13 Conclusions: recommendations for Amsterdam

The goal of this thesis was to propose a new integrated system for improving the collection and treatment of residential waste in Amsterdam. The new systems are based on circular principles and create a scientific link between the conceptual circular economy and practical profession of urban design. By looking back at the defined problem statement and set objectives, this chapter discusses the outcomes of the research. Conclusions will be drawn on a scientific level and recommendations for the city of Amsterdam will be outlined. This way, the conclusions of this thesis can be used within the further developed of Amsterdam as a circular city. In chapter 14, a reflection is given on the executed research and design proposals. This reflection results in recommendations for further research.

13.1 Contribution to scientific discussion

As described in the theoretical framework, knowledge is absent on the translation of circular concepts into spatial systems that are able to integrate in urban environments. The goal was to create a link between circular economy theories and urban design to better understand the spatial impact of the circular transition. The well known circular framework of the Ellen Macarthur foundation was used to develop a framework to evaluate the level of circularity of the waste treatment in Amsterdam. This framework contributed to defining potential enhancements. New circular diagrams of innovative waste treatment systems could be made which showed improved forms of treatment to create improved circular systems.

The next step was to translate these new concepts into a spatial system. By looking at the necessary facilities for these new ways of treatment, spatial elements were developed. These facilities were described as the nodes of the new system where waste is compiled or treated.

This translation made it possible to investigate where links to other urban systems and environments could be made. The characteristics of the different facilities were described and for some facilities the potential for integration within the urban environment was determined.

The question in the end is if a new valuable method is created. The method is based on a very simplified version of a waste treatment system of a city. Besides that, does the method make use of a world wide well known model of circular economy, developed by the Ellen MacArthur foundation. This makes the method easy to understand and explains how circular economy can influence other urban systems. The method eventually shown is especially useful for the policy and decision-makers, as they get an improved understanding of the spatial consequences and opportunities a circular economy brings.
Design outcomes and recommendations for Amsterdam

The goal related to this research objective was to show how the developed systems could be integrated within an urban environment. Amsterdam was the case study area where an improvement for the residential waste system was needed.

Amsterdam is highly ambitious and wants to be among the leading circular cities of Europe. By experimenting and conducting detailed research on waste flows, the municipality tries to find circular solutions in facilitating urban development. In 2020, 65% of the residential waste flow should be collected in separate homogeneous waste flows. This goal has definitely not been reached. Amsterdam faces multiple spatial challenges concerning the integration of waste collection infrastructure. In the city centre, no waste collection infrastructure is available and waste points throughout the city are under pressure by housing development projects. Besides the lack of collection possibilities, the treatment of some waste flows can still be improved and made more circular.

For that reason, this thesis presented proposals on how more collection options in Amsterdam could be created and how waste treatment can be made more circular and integrated within the city. These proposals provide a wide range of possibilities and some crucial recommendations for the municipality can be drawn. These recommendations can be used when further developing the residential waste system of Amsterdam and should lead to a more diverse and better anchored system within the society. Links with other urban systems have to be made to create a real progressive circular city, which is ready for the future and a global example on how residential waste systems can be enhanced in terms of circularity. The conclusion of this thesis is in this way in line with the statements by Murray et al. (2017). Real sustainability can only be achieved when making changes within the three pillars of our society: social, economic and environmental. These pillars should be the core of every circular urban solution that aspires to create a society dedicated to sustainability. From the proposals the following main recommendations can be derived:

The value of local treatment
Research has made clear that circular economy and new circular treatment methods have economic value. However, this value is most of the time expressed in money and related to larger scale treatment facilities. A major conclusion that can be drawn form the proposed solutions is the creation of value in different ways than just monetary value. The creation of a more sustainable and circular society is maybe more important compared to the economic benefits. Small scale and local treatment of waste may not have the highest economic benefits but has high value in creating awareness and showing the benefits on a societal and environmental level. By investing in local treatment methods, residents are able to experience circular economy and they will see the value of reusing and recycling waste. Bringing these processes closer to the people will contribute to the creation of a more sustainable society. Changing the daily habits of the citizens will support the transition and will result in a complete circular city. When the whole city is in support of this transition and together progression is made, a real circular and sustainable city is created. A balance has to be found between profits and benefits, nevertheless, the municipality should also consider other values apart from economic benefits.

