reduction</p>			
4: Actors involved	Businesses, local government			
5: Type of Urban Business Model identified	Product and Resource Looping			
6: How is value created?	Value is created from waste through the many different ways that waste is being recycled, reused, managed and prevented within this project.			

1: Country & City	Finland, Helsinki	Indicator	UBM	Dimension
2: Project name	Eco-Viikki	Cooperation Renewable Energy Waste Reduction Waste Reduction Reusing Looping Sharing Cooperation Sharing	Urban Circular Community Product and Resource Optimizing Product and Resource Looping	Community Based models Circular based models
3: Short description of the project	The Eco-Viikki project is a sustainable neighbourhood that was built to create a healthy, sustainable living environment with solutions that save energy and reduce the amount of waste that is generated. It houses around 2000 inhabitants. It revolves around many circular themes such as reduction of pollutants, the use of natural resources, waste reduction , rainwater reusing , and sharing possibilities among residents .			
4: Actors involved	Citizens, businesses, local government			
5: Type of Urban Business Model identified	Urban Circular Community, also Product and Resource Looping and Product and Resource Optimizing through the many processes going on within the neighbourhood.			
6: How is value created?	Value is created in many ways in the neighbourhood, because there are many circular themes and processes within the neighbourhood, that are taking place through interaction and cooperation between the different actors .			

1: Country & City	France, Paris	Indicator	UBM	Dimension
2: Project name	La Métropole du Grand Paris	Educating Cooperation Educating Sharing Cooperation Sharing Sharing Educating	Urban Circular Community	Community Based models
3: Short description of the project	<p>The Métropole project is a big project that supports and funds smaller circular projects in the city and surroundings regions of Paris. Its main objective is sustainable development of the region's economy and employment to maintain and strengthen their position among the most attractive global cities. They want to impulse the metropolitan dynamic of circular economy. They have created a metropolitan network that allows the raising of awareness within the region as well and opportunities for training, and sharing best practices. They also have a collaborative digital platform, for the purpose of sharing and exchanging ideas. The project is more a platform for sharing, supporting and developing smaller projects in the area.</p>			
4: Actors involved	Citizens, local businesses, local government			
5: Type of Urban Business Model identified	Urban Circular Community, Product and Resource Looping, Product and Resource Optimizing			
6: How is value created?	Value is created in many ways in this sharing platform where citizens and businesses can learn about the circular economy and find funding to take action and carry out circular projects.			

1: Country & City	Germany, Hamburg and Munich	Indicator	UBM	Dimension
2: Project name	City2Share	<p>Cooperation</p> <p>Sharing Servitization Increasing functionality of products</p> <p>Increasing functionality of products</p>	Urban Circular Community	Community Based models
3: Short description of the project	The City2Share project focuses on urban electromobility. Hamburg and Munich are the pilot city, the project is to be expanded into other cities. The project connects multimodality, urban electromobility, autonomous driving, carsharing , logistics, which leads to less traffic and less emissions , with the aim to increase quality of life in the urban environment. The central theme is traffic and emission reduction.			
4: Actors involved	Citizens, businesses, local government			
5: Type of Urban Business Model identified	Urban Circular Community			
6: How is value created?	Value is created through the improvement of the urban mobility system with for example carsharing leading to less traffic and less emissions.			

1: Country & City	Germany, Munich	Indicator	UBM	Dimension
2: Project name	Civitas Eccentric	Servitization Educating Increasing functionality of products Servitization	Urban Circular Community	Community Based models
3: Short description of the project	This project is part of a broader project focused on mobility as a service , and wants to demonstrate the potential of integrated and inclusive urban planning approaches . The projects will for example test clean vehicles and fuels and looks at e-mobility and software controlled security management in the road network. The central theme is the servitization of mobility			
4: Actors involved	Citizens, businesses			
5: Type of Urban Business Model identified	Urban Circular Community			
6: How is value created?	Value is created through the improvement of the urban mobility and mobility as a service, potentially leading to less traffic and emissions from cars.			

1: Country & City	Ireland, Dublin	Indicator	UBM	Dimension
2: Project name	Rediscovery Centre			
3: Short description of the project	<p>The Rediscovery Centre project provides a platform for people to come together and connect, and exchange ideas as well as resources. The centre has four types of reuse activities: Rediscover Furniture, Rediscover Fashion, Rediscover Cycling, and Rediscover Paint. They use waste as the resource for new products. The centre has circular workshops where citizens can participate and learn, and allows for businesses to present their circular ideas and products. The centre is based in a building in Dublin that is built according to best practices concerning construction, design and operation and the building is thus also used as an educational tool and example for circular principles with regards to buildings.</p>	<p>Sharing Educating</p> <p>Waste Reduction Waste Prevention Educating</p> <p>Sharing Cooperation</p> <p>Optimizing</p> <p>Educating</p>	<p>Urban Circular Community</p> <p>Product and Resource Looping Product and Resource Optimizing</p>	<p>Community Based models</p> <p>Circular Based models</p>
4: Actors involved	Citizens, businesses			
5: Type of Urban Business Model identified	Urban Circular Community, Product and Resource Looping, and Product and Resource Optimizing			
6: How is value created?	<p>Value is created in many different ways throughout the different processes going on in the centre. The main value could be that the centre provides a platform for educational opportunities as well as raising awareness on the circular economy.</p>	Educating		

