

# Circular urban area development: Myth or reality?

## Management Summary

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### Introduction

As a result of the human behavior of the past century, reducing the effects of climate change is a much discussed topic in politics. Here in the Netherlands, which is located below sea level, we will immediately face the effects of global warming. In 2009, a group of environmental scientists established the 9 planetary boundaries which refer to 9 essential Earth systems that need to stay stable to sustain a safe and sound future for next generations. Some Earth systems are already beyond the zone of uncertainty and therefore create enormous environmental risks (Steffen et al., 2015). Since the awareness of climate change and its risks, politics and planning departments are focusing on sustainable development in which the social, economic and environmental dimensions are combined. In this, cities can play an important role in developing sustainable urban areas where these three dimensions are combined (Hoorweg et al., 2016). At the moment, many urban areas are being developed in the Netherlands and due to the housing shortage in the Randstad area 1 million new dwellings are planned. Unfortunately, the building industry, who will build these houses, is for a large part responsible for these environmental effects. The building industry is responsible for 25% of the CO<sub>2</sub> emissions, 60% of the material demand and 80% of the embodied energy in buildings is generated by the production processes of building materials (Hawken et al., 2013; EMF, 2013). These numbers belong to the linear economy in which the focus is on resource consumption and where waste is the final step of the material lifecycle. Because of this polluted character of the building industry, they are designated as one of the critical sectors that need to change to a circular economy approach where the value of resources and materials is maintained in the economy (Schokker, 2018; Sauve et al., 2016). Together with 192 other world leaders, The Netherlands agreed to the 17 sustainable goals for a better world by 2030. Further, the Dutch government declared to become 100% circular in 2050. Developing urban areas in a circular way can contribute to the achievement of these goals (Rijksoverheid, 2016; Global Goals, 2015).

### Problem statement

In recent years the concept of circular economy emerged and is much used in the context of sustainable development (Hoorweg et al., 2016). Applying the principles of the circular economy in an urban area development can be called a 'circular urban area development', which is a relatively new concept. According to Kirchnerr et al. (2017) 114 different definitions of the circular economy can be found in literature. The main of the circular economy, which is identified by Kirchnerr et al. (2017) is the aim for economic prosperity, however valuing circularity in our current business models is difficult and often not feasible, which is a reason why we still using traditional approaches in our urban development processes (Personal communication, O. Wagenaar and B. Terpstra, 10 January 2019). Furthermore, circular principles are already applied on the building and city scale, however knowledge and research about circular urban area development is lacking (Schokker, 2018).

### Research goal and question

The main aim of this research is to define the concept of circular urban area development by identifying and explaining the factors of circular urban area development and the management tools that can be used to apply them in practice. These findings are summarized in a circular urban area development guideline that can be used in Dutch practice. The next objectives were formulated: (1) to get a comprehensive definition of the circular economy and circularity in the built environment, (2) to get a comprehensive definition of circular urban area development, (3) to get an overview of the factors that contribute to the development of a circular urban area and (4) to get insight into the instruments and tools that can be used in practice to steer on the factors of circular urban area development.

The research question that is answered by this research is: *“What are the factors that contribute to the development of a circular urban area and how can these factors be managed in practice?”*

To provide an answer on the main question five sub-questions were formulated:

- *What are the characteristics of a circular economy and circularity?*
- *What is circular urban area development?*
- *Which performance indicators, that could possibly be used in circular urban area development are available?*
- *Which factors contribute to the development of a circular urban area?*
- *Which instruments can be used to manage these factors of circular urban area development in Dutch practice?*

## Methodology

The aim of this research is to define the concept of circular urban area development by identifying the circular urban area development factors and their applicability in Dutch practice. Because circularity in urban area development is a relative new concept, where no consensus is yet established, this research has an explorative character (Kumar, 2014). This results in the development of new theories, the reason why a qualitative research approach is chosen (Bryman, 2012). The theoretical part is focused on defining the concept of circular urban area development. Because the scale of an urban area is in between a building and city scale, circular concepts on these two scales are used to establish a circular urban area development framework.

