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Circular Aalborg: How can redevelopments serve the transitioning of Aalborg into a circular city?

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Synopsis:

This report investigates the concept of a circular city in the context of Aalborg and in opposition to redevelopments which currently support the growth strategy rather than the sustainability strategy. The research starts by defining what circular cities are, reasoning why cities should be circular and presenting a framework which is later used to analyse the concept in Aalborg. Next, the paper explores the presence of circular actions on each level of a multi-level perspective along with the planning process behind the actions. Finally, Karolinelund and Spritten are presented as opposing examples of redevelopments and discussed focusing on their contribution to Aalborg's circular transition. The report concludes that redevelopments are currently more the tool of growth than the tool of a circular transition, and this is a big obstacle in the transition of the urban fabric. Redevelopments provide an opportunity of a variety of circular actions, but they can also serve as tools which help overcome obstacles of the transition. They are found to be the perfect tool to introduce flexibility and infrastructures that support circularity into the city's physical structure.

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Abstract

Department of Planning

Urban, Energy and Environmental Planning

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by Dorina MERICSKAI

Cities which are working as growth engines are largely responsible for the environmental crisis. As a reaction, cities are setting an ambitious goal to transition into sustainable cities. This paper takes transitioning to a circular city as a strategy that is essential to reach such an objective. Focusing on the case of Aalborg, the research aims to gain an understanding on what the city could do to unlock the potential in redevelopments to support a sustainable transition rather than growth strategies through asking the question: *How can redevelopments serve the transitioning of Aalborg into a circular city?* Through the use of literature review, interviews and document analysis the research reveals the efforts that have been found on each level of a multi-level perspective to transition towards a circular city and what is yet to be done to further the circular city status. Next, the report discusses how redevelopments could contribute to the transition through the investigation and evaluation of two contrasting redevelopments in the city. On one the hand is Karolinelund, a public redevelopment with a strong focus on the creation of a natural regenerative environment. On the other hand is Spritten, a private waterfront redevelopment with a focus on housing and culture. Finally, the report concludes that redevelopments can be used as a tool for circular transition in two ways. First of all, they provide an opportunity for a variety of circular actions, second they can serve as tools which help overcome obstacles of the transition. More specifically, there was found to be a lack of adapt actions taken in the city, which are essential to increase the flexibility of the urban fabric and decrease the dependency on outdated infrastructures. Redevelopments are found to be the perfect tool to introduce adaptability into the city's physical structure, yet are found to serve growth strategy primarily and the sustainability strategy secondarily.

Key words: Circular City, Sustainable Transition, Circular Economy, Circular transition, Redevelopments, Aalborg

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Dorina Mericskai

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List of Abbreviations

AAU	**AA**lborg **U**niversity
BRT	**B**us**R**apid **T**ransit
EU	**E**uropean **U**nion
MLP	**M**ulti-**L**elvel **P**erspective
NBE	**N**etværk **B**æredygtig **E**rhverv NordDenmark (Network for Sustainable Business Development North Denmark)
SDGs	**S**ustainable **D**evelopment **G**oals
UN	**U**nited **N**ations

Chapter 1
Introduction

This chapter introduces the context of the research and presents problem formulation, where the research question and sub-questions are explained. Next, the chapter presents and explains the research design and the theories of science present in the research. Finally, there is a short summary of the structure of the report and what each chapter focuses on.

Industrial development was the source of significant economic growth and increasing quality of life in many places around the world in the past century. However, such benefits came with significant pressure on Earth's resources. This increasing pressure is to carry on as global material consumption is skyrocketing. (Krausmann et al., 2009) It is clear that this system cannot be sustained. (UNEP, 2011)

Today more people are living in cities than those who are not (United Nations, 2015). On a global scale, cities consume 60-80% of natural resources while producing half of all waste. Furthermore, cities are responsible for 75% of greenhouse gas emissions globally. (Hoballah, Peter, and l'environnement, 2012) The threats of climate change for cities (floods, storms, droughts, etc.) are as significant as their contribution to the phenomena (Parry et al., 2007). The 11th goal of the Sustainable Development Goals (SGDs) is to *"Make cities and human settlements inclusive, safe, resilient and sustainable"* (United Nations, 2015) which means sustainability transition in cities is also found necessary by experts. Based on such data and the scientific researches on the topic, it can be concluded that solutions to planetary unsustainability can be found in planning cities in a different way and in transitioning them into a sustainable form.