Investment in infrastructure
The municipality recognizes the importance of waste collection infrastructure which is available for all the residents of Amsterdam. In some areas of Amsterdam, access to these infrastructures is lacking. Within this
Conclusions: recommendations for Amsterdam

thesis, multiple options are shown how collection infrastructure could be integrated in areas with limited space. By looking to other possibilities compared to the conventional street containers, options arise to make waste collection infrastructure accessible for all the residents. In the city centre of Amsterdam, high investments are needed to facilitate this. However, by making these investments and by making connections to ongoing research projects like Roboat, these new infrastructures show the serious ambitions the city has. These investments do not only make collection infrastructure available everywhere in Amsterdam, it also shows the capacity to find smart urban solutions. These investments will make sure Amsterdam stays one of the leading cities in the world in the circular transition and it will become an example to cities around the world. By doing a serious one-time investment, Amsterdam can show in this way the real eager and progressiveness of the city.

These investments also include the expansion of waste collection points to make it more easier for residents to dispose their waste. When the network of drop off points is expanded, less waste has to be picked up, which will reduce the amount of waste transportation in the city. Multiple options for increasing the number of waste points are given within this thesis. There are multiple options on different scales, with different objectives and profits. These proposals can be of inspiration when looking for new implementing solutions. They definitely make clear that certain forms of residential waste treatment can happen within the city borders. Waste is not inextricably linked to industrial areas and it can be valuable for the city.

Motivating residents by rewarding

Within the future plans concerning the improvement of waste collection, the municipality speaks of the possibility to reward residents when less residual waste is being disposed. Rewarding residents can be a great motivation to foster the awareness on sustainability and increase the separated collection of residential waste. When creating the proposals for a better collection system these ideas also popped up. Experiments should start where the disposal of waste is being monitored. Especially in areas where waste collection can be organized on a housing block level, it becomes possible to monitor the disposal habits of residents. By organising this system per housing block it becomes possible to reward this group at the same time. The forming of communities may occur, in which residents encourage to separate collection of waste and reduce the generation of waste. The municipality itself proposes a system where residents have to pay less for the waste disposal when improvements are being made. However, this rewarding could better be done on a communal level. By rewarding a whole housing block by offering money to improve the public space in their area or to organize a street party during summer, the rewarding also contributes to the creation of a stronger community. In this way, waste becomes not only a resource in a material way, but also a resource for strengthening communities.

Linking waste to existing urban systems

The contribution of waste collection to the creation of stronger communities may occur in multiple ways. As mentioned before, waste treatment on a local scale can have more value than just economic. By making the connection to already existing communal system throughout the city, a more vibrant treatment is created and communities can experience this value. Within this thesis, proposals were made for connecting local treatment of waste to already existing urban systems. Making links to education, local markets and sport accommodations can strengthen communities. The community can experience the value of waste, make a contribution to the community by improving their disposal habits and participate in circular treatment activities. A new waste treatment system should not be an isolated system, controlled by the municipality. It should be part of the society and integrate within the current urban systems that make the city. In this way waste treatment contributes
to the city in an economic, social and environmental way, which are the three pillars of true sustainability.

**New management structures for waste systems**
The connection to existing urban systems also creates new possibilities for organizing and managing waste treatment. Communities can be in charge of their waste disposal to a certain level. By making communities on a lower scale responsible for their own waste disposing and by implementing reward systems, local waste collection and treatment can be organized by the residents themselves. In doing so, costs can be reduced and profits for residents increased.

**Supporting local initiatives**
The local treatment of waste and the supporting of local communities is not to be directed completely top down. To make this processes reality, there should be a certain initiative form the residents themselves. The municipality already states within their future waste collection vision that local initiatives should be supported more. This should not stay at the level of just supporting. The municipality can create initiatives together with residents. By combining rewarding mechanisms with initiatives, residents can be stimulated to continue their enhanced waste collection efforts. Local resident groups should be able to create a collection plan adjusted to their needs and with their own ambitions. This can include local biowaste treatment, or the need for more or better placed waste containers. By talking to residents and asking what kind of improvements they would see could be the key to success. This way, waste collection and treatment is adjusted to the circumstances in every neighbourhood and also rewarding can be adjusted to the needs of the residents.