1: Country & City	Italy, multiple cities	Indicator	UBM	Dimension
2: Project name	Movimento Legge Rifiuti Zero per l'Economia Circolare	Educating Waste Reduction Recycling Looping Waste Reduction Waste Reduction Waste Reduction	Urban Circular Community Product and Resource Looping	Community Based models Circular Based models
3: Short description of the project	The project is a movement creating awareness and providing education on Zero Waste . They aim to try to change peoples' way of thinking about waste, and how they can better deal with it through for example recycling . The central theme is waste reduction .			
4: Actors involved	Citizens, local governments			
5: Type of Urban Business Model identified	Product and Resource Looping			
6: How is value created?	The project promotes and educates people on the zero waste concept and thus can eventually create value once citizens pick up and learn the value of waste reduction .			

1: Country & City	Latvia, Jelgava	Indicator	UBM	Dimension
2: Project name	Fortum biomass plant	Renewable Energy Sharing Cooperation Waste Reduction Waste Reduction Renewable Energy Sharing	Product and Resource Optimizing Urban Circular Community Product and Resource Looping	Circular Based models Community Based models
3: Short description of the project	The Jelgava Biomass Combined Power and Heat plant is the largest and most modern CPH plant in Latvia that uses renewable energy. It can provide up to 85% of the city's district heating and in the future wants to provide the whole city with renewable energy. The biomass plant uses regional waste to generate energy. The central theme is renewable energy sources.			
4: Actors involved	Citizens, businesses, local government			
5: Type of Urban Business Model identified	Product and Resource Looping, as well as Urban Circular Community through the district heating system			
6: How is value created?	Value is created in the reduction of waste and creation of renewable energy providing for the local environment/citizens.			

1: Country & City	Netherlands, multiple cities	Indicator	UBM	Dimension
2: Project name	SwapFiets	<p>Increasing functionality of products Servitization Reusing Repairing</p> <p>Sharing</p> <p>Cooperation Sharing</p>	Urban Circular Community	Community Based models
3: Short description of the project	SwapFiets allows you to rent a bike for around 15 euros per month. If the bike stops working for whatever reason, a new one is provided within 24 hours. The project makes sure no bikes are thrown away unless absolutely necessary . They reuse and repair bikes. The SwapFiets bikes are currently available in 16 cities across the Netherlands.			
4: Actors involved	Citizens, businesses			
5: Type of Urban Business Model identified	Product and Resource Looping, also Urban Circular Community			
6: How is value created?	Providing a platform through which bikes are provided, shared, and repaired when broken. This gives users all the benefits of a bike without having to worry about it breaking or having to repair it themselves.			

1: Country & City	Netherlands, Amsterdam	Indicator	UBM	Dimension
2: Project name	Circulair Buiksloterham	<p>Cooperation</p> <p>Renewable Energy Waste Reduction Waste Prevention Optimization Increasing functionality of products</p> <p>Sharing Cooperation</p>	<p>Urban Circular Community</p> <p>Product and Resource Looping Product and Resource Optimizing</p>	<p>Community Based models</p> <p>Circular Based models</p>
3: Short description of the project	<p>Buiksloterham is a neighbourhood in Amsterdam that is being built into a circular and carbon neutral neighbourhood. The project is a combination of many smaller projects contributing to the overlapping project which is Circulair Buiksloterham. There are many different objectives within the project, such as making use of renewable energy, waste reduction in trying to become a zero-waste neighbourhood as well as reusing waste water, and the optimizing of the functionality of the infrastructure in the neighbourhood together with the local zero-emission mobility. There are thus many central themes involved in the project.</p>			
4: Actors involved	Citizens, businesses, local government			
5: Type of Urban Business Model identified	Urban Circular Community, also Product and Resource Looping and Product and Resource Optimizing			
6: How is value created?	<p>Value is created in many different ways through the different processes taking place within the community and through the collaboration and interaction between the citizens, businesses and the local government.</p>			

1: Country & City	Netherlands, Hoofddorp	Indicator	UBM	Dimension
2: Project name	Park 20 20	Renewable Energy Reusing Recycling Optimization Looping Renewable Energy Reusing Waste prevention Waste Reduction Waste prevention Reusing Renewable Energy	Product and Resource Optimizing Product and Resource Looping	Circular Based models
3: Short description of the project	The Park 20 20 project has created a business park/working environment completely based on the Cradle-to-Cradle principle. The buildings use renewable energy and are built with materials that were reused or recycled, or are able to be reused or recycled in the future. Within the park, the processes with regards to energy, waste, and water are closed loops, for example there is a central energy system that enables energy reusing, and rain water is being used for sanitary purposes. There are different central themes within the project.			
4: Actors involved	Businesses			
5: Type of Urban Business Model identified	Product and Resource Looping, Product and Resource Optimizing			
6: How is value created?	Value is created in different ways within the business park, through for example waste reduction, wastewater reusing, renewable energy sources.			