There is a general consensus that cities should have sustainable transitions. There are also many strategies existing which are necessary to follow or consider when such transition is the goal. This research focuses on the circular strategy and argues that a first step to achieve sustainable cities should be by designing them to be circular. The concept of circular cities originates from the concept of circular or closed-loop economies which are yet ill-defined due to scarce investigation. Consequently, the concept of circular cities is also work in progress and often not adequately distinguished from sustainable cities. (Prendeville, Cherim, and Bocken, 2018) Additionally, projects working on circular cities often use frameworks of the circular economy concept (for example the ReSOLVE framework) without proper adaption to the urban context and thereby neglecting to consider significant differences of economies and cities (Williams, 2019).

A sustainable transition is a long term radical change that needs the complementary of many strategies in order to happen. By focusing on the circular transition as a tool to have a sustainable transition, this report aims to clarify the process of transitioning into a circular city and to take a step to bridge the gap between theory and practice by investigating how the city of Aalborg (in Denmark) could transition into a circular city. Besides serving as inspirations for further research, the conclusion of the report also aims to shine a light on the role redevelopments can have in the transition as well as the way they can contribute to overcome the most significant obstacles of the circular transition in Aalborg as they are found to support growth before sustainability.

1.1 Problem Formulation

The city of Aalborg has set out a Sustainability Strategy which acknowledges the nine planetary boundaries and the urgency of climate change (Green, 2016). Recently, efforts have been made to promote circular actions and a focus on circular economy under the Circular North Jutland program. Additionally, a mapping of the achievement of the SDG-s was done in the city by the

Municipality which collects all local efforts and goals in order to be able to decide on the next steps. To take these efforts one step further, this research aims to explore the circular transition in Aalborg with a focus on the potential in the role of redevelopments in achieving such a goal. Therefore the main question researched is:

How can redevelopments serve the transitioning of Aalborg into a circular city?

As the main research question is very complex, has many aspects to it and little literature on it, three sub-questions were chosen to simplify the task of answering. First, the theoretical background is explored through essential concepts needed for the rest of the research and a theoretical framework is established for the empirical research phase to follow. Next, the present situation of the circularity of Aalborg and the efforts made so far is analysed. Finally, comparing Spritten with Karolinelund redevelopment, and investigating the contributions and potential ways to the process of transitioning to a circular city are investigated. The three questions are formulated in the following way:

1. ***Why should cities be circular, how can circularity be planned for, and how can the transition happen through redevelopments?***
2. ***How is circularity present in Aalborg on the different levels of a multi-level perspective and what is needed to further increase the circularity?***
3. ***How do redevelopments like Spritten and Karolinelund contribute to the circular transition of Aalborg and what could they do more?***

1.2 Research Design

The research design is presented in figure 1.1 and breaks down the process of the research into three phases.