**Reversed collection of residential waste**
Preference should be given to the desired homogenous waste flows compared to residual waste. Residual waste will not be eradicatd completely. When positioning waste collection infrastructure, or applying new collection methods, this principle should be taken into account when allocating the needed infrastructures. In this way, residents are motivated and in some way forced to separate their waste.

**Port of Amsterdam as a circular cluster**
The municipality of Amsterdam should try to attract new circular waste treatment companies to the Port of Amsterdam. In this way, sustainable economic activities are attracted and all waste produced within the city can be treated within the region.

These recommendations contribute to achieving the set goals and create more value on multiple scales. Some recommendations require large investments and probably long term planning. Nevertheless, some recommendations can already be applied on a short term. Small scale local initiatives and the promotion of these initiatives in Amsterdam do not require high investments or long term planning. On a small scale, first steps towards a more circular city and society can already be made. However, for these future steps, more search needs to be conducted on different topics. In the next chapter some crucial recommendations for further research will be given. This total list of recommendations creates a solid future plan on how circular waste treatment and collection actually can be improved.
Reflection

Within this final chapter a reflection is given on this thesis. The reflection will consist of a critical view towards the conducted research and the eventual design proposals. Within the first part the expected scientific relevance and design proposals will be discussed. This will include limitations of this thesis and the resulting recommendations for further research. The second part will be a personal reflection on how this thesis connects to the chosen research group, its methods and how I personally developed this thesis within the chosen research group.

14.1 Reflection on the conducted research and design proposals

The goal of this thesis, from a scientific perspective, was to create a method which translates conceptual circular thinking into spatial systems. By doing this, the spatial effects of circular economy would become more visible and integration possibilities within urban environments easier to find.

In my opinion, I did contribute to this scientific discussion. By creating a simple method which translates conceptual systems into physical nodes, a link between circular economy and urban design has been made. However, this was just one of the first steps in creating a solid method. Because of the high complexity of urban systems and a wide variety in types of waste, it was difficult to formulate a method which applies to all cases. During the processes, the different systems needed to be simplified to make the research possible within the time frame. By choosing for a wide scope and addressing multiple waste flows, details in the research got lost. However, in my opinion, choosing for a wide scope created a nunderstanding of the complexity of the systems and still created an understandable method which shows multiple solutions and improvements. By translating the known concept of circular economy by the Ellen MacArthur foundation, I think I especially created a method which can be understood by a big audience. It shows the essence of linking circular economy to urban environments and urban design. In my opinion does this thesis particularly increase the understanding of spatial effects of circular economy. In this way it forms a good base for policy makers and researchers to analyse these effects in more detail. This thesis shows that a link between circular economy and urban design can be made. Circular economy concepts can be input for sustainable urban designs and urban design can implement circular concepts. Even though a link has been made, I think this method should be applied more to get a better understanding of the links between both professions. By doing, most can be learned.

From a societal perspective does this thesis contribute to questions raised by city concerning sustainable urban growth. The question remains if these proposals for Amsterdam would really work, and that question remains unanswered. In the research the actual effects of the different proposals on the waste system remain unclear. In my opinion it is especially a story that could inspire policy makers at the municipality to rethink the use of waste and think in other systems. It could also help to make policy makers familiar with systemic thinking and how different flows can be combined and synergies can be created. The proposals led to more general recommendations for Amsterdam. These recommendations can be used in further development of policies and vision concerning waste treatment and collection. In this way, the main
message is not the created proposals and the need to execute them. The main message of this thesis are now these recommendations which will help to continue and speed up the transition of Amsterdam. This thesis could lead to more awareness on what the different options are to recycle waste. They can get inspired by the idea of maintaining the most value of the product of material before disposing it. For the design of actual solutions and how they could be implemented, more research is needed, especially on the actual contribution to the problem in the form of data and figures which suggest improvement.

A total re-configuration of the treatment system is in my opinion unrealistic. However, some aspects could be translated to the city and maybe it can be of inspiration for making Amsterdam more sustainable and circular. Solving in this way a part of the problems around depleting resources.