1: Country & City	Netherlands, multiple cities	Indicator	UBM	Dimension
2: Project name	Cirkelstad	Cooperation Waste prevention Waste Reduction Looping Educating Waste Reduction	Urban Circular Community Product and Resource Optimizing Product and Resource Looping	Community Based models Circular Based models
3: Short description of the project	<p>The Cirkelstad project is an initiative of cooperating companies in the building and construction sector. They see the built environment as a source of materials that should not go to waste, but can be kept in the loop and can be used as new materials for products. Next to that, they also aim at the talent in cities with regards to people, as they say that when they are operating in a certain city or neighbourhood they try to look at the human capital and talent available and try to develop those people as well as themselves for the good of the project. The central theme is waste reduction.</p>			
4: Actors involved	Citizens, businesses			
5: Type of Urban Business Model identified	Urban Circular Community, Product and Resource Looping			
6: How is value created?	Value is created from waste, in the turning of unused materials that would otherwise be wasted into new materials that can be used within the building sector.			

1: Country & City	Norway, Oslo	Indicator	UBM	Dimension
2: Project name	Losøter	<p>Increasing functionality of products</p> <p>Cooperation</p> <p>Sharing</p>	Urban Circular Community	Community Based models
3: Short description of the project	On the edge of the city centre of Oslo, in an area called Bjørvika, there was a temporary bakehouse created for urban food production. Soil from 50 farmers throughout Norway was transported to this area creating the beginning of a cultural grain field, and it has since developed into a city garden where people come together to hold so called 'community dinners' for which they get the ingredients from the city garden. The central theme is urban farming.			
4: Actors involved	Citizens, businesses, local government			
5: Type of Urban Business Model identified	Urban Circular Community, perhaps also Product and Resource Optimizing in a way, as they are not only using the urban garden as a sharing platform but also making optimal use of the resources available within the urban environment.	Optimization	Product and Resource Optimizing	Circular Based models
6: How is value created?	Value is created through making use of the overvalues within the urban environment, that being the unused land that is now turned into a productive space where food is grown, through the interaction between the local government, who made the space available for the project, as well as businesses and citizens.	Sharing Cooperation		

1: Country & City	Slovenia, Ljubljana	Indicator	UBM	Dimension
2: Project name	Refurbish public buildings	Renewable Energy Optimization Renewable Energy	Product and Resource Optimizing	Circular Based models
3: Short description of the project	The main aim of this project is to improve the energy consumption in rental apartments in Ljubljana, both through the adaptation of existing housing and by building new low energy housing. They use innovative renewable energy systems for both the refurbishment of existing houses and the construction of new houses. The central theme is renewable energy sources			
4: Actors involved	Citizens, businesses, local government			
5: Type of Urban Business Model identified	Product and Resource Optimizing	Optimization Renewable Energy		
6: How is value created?	Value is created through the optimization of both existing and newly built houses, making them into low impact houses with regards to energy consumption and thus the environment.			

1: Country & City	Slovenia, Ljubljana	Indicator	UBM	Dimension
2: Project name	Zero Waste	Waste Reduction Educating Waste Reduction Reusing Repairing Recycling	Product and Resource Looping Urban Circular Community	Circular Based models Community Based Models
3: Short description of the project	The Zero Waste project in Ljubljana wants to redesign society into thinking differently about waste, to see it as a resource, to change peoples' lifestyles and consumption patterns in general and to make them think circular. They want to eliminate all superfluous waste and to reuse, repair and recycle everything that is produced. The central theme is waste reduction			
4: Actors involved	Citizens, businesses, local government			
5: Type of Urban Business Model identified	Product and Resource Looping, also Urban Circular Community cause they not only strive for waste reduction but to redesign society into this way of thinking about waste.			
6: How is value created?	Value is created from waste, in the reduction or even elimination of waste and through the creation of closed loops.	Waste Reduction Looping		

1: Country & City	Spain, A Coruña	Indicator	UBM	Dimension
2: Project name	Closing the Loop	Looping Reusing Recycling Waste Reduction Waste Reduction Recycling	Product and Resource Looping	Circular Based models
3: Short description of the project	In the city of A Coruña there is a company called Inditex that has an initiative called 'Closing the Loop', which has the aim to reuse and recycle textile products, footwears and accessories, making high-quality textile out of the textile-waste, which is then used to make clothes, from example the clothes of Zara are made from Inditex' recycled textile. The central theme is waste reduction and recycling.			
4: Actors involved	Citizens, businesses			
5: Type of Urban Business Model identified	Product and Resource Looping			
6: How is value created?	Value is created from waste and the recycling or upcycling of textile into new clothes.			