The empirical part of this research consists of several methods: explorative interviews, case study analysis and an expert panel. First, because of the newness of this concept, explorative interviews are held with 11 practitioners with different backgrounds, but all employed in real estate and experienced with circularity. The interviews were semi-structured and aimed to make a first draft of the factors that contribute to the development of a circular urban area. Second, these found factors were validated and sharpened by conducting an in-case and cross-case analysis of three case studies in Dutch practice: (1) Lincolnpark in Haarlemmermeer, (2) Beurskwartier in Utrecht and (3) Kabeldistrict in Delft. For every case analysis multiple methods were used to collect data, so that findings can be cross-checked (Bryman, 2012). The next techniques were used: (1) project analysis, (2) policy document review and (3) semi-structured interviews with three involved stakeholders per case. Lastly, an expert panel was organized to validate the found factors of circular urban area development and to define the managerial tools that can be used to steer and manage them in practice. The invited participants were all individual experts who are experienced with steering and measuring tools used in real estate development. As a result, conclusions were drawn to design the circular urban area development guideline for Dutch practice.

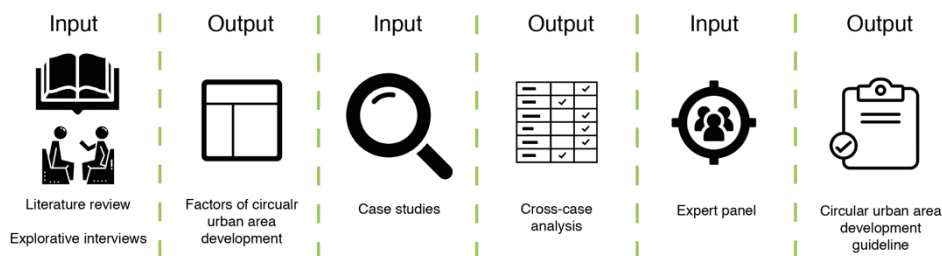


Fig. 1: Research process (Own ill.)

## Theoretical framework

The goal of the theoretical framework is to gain insight into the concept of circular economy, circularity and circular urban area development.

### Circular economy and circularity

The building industry is designated as an industry that is for a large part responsible for the effects of climate change. The building industry has a pollution nature which is a result of the linear approach there using to produce building materials. This linear approach is part of the linear economy which is focused on resource consumption, extraction of raw materials and where demolition waste is the final step of the material lifecycle. In this linear approach a lot of value, embedded in materials and resources, is lost during the process (Schokker, 2018; Sauve et al., 2016). Therefore, a switch from a linear to a circular economy is needed to preserve the worlds resources and to maintain their value. In the circular economy there is a closed loop in the whole economic system where products and materials retain the highest value at all time meaning there is no loss in value, efficiency or effectiveness of these products and no waste is generated (Geisdoerfer et al., 2017). Resources and materials will have a second life after their first lifecycle by being reduced, re-used, recycled or recovered (Kirchnerr et al., 2017). Besides the concept of the circular economy, exists the concept of circularity. These two concepts are closely related; however, they have a slightly different meaning and aim. Circular economy is the holistic economic system in which products and materials retain the highest value at all time. The main aim of the circular economy is to gain economic prosperity. The concept of circularity is a derivative of the circular economy. In the built environment this concept has a focus on the reduction of the environmental impact of building materials throughout the whole production process: delving > transport > manufacture > construction > in use > 2<sup>nd</sup> lifecycle. Further, there is a focus on the closing of resource-cycles. The main aim of the concept of circularity is gaining environmental quality (Kirchnerr et al., 2017). Both concepts are used in the context of sustainable development (Hoornweg et al., 2016).

### Circular urban area development

To understand the concept of circular urban area development, first the scale of an urban area needs to be explained. An urban area is a physical scale in the built environment in between the building and city scale and therefore has characteristics of both: public-private initiative, focused on product and process (Heurkens, 2018). In the last 10 years the importance of sustainable development in city planning has become an important topic. Therefore, authorities are focusing on developing sustainable urban areas in which the three development dimensions: social (people), environmental (planet) and economic (profit) are combined (Hoornweg et al., 2016). In this, the concept of circularity is often used as condition for sustainable development (Geisdoerfer et al., 2017).

Because an urban area is in between the building and city scale special attention is paid to circular principles on these two scales. First, on the building scale, circular principles derive from the concept of creating 'adaptable buildings' that refers to the ability of a building to continuously adapt its layout to evolving needs and changing circumstances. Duffy (1990) and Brand (1994) stated that a building as an own entity doesn't exist. A building consists of "shearing layers of change", which means that every building component has its own lifecycle. These components are flexible and cannot have fixed connections. Urban areas consist of the following components: (1) buildings, (2) publics space and (3) underground infrastructure, that all have their own lifecycles. Second, on the city scale, the ecosystem approach of van Bueren (2012) is often used. In this approach a city can be seen as a big open system consisting of several subsystems mostly referred to the industrial flows: energy, water and materials (EMF, 2013). These subsystems are seen as flows that all have their own input – throughput – output. By creating closed-loops with these flows, the value and quality of these resources can be maintained in the economy for as long as possible.