Recommendations for further research

The research conducted in this thesis had a wide scope and for this reasons for a lot of parts limitations arise. Within this thesis, the problem was approached from a systemic perspective. Due to this perspective, other important aspects of creating a circular city have not been addressed. However, during the process of creating proposals and implementing the systemic designs, interesting recommendations could be created (chapter 13). These recommendations include proposals on a social, economic and environmental level. To be able to continue with this recommendations in Amsterdam, I propose the following recommendations for further research:

The value of circular economy

As explained within the theoretical framework, circular economy is at the moment mainly a sustainable business model. This results in the fact that profits for larger business and companies are quite clear. In the recommendations for Amsterdam comes forward how important the value of circular economy is on a lower scale, related to residents. When the value can be experienced by the residents itself, circular solutions have a higher chance of success and can contribute to a more circular society. For that reason, methods should be developed on how residents can experience the value of this economy directly. By looking into rewarding and monitoring systems, residents can be motivated and persuaded to change their behaviour regarding waste collection and treatment. In other words, I recommend the further investigation of how the value of circular economy can be translated to the residents and how they can experience the value to persuade and motivate them. Experimenting with rewarding and monitoring systems could lead to valuable information on how residents can be motivated.

Continuing page 164
**Reflection**

**Adapted waste treatment and collection**
At the moment, a unilateral waste system is applied to Amsterdam. Street containers are the norm and is seen as one of the main options. However, experimenting and supporting local initiatives already made clear that a lot of improvement can be made when the waste system is adjusted to the needs of the residents. Local composting of biowaste is one of those examples. Amsterdam knows a lot of different types of neighbourhoods, with a wide diversity of residents. Not only the spatial characteristics of the neighbourhood determine the possibilities for integration waste collection infrastructure. The motivational reasons or restrictions experienced by the residents should be taken into account. Hence, I recommend the continuation of research on resident’s motives for potential adhering to separating waste or not. In this way, local initiatives can be created with the support of the municipality to create waste systems adjusted to the needs of the residents. A tailored waste system (within a certain bandwidth) will contribute to a changing society. These adjustments can be combined with new forms of rewarding the residents for improvement.

**Monitoring, calculating and predicting**
Amsterdam has been experimenting with circular solutions and local initiatives for many years. As stated in the recommendations larger investments are needed to make an actual change. More research is needed on the actual effects of these large investments. Estimations should be calculated on what kind of improvement is to be expected. With this crucial information, Amsterdam can stop experimenting and start investing in the future. New methods should be created on how the impact of circular solutions can be determined as a burden of proof for implementation and justification of the costs.

This new method also includes the development of more advanced monitoring systems which can also provide feedback to the residents directly. In this way, residents gain insight in their waste generation and directly see any progression made.

**Linking to other professions**
This thesis tries to make a link between circular economy and urban design. The proposals are created from an urban design perspective, thinking mostly about integration within the public space. However, waste collection and treatment systems are not limited to the available outdoor space. Waste separation starts within the residency itself. This requires solutions on an architectural and interior design level to create possibilities for separating and storing waste easier within the building itself. This will require a connection between urban design, architecture and interior design to create one system dealing with challenges on different scales and in different domains. Research on finding residential waste solutions should be done by a combination of professions, trying to improve the complete waste ‘production’ line from generating till treatment. This also include industrial process to reduce the production of waste and industrial ecology to create circularity between treatment facilities and making connections to the city. The challenge of reducing and recycling residential waste needs an approach supported by a wide range of professions. Urban design alone is not able to solve all outlined issues.
14.2 Personal reflection on work process

This part of the reflection consists of a more personal reflection on the provided work and the process over the last year. It reflects on the relation to the chosen research group and how a contribution has been given.

Relation between research and design
The combination of performing research and making spatial translations through design is according to me the most important goal of writing a thesis within the master track urbanism. Within my thesis I tried to translate theoretical concepts, like circular economy, to spatial interventions and its integration within urban environments. The ultimate goal was to provide a method to turn a more economic and technological driven theory in a spatial challenge. Research played a big role in understanding the characteristics of circular economy, getting the right data to make implementation possible and finding simple methods to translate a systemic theory in spatial interventions. At first I did not really believe in the concept of research by design and design by research, since everyone is just using this term without even being possible to explain what it exactly means. However, I think I got a better understanding on how design can contribute to research. In the end I even think I had to use a design thinking even more within the research process. Design is a great tool to test your findings from research or created methods based on theoretical information. The feedback you get by implementing and designing the method can enrich your method since you get more knowledge on integration of the method and the aligning with the bigger urban system. It eventually led to interesting recommendations which are not related to systemic design but relate to other more social subjects.