1: Country & City	Spain, Valencia	Indicator	UBM	Dimension
2: Project name	FISSAC	Cooperation Educating Educating Sharing Cooperation	Urban Circular Community	Community Based models
3: Short description of the project	<p>The FISSAC project involves stakeholders at all levels of the construction and demolition value chain to develop a methodology and software platform, to facilitate information exchange, that can support industrial symbiosis networks and replicate pilot schemes at local and regional levels. FISSAC tries to make a model for manufacturing processes, product validations and industrial symbiosis models that can be replicated in other regions and value chain scenarios.</p> <p>The central theme is industrial symbiosis.</p>			
4: Actors involved	Businesses			
5: Type of Urban Business Model identified	Urban Circular Community			
6: How is value created?	<p>Value is created through the exchange platform that allows for industrial symbiosis to occur, making it possible to have multiple value creation between businesses.</p>			

1: Country & City	Sweden, Linköping	Indicator	UBM	Dimension
2: Project name	Linköping biogas plant			
3: Short description of the project	<p>The Linköping projects collects food waste from citizens through a so called ‘the green bag’ as well as from local canteens and restaurants. Food waste is converted into biogas. This biogas is used for public transport, and there are stations for citizens to use biogas as fuel for their cars. Residues are upcycled and used as fertilizer in the farming industry again. Next to this, the project also operates in wastewater treatment and uses the residual heat to deliver district heating and cooling. The central theme is waste reduction and renewable energy sources.</p>	<p>Waste Reduction</p> <p>Cooperation</p> <p>Renewable Energy</p> <p>Looping</p> <p>Waste Reduction</p> <p>Sharing</p>	<p>Product and Resource Looping</p> <p>Urban Circular Community</p>	<p>Circular Based models</p> <p>Community Based models</p>
4: Actors involved	Citizens, businesses			
5: Type of Urban Business Model identified	Product and Resource Looping, partly Urban Circular Community as it makes use of citizens’ food waste.			
6: How is value created?	Value is created from waste through the transformation of food waste into something useful such as biogas	<p>Waste Reduction</p> <p>Renewable Energy</p>		

1: Country & City	Sweden, Eskilstuna	Indicator	Function	Dimension
2: Project name	ReTuna	Reusing Repairing Cooperation Sharing Waste Reduction Waste Reduction Repairing Remanu- facturing	Product and Resource Looping Urban Circular Community	Circular Based models Community based models
3: Short description of the project	<p>The ReTuna project has opened a shopping mall for reused and repaired products. The mall is divided into different, smaller stores run by entrepreneurs and supported by the local government. The citizens can drop off their used items at the mall. It is thus essentially a second-hand store, but divided into smaller stores by product type, making it more structured and with that more attractive for customers. The central theme can be seen as waste reduction, because instead of throwing stuff away citizens can bring it to the mall.</p>			
4: Actors involved	Citizens, businesses, local government			
5: Type of Urban Business Model identified	Product and Resource Looping, Urban Circular Community			
6: How is value created?	Value is created from waste, as the used products being brought in are repaired, or perhaps remanufactured, and then resold.			

1: Country & City	Sweden, Växjö	Indicator	UBM	Dimension
2: Project name	Sandvik Plant, Växjö Energi AB	Waste Reduction Bio-based materials Renewable Energy Sharing Cooperation Looping Waste Reduction Renewable Energy Looping	Product and Resource Looping Product and Resource Optimizing Urban Circular Community	Circular Based models Community Based models
3: Short description of the project	<p>The Sandvik plant burns waste from the wood production and uses it to generate heat. They use a district heating system for the generated power and heat, which provides almost the whole city with this circular energy. The ashes from burning the wood are used to fertilise soil in the woods. The waste of the wood industry is thus used as a source of energy, and the waste from that process is in turn used as a source of fertilisation for the wood industry. The central theme is waste reduction as well as renewable energy sources.</p>			
4: Actors involved	Citizens, businesses, local government			
5: Type of Urban Business Model identified	Product and Resource Looping, also Urban Circular Community in a way due to the sharing of the heat through the district heating system.			
6: How is value created?	Value is created from waste, in the waste from the wood industry being to generate heat, and in the waste the project itself creates being used back in the woods again as a fertilizer.	Waste Reduction Looping		

1: Country & City	Sweden, Malmö	Indicator	UBM	Dimension
2: Project name	The Waste to Energy plant	Waste Reduction Looping Recycling Renewable Energy Sharing Cooperation	Product and Resource Looping	Circular Based Models
3: Short description of the project	This project has changed the way the city collects waste, instead of letting trucks drive through the street to pick it up, citizens drop it in underground containers. From the collected waste, the organic waste is burnt and converted into biofuel and biofertilizer. The other types of waste are burnt and recycled into electricity and district heating. Through the district heating the project provides over 60% of the heating to Malmö and neighbouring city Burlöv. The central theme is waste reduction as well as renewable energy sources.			
4: Actors involved	Citizens, businesses, local government		Urban Circular Community	Community Based models
5: Type of Urban Business Model identified	Product and Resource Looping, also Urban Circular Community through the district heating system.			
6: How is value created?	Value is created from waste, the household waste is effectively given back to the households in the form of power and heating.	Waste Reduction Looping Sharing Cooperation		