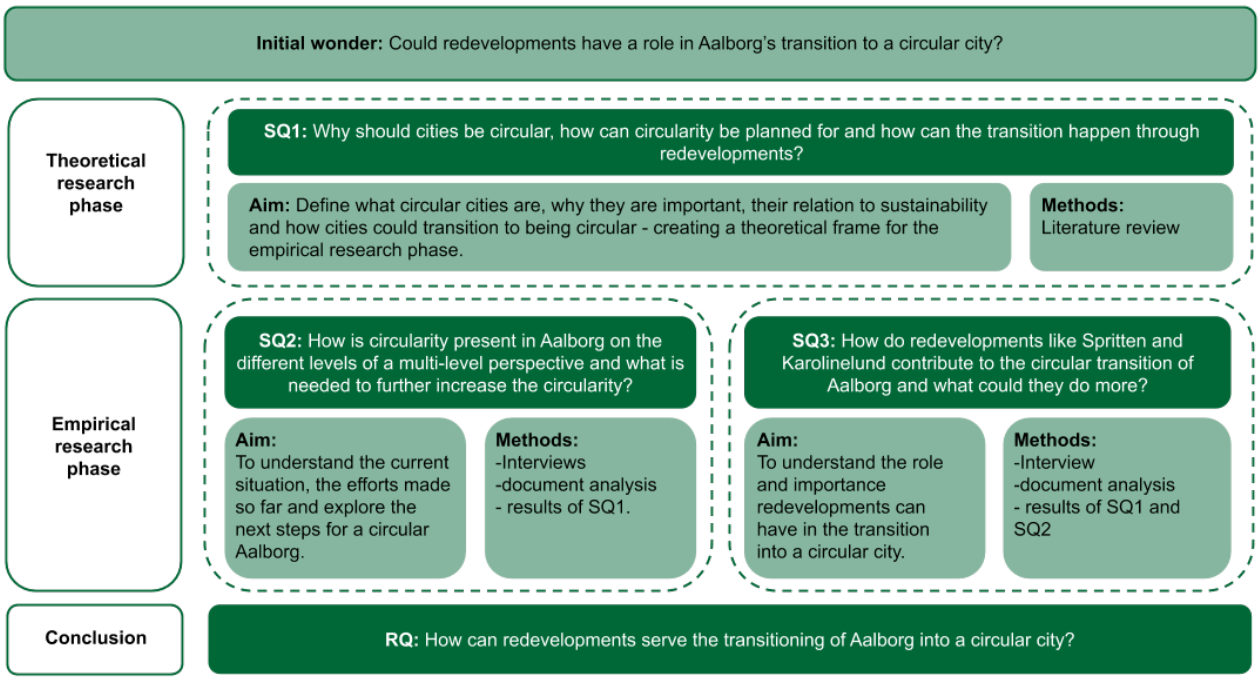

FIGURE 1.1: Research design

The first phase is an explorative theoretical phase, in which the main concepts and theories are explored and defined. This phase uses literature review to get a picture of the most recent understanding of the topic and answer the first sub-question. The chapter (2) not only defines what circular cities are but also elaborates on why they are important, what their relationship is with sustainability and sustainable cities as well as how cities can transition into one. Additionally, it builds up a theoretical frame which was used to carry out the empirical research phase.

The second phase is the empirical research phase which answers to sub-questions 2 and 3. The second sub-question is explorative, and the answer explains the current circularity found in Aalborg on each level of the multi-level perspective and the planning process behind it. Additionally, it goes into the main issues to be solved in the future. To gain such knowledge, the data collected through interviews and document analysis is analysed using aspects from the theoretical framework developed in the first research phase. The answer to the third sub-question is also based on empirical data. However, here the research focuses on the comparison of two redevelopments and investigates how they could fit and contribute to the vision of a circular Aalborg. Data is collected through interviews and document analysis and is discussed based on the findings of the first two sub-questions.

The third and final phase of the research is the conclusion, where the main research question is answered. This is done through the use of the findings of the three sub-questions. The conclusion focuses on the way redevelopments can be used to transition the urban fabric, so it supports circular economies, and the way redevelopments can provide an opportunity for circular actions.

1.3 Theories of science

The view of critical realism in the research is connected to the use of the multi-level perspective in the theoretical framework presented in the literature review (chapter 2). Realism revolves around the idea that what is sensed is reality and critical realism takes this thought one step further by claiming that it is not reality but a sensation which is basically a representation of reality (Mark Saunders, 2013). In other words, reality exists independently to what its participants are able to perceive but also argues that well-founded assumptions can be constructed of the reality (Næss, 2015). Furthermore, it points out that it is only possible to comprehend what is happening in the social world if the social structures which caused the investigated social phenomena are understood (Mark Saunders, 2013).