A circular urban area development is a part of a sustainable urban area development in which the focus is on applying the principles of the circular economy (Hoorweg et al, 2016). Applying the thoughts of Brand (1994) on the urban area scale, combining it with the system approach of van Bueren (2012) the next summarizing figure can be drawn of the physical components of a circular urban area.

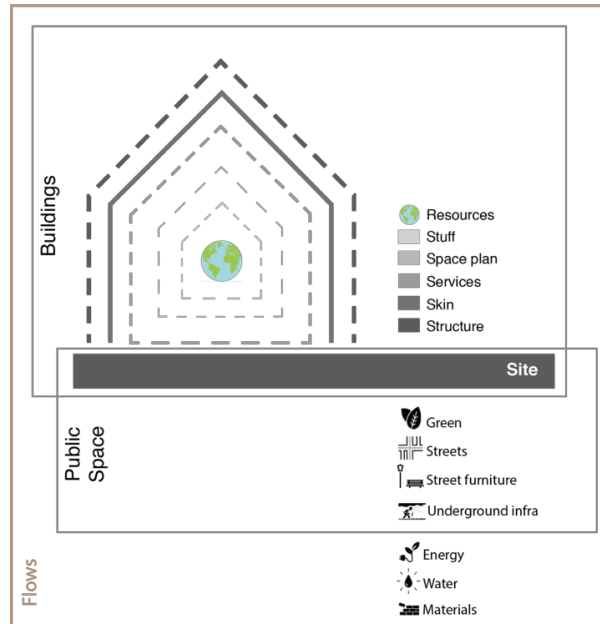


Fig. 2: Components of a circular urban area

### Empirical research

In this part the empirical research is explained: explorative interviews, case study analysis and an expert panel, to find the factors of circular urban area development and their applicability in Dutch practice.

### Explorative interviews

Out of 11 explorative interviews 7 factors of circular urban area development could be distinguished. The 11 interviewees all had experience with circularity. To get an understanding of circularity throughout the whole real estate sector, experts with different background were interviewed: municipality, developers and consultants. The next factors were found:



Fig. 3: Factors of circular urban area development found by explorative interviews (Own ill.)

### Case studies

In the case study analysis three circular urban area developments, all located in the Randstad area were researched by an in-case and cross-case analysis. The aim for every case is to: (1) Analyze each project by gathering information about the specifications and characteristics of the urban area (re)development project, (2) get insight into the sustainability and circularity policy documents of the

municipality, (3) get insight into the sustainability and circularity objectives of the project and (4) evaluate the significance of the 7 circular urban area development factors found in earlier research. For every case the municipal policy, project ambitions and opinions of the involved stakeholders are compared to define the factors of circular urban area development.

### Lincolnpark, Haarlemmermeer

This case is a new built project located in the municipality of Haarlemmermeer which is part of the Metropolitan region Amsterdam. Lincolnpark is part of the larger development called “de Parken” and is called a circular urban area development. In Lincolnpark 850 new dwellings, retail, a school, a restaurant and a care center will be realized that will be delivered in 2025 (Gemeente Haarlemmermeer, 2017). The plot of Lincolnpark is the last plot that is owned by the municipality which means that they can set the boundaries for the development. The aim of the development of Lincolnpark is to create the “neighborhood of the future” that can easily adapt to changing demands of its residents.

*“The development itself can be seen as a sustainable urban area development in which the principles of the circular economy are being applied. In this, circularity is used as a principle to be able to act sustainable. Circularity is not the main aim but a means to achieve sustainability in the urban area development” (Personal communication, M. Korse, 25 March 2019 and I. Groet, 3 April 2019).*

According to Lincolnpark the next factors of circular urban area development can be distinguished:

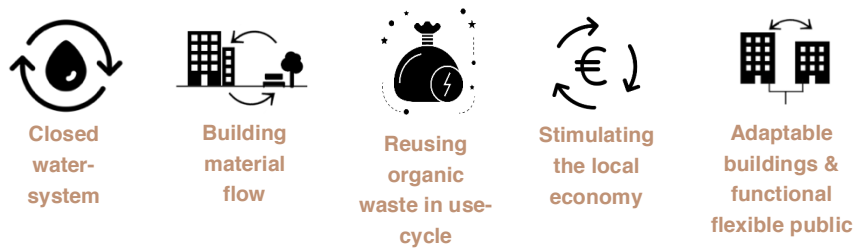


Fig. 4: Factors of circular urban area development according to Lincolnpark (Own ill.)