1: Country & City	Switzerland, Zurich	Indicator	UBM	Dimension
2: Project name	2000-Watt Society	Renewable Energy Optimization Increasing functionality of products Educating	Product and Resource Optimizing	Circular Based models
3: Short description of the project	The aim of this project is to reduce the use of energy by the citizens of Zurich to 2000 watt by 2050. They aim to achieve this through for example energy efficiency and renewable energy, sustainable buildings, and public transport solutions. The Zurich government promotes the project to its citizens through incentives that stimulate the use of green energy. The central theme is renewable energy systems.			
4: Actors involved	Citizens, local government		Urban Circular Community	Community Based models
5: Type of Urban Business Model identified	Product and Resource Optimizing in a way also Urban Circular Community as a small part of the projects involves a bike-sharing system.			
6: How is value created?	Value is created through the interaction between the city's government and citizens and the subsequent achievement of the use of for example more renewable energy within the city of Zurich.	Sharing Cooperation		

1: Country & City	Switzerland, Zurich	Indicator	UBM	Dimension
2: Project name	Fernwärme	Waste Reduction Sharing Cooperation Waste Reduction Waste Reduction Looping	Product and Resource Looping Urban Circular Community	Circular Based models Community Based models
3: Short description of the project	Fernwärme Zurich AG is a company that processes waste to produce eco-friendly heating for the Zurich West district. They primarily make use of waste from neighbouring countries, generating safe, economic and ecological energy while processing waste. The central theme is renewable energy sources and waste reduction			
4: Actors involved	Businesses, local government			
5: Type of Urban Business Model identified	Product and Resource Looping			
6: How is value created?	Value is created through the process of waste turning into renewable energy, creating value from waste.			

1: Country & City	Switzerland, Bern	Indicator	UBM	Dimension
2: Project name	Repair Cafe	Cooperation Repairing Remanu- Facturing Waste Reduction Waste Reduction Looping Cooperation	Urban Circular Community Product and Resource Looping	Community Based models Circular Based models
3: Short description of the project	The Repair Café Bern provides a workplace where people can bring broken clothes, sports gear, electronics, and other stuff in order to repair it or make something new out of it. The project aims at waste reduction by enabling the repair and remanufacturing of broken products that would otherwise have been thrown away.			
4: Actors involved	Citizens, businesses			
5: Type of Urban Business Model identified	Product and Resource Looping			
6: How is value created?	Value is created from waste, waste is being reduced through the repairing and recycling that the Repair Cafe provides a place for and thus enabling citizens to create value from their otherwise wasted broken products.			

1: Country & City	United Kingdom, Hackbridge, London	Indicator	UBM	Dimension
2: Project name	BedZED	<p>Cooperation</p> <p>Optimization Cooperation</p> <p>Renewable Energy Optimization Looping Reusing Recycling</p> <p>Waste Reduction Waste Prevention Sharing Increasing functionality of products</p> <p>Servitization</p> <p>Cooperation Sharing</p>	<p>Urban Circular Community</p> <p>Product and Resource Optimizing</p> <p>Product and Resource Looping</p>	<p>Community Based models</p> <p>Circular Based models</p>
3: Short description of the project	<p>The BedZED project, which stands for Beddington ZeroEnergy Development. It is the UK's first large-scale, mixed use sustainable community with a 100 homes, office space, a college and community facilities. The objective was to enable people to live sustainably without sacrificing a modern, urban and mobile lifestyle.</p> <p>There are many different processes going on in the project, such as a zero energy concept that uses renewable sources of energy generated onsite, high quality buildings with low-impact materials that were reused or recycled, waste recycling, water and energy efficiency through water collection and solar panels, and car sharing in the community.</p>			
4: Actors involved	Citizens, businesses, local government			
5: Type of Urban Business Model identified	Urban Circular Community, Product and Resource Looping, Product and Resource Optimizing			
6: How is value created?	Value is created in different ways in different processes taking place within the community and through the collaboration and interaction between the citizens, businesses and the local government.			