My personal reflection on combing research and design is that I should have used it more. The alteration process was present within my thesis, but because of the complexity of understanding the whole system at once, it would have been more valuable to integrate design processes within the research in an earlier stage. My biggest pitfall was trying to understand the complete circular economy system at once. It was hard to create a complete new system at a conceptual level. Probably, in between steps where I would have tried to implement the system within the city of Amsterdam and used the feedback I got from the implementation, would have helped to understand the system.

So, one of the biggest things I learned from this thesis that it is almost impossible to understand a whole complex system at once. In between reflections and connections to the real world are necessary to get valuable input. However, I think I made a good attempt to connect theoretical perspectives and research to spatial challenges and design. Eventually, it resulted in a thesis which has a more research and conceptual character, instead of ready to use design workout in detail.

The connection, and contribution of this thesis to the Smart Cities and Urban Metabolism research group
Originally, my motivation to graduate at the research group of Smart Cities and Urban Metabolism was based on my personal interest in the concept of circular economy. My interest within this subject started by running an internship at the municipality of Amsterdam where I was part of a team which investigated the potentials of circular economy on a regional scale. This project, called Westas, introduced me to this for me unknown concept. During my internship I was given the opportunity to experience the way policy makers approach such new concepts and what the challenges from practice are.
Within my thesis I aimed to deal with these challenges derived from my experience in practice. I commenced with a research proposal which tried to deal with these challenges, which were mainly about industrial processes and governance structures. After a long period of trying to find my focus and limiting the scope of my thesis the realisation came that I was leaving my field of expertise (urbanism). The thesis had little spatial relevance and became a research proposal which suited more the field of industrial ecology.

A more intensive collaboration with the chosen research group helped me to redefine my project, where my knowledge gained within the master of urbanism was present again. Presentations I gave in front of the whole research group and especially a stronger involvement within the REPAIR research helped to reconnect to the chosen research group. By being involved within the REPAIR research I got (re)inspired by used methods like geo-design and systemic design. During a trip to Naples and helping out with their contribution to the landscape triennial and other REPAIR related workshops I had the chance to practice these methods and learn how they could benefit my own thesis project. Since REPAIR is performing their research on Amsterdam (one of six case studies), my stronger involvement helped to understand Amsterdam better in relation to my thesis.

Because of this stronger involvement, I think my thesis got a stronger connection to the focus of the research group. I had a refocus on the translation of circular economy in a spatial way, which is strongly related to combining urban metabolism and urban design which is a focus point of this research group and previous graduation projects within this graduation lab.

**Final personal remark**

At last it is time to give an overall personal reflection on my work and process. I think I addressed an interesting and relevant topic, where I reduced the gap between research and practice a bit smaller. However, for a master thesis it would have been better to try to limit the scope even further. By spending almost half a year on finding the right focus, I think I eventually did not succeed in limiting the scope enough for a master thesis. My enthusiasm and drive to try to understand the circular economy as a whole and trying to create a complete city model, caused in my opinion a thesis which lacks a bit of detail.

Nevertheless, I think when people read this thesis, they will be inspired, or at least rethink their use of waste. In this sense I think I contributed something to society, and makes me happy with the end result.

**Used methods and the relation to the research group**

As explained in the previous part, I gained a lot of knowledge about different methods used and researched by the research group of Smart Cities and Urban Metabolism. This applies the most to designing in a systemic way and applying the system in a context through geo-design and integration through urban design.

I got to know this knowledge by participating in the elective ‘Geo-design for a Circular Economy in Urban Region’ organised by my graduation mentors. Eventually, this became the cornerstone of my graduation project.
‘Only if societal needs are defined and included in the basic formulation, can we hope to build on all three pillars of sustainability. This needs urgent attention in the Circular Economy conceptual framework’

(Murray et al., 2017)