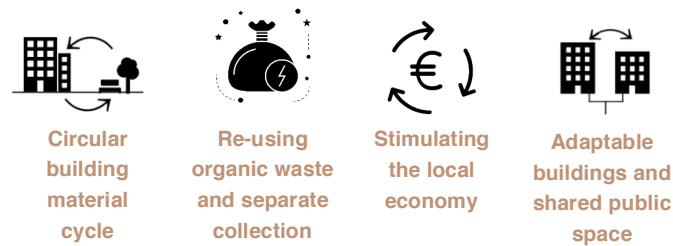
### Beurskwartier, Utrecht

This case is a redevelopment project which is located in the municipality of Utrecht next to Utrecht central station. As G4 city, Utrecht has the responsibility to build 70.000 new dwellings. In Beurskwartier 3.000 new dwellings will be realized and 50.000 m<sup>2</sup> of workplaces and 10.000 m<sup>2</sup> of other facilities. This will be finished by 2025. In anticipation of the redevelopment many researches in the form of ‘living-labs’ were organized by the municipality. A living lab into the possibilities of the implementation of the circular economy was called: “Circular Beurskwartier”, where circularity is defined by creating an (almost) zero waste neighborhood.

*“The circular economy is not the main aim of the development. The aim of the redevelopment of the Beurskwartier is to create Healthy Urban Living. The circular economy is used as a tool to organize society in such a way that it is sustainable” (Personal communication J. Hekhuis, 30 april 2019, G. de Zoeten, 9 april 2019 and R. Kapel, 10 april 2019).*

According to Beurskwartier the next factors of circular urban area development can be distinguished:

Fig. 5: Factors of circular urban area development according to Beurskwartier (Own ill.)



### Kabeldistrict, Delft

This case is located in the municipality of Delft and is the first plot that will be developed on the Schieoevers Noord. In Delft 10.000 new dwellings have to be build and 3.000 – 4.000 are planned in Kabeldistrict which is the redevelopment of the old Dutch cable factory. Besides dwellings, another 60.000 m2 of workplaces including the manufacturing industry will be realized. Despite, at the time of writing, no policy documents have been written on circular economy, Schieoevers Noord is designated as a place where the principles of the circular economy can be applied on a large scale.

*“Schieoevers Noord needs to become a vibrant area where living and the manufacturing industry are mixed. This creates opportunities for the circular economy” (M. van den Berg, Personal communication, 1 April 2019).*

*“The old cable factory is a goldmine of material resources that can be upgraded and re-used in the new development” (M. van Loon, Personal communication 23 April 2019).*

According to Kabeldistrict the next factors of circular urban area development can be distinguished:

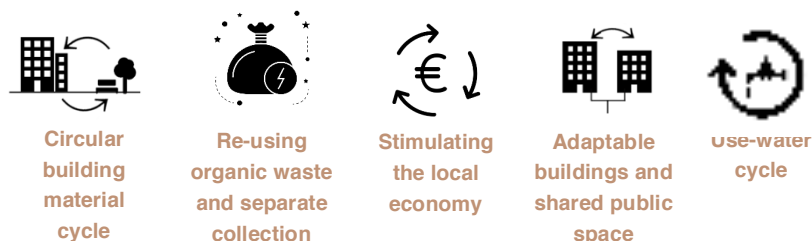


Fig. 6: Factors of circular urban area development according to Kabeldistrict (Own ill.)

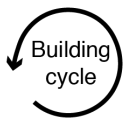
### Expert panel

Preconditions for the development of a circular urban area development were discussed during the expert panel. According to the experts the next preconditions must be set:

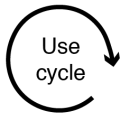
- Define the boundaries of the circular urban area and look beyond the line on the map because ‘flows’ are flowing in and out of the area.
- The role of the public space is key in the development of a circular urban area and solutions can be found in the public space.
- Involve stakeholder(s) with long-term perspectives, such as investors or housing corporations, to be able to create feasible circular business cases.
- Consensus between the different stakeholders about the definition of circularity is key.
- Create value in the design of the urban area.