5. Frequency Tables

Table 4. Urban Circular Community	
Indicator:	Frequency:
Cooperation	26
Sharing	22
Education	12
Reusing	12
Increasing functionality of products	8
Servitization	5

Table 5. Product and Resource Looping	
Indicator:	Frequency:
Waste Reduction	24
Looping	17
Reusing	12
Recycling	7
Repairing	4
Remanufacturing	4

Table 6. Product and Resource Optimization	
Indicator:	Frequency:
Renewable Energy	18
Optimization	9
Waste Prevention	9
Bio-based materials	3
Recycling	2
Durability of products	0

Table 7. Frequency of UBMs in the cases	
Urban Business Model type:	Frequency:
Combination of UCC & PRL	9
Product and Resource Looping	8
Combination of UCC+PRL+PRO	8
Urban Circular Community	6
Combination of UCC & PRO	4
Product and Resource Optimization	3
Combination of PRL & PRO	2

Table 8. Frequency of UBMs per cluster, cluster 1	
Cluster 1: Renewable Energy Systems	Frequency
Combination of UCC & PRL	5
Product and Resource Optimization	3
Product and Resource Looping	2
Combination of UCC & PRO	2
Combination of PRL & PRO	1
Combination of UCC+PRL+PRO	0
Urban Circular Community	0

Table 9. Frequency of UBMs per cluster, cluster 2	
Cluster 2: Waste Reduction	Frequency:
Product and Resource Looping	6
Combination of UCC & PRL	5
Combination of UCC+PRL+PRO	0
Urban Circular Community	0
Combination of UCC & PRO	0
Product and Resource Optimization	0
Combination of PRL & PRO	0

Table 10. Frequency of UBMs per cluster, cluster 3	
Cluster 3: Circular Neighbourhoods	Frequency:
Combination of UCC+PRL+PRO	8
Urban Circular Community	1
Combination of UCC & PRO	0
Product and Resource Optimization	0
Combination of PRL & PRO	0
Combination of UCC & PRL	0
Product and Resource Looping	0

Table 11. Frequency of UBMs per cluster, cluster 3	
Cluster 4: Sharing Models	Frequency:
Urban Circular Community	4
Combination of UCC & PRL	1
Combination of UCC+PRL+PRO	1
Combination of UCC & PRO	1
Product and Resource Looping	0
Product and Resource Optimization	0
Combination of PRL & PRO	0

Table 12. Frequency of actors involved	
Actors involved in projects	Frequency
All three actors, Citizens, Local government, Businesses	18
Two actors, Businesses and Citizens	9
Two actors, Businesses and Local government	4
Two actors, Local government and Citizens	4
Single actor, Businesses	4
Single actor, Citizens	1
Single actor, Local government	0

6. Clusters

Table 1. Cluster 1: Renewable Energy Systems		
Country, City & Project name:	Short Description	UBM
Denmark, Copenhagen, <i>'Keep your city cool/Keeping cool under the CO2 pressure'</i>	A district cooling network providing air-conditioning for buildings in Copenhagen, generated from seawater absorption and surplus from a district heating network.	Product and Resource Optimizing, Urban Circular Community
Denmark, Copenhagen, <i>'Switch on district heating/Keeping the city warm efficiently'</i>	A district heating network, generating energy from waste, biomass and other fuel sources, in order to provide the city of Copenhagen with heating without being dependent on fossil fuels.	Product and Resource Looping, Urban Circular Community
Estonia, Paldiski, <i>'Pakri Science and Industrial Park'</i>	A privately owned science and industrial park that is focused on things such as renewable energy, energy efficiency, energy storing, and electrical vehicles	Product and Resource Optimizing
Latvia, Jelgava, <i>'Fortum biomass plant'</i>	A biomass plant that uses regional waste to generate energy and provides for the city through a district heating network.	Product and Resource Looping, Urban Circular Community
Lithuania, Vilnius, <i>'Danpower Vilnius'</i>	A joint venture company that focuses on combining heat and power in producing electricity and heat at low prices, the use of regional resources such as biomass and wood, as well as the use of regional waste for electrical and thermal purposes.	Product and Resource Looping, Product and Resource Optimizing
Slovenia, Ljubljana, <i>'Refurbish public buildings'</i>	Using innovative renewable energy systems for both the refurbishment of existing houses and the construction of new houses.	Product and Resource Optimizing
Sweden, Stockholm, <i>'Kungsbrosen'</i>	Using the body heat from commuters to heat the central station building. They also capture daylight to light the entire building, as well as places without windows with the help of fibre optics. Next to that there are windows to block the summer heat, while still letting daylight in.	Product and Resource Optimizing
Sweden, Linköping, <i>'Linköping biogas plant'</i>	Using waste from citizens as well as from local canteens and restaurants and converting it into biogas. This biogas is used for public transport,	Product and Resource Looping, Urban Circular Community