## Conclusion

Circular urban area development and sustainable urban area development are closely linked. According to the outcomes of this research, most urban areas are being developed with the aim of building new houses in the Randstad area, because of the increasing housing shortage. In these developments several sustainability themes, with its own subfactors, are used to create a sustainable urban area. The next sustainability themes can be distinguished: climate neutral, biodiversity, circularity, social sustainability and mobility. In this, circularity is used as a condition to develop a sustainable urban area. When special focus is set on implementing circularity, the development can be called a circular urban area development. A circular urban area development consists of several factors. These factors can be divided into two different cycles: building -and the use-cycle. This division is made because they differ in characteristics:



In the building-cycle the emphasize is on the high-quality re-use of building materials. In this building-cycle, the focus is on the lifecycles of buildings components and building materials that are log and mostly have long lifecycles.



The use-cycle is about the lifecycles of resources and products used on a daily-basis by the residents and employees in the urban area. Resources and products used on daily basis in the use-cycle are volatile and have short lifecycles.

The factors that are part of the building-cycle are:



**Circular building material cycle**



**Spatially adaptive Urban area**

The factors that are part of the use-cycle are:



**Efficient Energy system**



**Closed water system**



**Re-use, collection and logistics of waste**



**Stimulating the local economy**

Applying these six factors in Dutch practice can be organized by the use of different management instruments. For every factor several possible management instruments are explained that make it possible to apply these factor in Dutch practice. These management instruments can be divided into four different groups: (1) legal instruments, (2) organizational instruments, (3) financial incentives and (4) design tools.



**Legal instruments** can be used to set quantitative requirements for some factors; for example the EPC (energy performance). For other factors existing laws and regulations need to change to make implementation of these factors possible. For example, to create a closed water-system, the laws and regulations are now not allowing it to connect tap and waste-water into one system.





**Organizational instruments** can be used to organize the public space in such a way that separate collection of waste is possible. This instrument can also be used to set up an organizational structure for the companies in the urban area to collect their waste together.



The use of **financial incentives** can make certain products or applications financially more attractive for the residents or companies in the urban area. For example less taxes can be paid over local products which make them less expensive than imported products.



**Design tools** can be used in the design-phase of the urban area development to implement circular design principles. An online material database can for example be used to find buildings materials and the building circularity index can be used to design adaptable buildings.

An overview and explanation of these factors and their management tools can be seen on the next page in the circular urban area development guideline.