	and there are stations for citizens to use biogas as fuel for their cars. Residues are upcycled and used as fertilizer in the farming industry again. Next to this, the project operates in wastewater treatment and uses the residual heat to deliver district heating and cooling.	
Sweden, Heslingborg, <i>‘Öresundsverket’</i>	Collecting wastewater from which they remove the nitrogen and phosphorous through microorganisms, and using it for the production of biogas. It is then sold as bio-fuel for cars and buses.	Product and Resource Looping
Sweden, Växjö, <i>‘Sandvik Plant, Växjö Energi AB’</i>	The Sandvik plant burns waste from the wood production and uses it to generate heat. They use a district heating system for the generated power and heat. The ashes from burning the wood are used to fertilise soil in the woods.	Product and Resource Looping, Urban Circular Community
Sweden, Malmö, <i>‘The Waste to Energy plant’</i>	Collecting citizens’ waste from underground containers which is burned and converted into biofuel and biofertilizer or recycled into electricity and heating provided to citizens through district heating.	Product and Resource Looping, Urban Circular Community
Switzerland, Zurich, <i>‘2000-Watt Society’</i>	Promoting energy reduction and the use of green energy to citizens through providing incentives and stimulations, as well as the Zurich government implementing the use of renewable energy, sustainable buildings, and public transport solutions within the city.	Product and Resource Looping, Urban Circular Community
Switzerland, Zurich, <i>‘Fernwärme’</i>	Processing waste to produce eco-friendly heating for the Zurich West district.	Product and Resource Looping

Table 2. Cluster 2: Waste Reduction

Country, City & Project name:	Short Description	UBM
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Austria, Vienna, <i>'BauKarussell'</i>	Reusing building materials of demolished buildings in newly built buildings in Vienna, which reduces waste from the demolished buildings and allows it to be reused in new buildings.	Product and Resource Looping
Austria, Vienna, <i>'Wiener Tafel'</i>	Businesses donate food that would've otherwise been thrown away, and the project provides it to the poor and other people in need.	Urban Circular Community, Product and Resource Looping
Austria, Vienna, <i>'Energie & Reparaturcafe'</i>	Educating and informing people on circular possibilities with regards to repairing your own products, aiming to change peoples way of thinking and getting them to repair stuff instead of throwing it away.	Product and Resource Looping, Urban Circular Community
Austria, Retznei, <i>'GeoCycle Centre'</i>	Processing construction and demolition waste so it can be reused. For example, part of the waste is being reused in the cement production processes, and part is treated and sold as alternative materials.	Product and Resource Looping
Finland, Jyväskylä, <i>'CircWaste'</i>	Aims to decrease the amount of waste, increase the recycling of construction and demolition waste, improve material efficiency and waste prevention, as well as generating new information on these processes in order to better understand and develop waste management in the future.	Product and Resource Looping
Italy, multiple cities, <i>'Movimento Legge Rifiuti Zero per l'Economia Circolare'</i>	Creating awareness and providing education on waste reduction, trying to change peoples' way of thinking about waste, and how they can better deal with it through for example recycling.	Product and Resource Looping

Netherlands, multiple cities, <i>‘Cirkelstad’</i>	An initiative of cooperating companies in the building and construction sector. They see the built environment as a source of materials that should not go to waste, but can be kept in the loop and can be used as new materials for products.	Urban Circular Community, Product and Resource Looping
Slovenia, Ljubljana, <i>‘Zero Waste’</i>	Aims to redesign society into thinking differently about waste, to see it as a resource, to change peoples’ lifestyles and consumption patterns in general and to make them think circular. They want to eliminate all superfluous waste and to reuse, repair and recycle everything that is produced.	Urban Circular Community, Product and Resource Looping
Spain, A Coruña, <i>‘Closing the Loop’</i>	The company Inditex aims to reuse and recycle textile products, footwears and accessories, making high-quality textile out of the textile-waste, which is then used to make clothes.	Product and Resource Looping
Sweden, Eskilstuna, <i>‘ReTuna’</i>	A shopping mall for reused and repaired products, divided into different, smaller stores, and citizens can drop off their used items at the mall.	Product and Resource Looping, Urban Circular Community
Switzerland, Bern, <i>‘Repair Café’</i>	The Repair Café Bern provides a workplace where people can bring broken stuff and repair it or make something new out of it, reducing waste through enabling the repair and remanufacturing of broken products that would otherwise have been thrown away.	Product and Resource Looping

Table 3. Cluster 3: Circular Neighbourhoods		
Country, City & Project name:	Short Description	UBM
Belgium, Ghent, <i>'De Nieuwe Dokken'</i>	A residential area in the city of Gent, where there are several circular initiatives with regards to heating, waste, water and mobility, with the aim to make de Nieuwe Dokken a climate-neutral neighbourhood.	Product and Resource Looping, Product and Resource Optimizing, Urban Circular Community
Estonia, multiple cities, <i>'Estonian Smart City Cluster'</i>	The Estonian Smart City Cluster is designed to create an innovative environment in cities. The cluster focuses on the creation, development and exporting of innovative solutions in different areas of urban life	Urban Circular Community
Finland, Helsinki, <i>'Eco-Viikki'</i>	A sustainable neighbourhood that was built to create a healthy, sustainable living environment. It revolves around many circular themes such as reduction of pollutants, the use of natural resources, waste reduction, rainwater reusing, and sharing possibilities among residents.	Urban Circular Community, Product and Resource Looping, Product and Resource Optimizing
France, Paris, <i>'La Métropole du Grand Paris'</i>	A project that supports and funds smaller circular projects in the city and surroundings regions of Paris. They have created a metropolitan network that allows the raising of awareness within the region as well and opportunities for training, and sharing best practices, and a collaborative digital platform, again for the purpose of sharing and exchanging ideas.	Urban Circular Community, Product and Resource Looping, Product and Resource Optimizing
Ireland, Cloughjordan, <i>'Cloughjordan Ecovillage'</i>	A 'smart village' with an interest in sustainable living, with over a 100 residents living in high-performance green homes, over 20,000 newly planted trees, and the village has Ireland's largest renewable energy district heating system.	Urban Circular Community, Product and Resource Looping, Product and Resource Optimizing

Luxembourg, Ville de Luxembourg, <i>'Hollerich Village'</i>	A plan for a completely new village/neighbourhood designed to, amongst other things, achieve CO2-neutrality and using/offering water, transport, food and transport in a sustainable, local way, aiming to reduce energy consumption by producing 100% of the heat and 20% of the electricity onsite. The waste goal is for residents to recycle 75% of their waste, with 50% reduction in per capita waste generation from 700kg/resident/year baseline.	Urban Circular Community, Product and Resource Optimizing, Product and Resource Looping
Netherlands, Amsterdam, <i>'Circulair Buiksloterham'</i>	A neighbourhood in Amsterdam that is being built into a circular and carbon neutral neighbourhood, through for example making use of renewable energy, trying to become a zero-waste neighbourhood, as well as reusing waste water, and the optimization of the functionality of the infrastructure in the neighbourhood together with the local zero-emission mobility.	Urban Circular Community, Product and Resource Optimizing, Product and Resource Looping
Netherlands, Hoofddorp, <i>'Park 20 20'</i>	A business park/working environment completely based on the Cradle-to-Cradle principle. The buildings use renewable energy and are built with materials that were reused or recycled, or are able to be reused or recycled in the future. Within the park, the processes with regards to energy, waste, and water are closed loops, for example there is a central energy system that enables energy reusing, and rain water is being used for sanitary purposes.	Urban Circular Community, Product and Resource Optimizing, Product and Resource Looping
United Kingdom, Hackbridge, London, <i>'BedZED'</i>	A sustainable community with a 100 homes, office space, a college and community facilities, to enable people to live sustainably without sacrificing a modern, urban and mobile lifestyle. There are many different processes going on, the use of renewable sources of energy generated onsite, high quality buildings with reused or recycled materials, waste recycling, water and energy efficiency, and car sharing being available in the community.	Urban Circular Community, Product and Resource Optimizing, Product and Resource Looping

Table 4. Cluster 4: Sharing models		
Country, City & Project name:	Short Description	UBM
France, Paris, ' <i>La Charte Main Verte</i> '	This project has made 47 sites throughout Paris available to grow plants and vegetables in the heart of the city. The project uses processes like the reuse of land, refurbishment of land by making it a garden, and things such as reusing the rainwater for the garden, as well as creating a community through the shared gardens	Urban Circular Community
Germany, Hamburg and Munich, ' <i>City2Share</i> '	Focused on urban electromobility, connecting multimodality, urban electromobility, autonomous driving, carsharing, logistics, which leads to less traffic and less emissions, with the aim to increase quality of life in the urban environment.	Urban Circular Community
Germany, Munich, ' <i>Civitas Eccentric</i> '	Focuses on mobility as a service, and demonstrating the potential of integrated and inclusive urban planning approaches, through for example clean vehicles and fuels, e-mobility and software controlled security management in the road network	Urban Circular Community
Ireland, Dublin, ' <i>Rediscovery Centre</i> '	Provides a platform for people to come together and connect, and exchange ideas as well as resources. The centre has circular workshops where citizens can participate and learn, and allows for businesses to present their circular ideas and products. The centre itself is based in a building in Dublin that is built according to best practices with regards to construction, design and operation and the building is thus also used as an educational tool and an example for circular principles with regards to buildings.	Urban Circular Community, Product and Resource Optimizing, Product and Resource Looping

Netherlands, multiple cities, <i>'SwapFiets'</i>	SwapFiets allows you to rent a bike for around 15 euros per month. If the bike stops working for whatever reason, a new one is provided within 24 hours. Bikes are reused and repaired	Urban Circular Community, Product and Resource Looping
Norway, Oslo, <i>'Losæter'</i>	A city garden with a bakehouse created for urban food production, where people come together to hold so called 'community dinners' for which they get the ingredients from the city garden.	Urban Circular Community, Product and Resource Optimizing
Spain, Valencia, <i>'FISSAC'</i>	Involves stakeholders at all levels of the construction and demolition value chain to develop a methodology and software platform, to facilitate information exchange, that can support industrial symbiosis networks and replicate pilot schemes at local and regional levels.	Urban Circular Community