# Guideline

## Circular urban area development

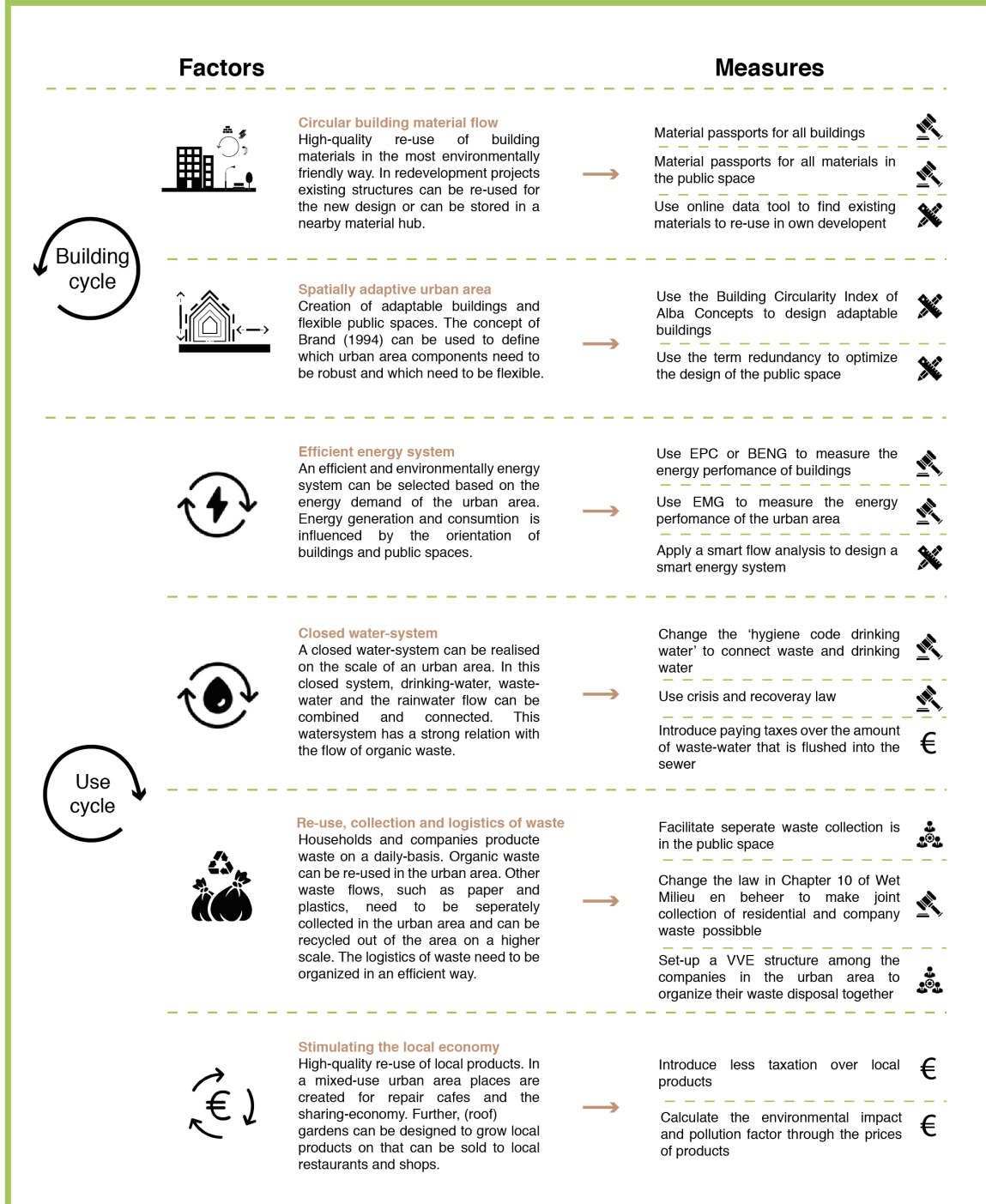


Fig. 7: Circular urban area development guideline (Own ill.)

## Discussion

### Discussion on theory

The existing theories of Kirchnerr et al. (2017), Hoornweg et al. (2016) and Geisdoerfer et al. (2017) provided a comprehensive overview of the terms 'circular economy', 'circularity' and 'sustainable development' and their mutual relations and differences in the built environment. The insights gained by this research deepen the existing knowledge of these terms in relation to circular urban area development. The used literature of van Bueren (2012) has been found partly useful. Despite, all industrial flows are reflected in the found factors, a connection between the material and energy or water flow cannot be made. Further, the factors 'waste collection' and 'stimulating the local economy' have not been found in studied literature.

### Discussion on practice

First, the 11 experts that were interviewed during the explorative interviews gave varied answers. Because of the newness of the subject, the interviewees were biased by what they have experienced in practice or have read in papers leading to broad outcomes. Nevertheless, this step of the research was indispensable to get a first feeling by the concept of circular urban area development

Second, because no circular urban area developments are in the execution or exploitation phase yet, three cases were conducted that were in the initiation or design phase. Therefore, the found factors have not been implemented and tested in practice.

Third, according to the experts of the expert panel 'consensus is key' for the development of a circular urban area. Unfortunately, no consensus could be establishing among the experts. Some used a broad definition which contained many sustainability themes while others used a smaller approach.

Although, many market parties are currently talking about the implementation of circular principles in their urban area developments, the actual execution of circular urban area development is not taken place because the next mismatches occur in practice: (1) public parties want to make use of qualitative measurements while private parties need quantitative measurements to justify their circular expenses, (2) researchers are using a broad definition of circular urban area development which is too vague for practitioners to use in real life and (3) the found factors of this research are still based upon linear norms instead of circular ones and therefore it is hard to state whether these factors are real circular.

## Recommendations

The next recommendations for further research can be stated:

- Conduct this research again when the projects are completed or in further stage of development to test whether these factors can really be used.
- More research into the relation between flows and scale levels to investigate which scale it the most efficient and suitable for which circular flow.
- More research into the possibilities of implementing circular principles in the public space, because 'public space is key' for the development of a circular urban area.
- Research into the role of smart data tools that can support decisions making and can be used to make it easier to manage circularity in urban area development.