The paper partly aims to explain the observable phenomena of circular transition by investigating underlying mechanisms and their interactions with the rest of the city's social structures. It perceives the world and the researched city as a complex, ever-changing system which has organised complexity and *"multitude of contexts, structures, changes and situations mutually influence each other. Interdependencies exist between the natural base and ecological situation of a city, the built environment, the economic conditions and the social life and living conditions of its inhabitants. The result of one particular measure in urban development usually depends on what influences are at the same time exerted by a number of other factors."*. (Næss, 2015, p. 1233) The agents interact with each other in many ways, creating societal structures (clusters, sub-systems, rules, and behavioural patterns etc.) which can vary in size and influence and are alive until they are maintained. Such societal structures can be physical (e.g. buildings) or immaterial (e.g. property relations or economic conditions) (Næss, 2015). To understand the different levels of the overall system and the social structure within it, a multi-level perspective (MLP) is used when analysed the data collected. This simplifies the system and helps in learning about the presence and transition of circularity in the investigated city. Furthermore, the third sub-question and the main research question take a focus on the role of one element in the system (the redevelopments), which are seen as a consequence of behavioural patterns and the social structure as well as being a tool of transition (whichever direction it may serve). The base of the main research question is the idea that if the

redevelopments bring change into the city either way, they should be 'tamed' to bring the change desired.

The process of data collection is aligned with critical realism's inclusiveness of methodological pluralism (Næss, 2015) as it combines document analysis and interviews. It is driven by the idea that the individuals are experts of the system in which they are embedded in, including the projects they work within their everyday. Therefore, one person working on making a change on each level of the MLP was interviewed along with planners working on the two redevelopments investigated. Furthermore, documents created by those who are considered experts in the topic where analysed.

Interpretivism's position is that a researcher investigating social structures needs to consider that the social actors interpret the social role of their own and of others (Mark Saunders, 2013). In this research, interpretivism appears mainly in the use of interviews and document analysis as this form of data collection relies heavily on the way the interviewees and document creators interpret their role in the world and how they perceive the system around them. It is considered key in gaining acceptable knowledge *"to enter the social world of our research subjects and understand their world from their point of view"* (Mark Saunders, 2013, p. 104)

The interviews focused on how the interviewees perceive their own work or projects and that of their closet co-workers. The questions asked focused on the goals they set, the ideas behind it and the way they interpret the obstacles or supporters of their work. The interviewees are considered experts in the decisions made and the strategies used in their work, therefore, the questions often focused on just that. The documents analysed were considered a collection of thoughts, decisions and strategies of experts, and consequently are reliable data. The data collected was analysed through a multi-level perspective, and the information of each level was prioritised according to which level the source (interviewee) is working on. In other words, for example, the interviewee working on a niche level was considered to know most about that level; therefore, her answers were prioritised over other's answers when analysing the happenings on that level.

1.3.1 Literature review

As the theoretical research phase is conducted using the method of literature review, here it is explained how the method is used. The methods used in the empirical research phase are described in chapter 3.

The literature review is the most efficient way to collect knowledge from the most recent findings in the topic and develop a relevant theoretical frame for the current research. Additionally, the literature review can also provide a better understanding of the context of the research and helps define important concepts.

Besides answering the first sub-question, the literature review is used to achieve the following steps: (1) distinguish between sustainability and circularity as well as define their relation and importance; (2) Collect what is known about circular economy and circular cities and define them in a relevant way to the research; (3) Explore and explain the transition theory used in the research and explain why it is essential.

Many scientific reports and articles were used in the theoretical research phase; however, the following were relied on with most significance:

- Geissdoerfer et al. (2017) - to understand the differences, similarities and relationships between sustainability and circularity.

- Williams (2019) - to understand what the most commonly used circular economy concepts lack to be applicable to a city and use the framework in the conclusion of article which is considered to be sufficient for circular cities.
- Prendeville, Cherim, and Bocken (2018) and Marin and De Meulder (2018) - To explore examples of cities in transition to being circular and how these scenarios differ.
- Geels (2005) - To understand and explain the transition through a multi-level perspective in a city.

1.4 The structure of the report

This report consists of six chapters altogether. Starting with this chapter, the introduction, the problem studied is presented, and the research is introduced along with the research questions, theories of science and the research design. Moreover, the way the literature review is used is explained. The next chapter (2) consists of the literature review's findings, answers the first sub-question, builds up a theoretical frame and explains every concept used in the research. After that, the process of data collection in the empirical research phase is explained in the Methodology chapter (3). The chapter presents each method used, explains the process and decisions made through it. Chapter 4 is the analyse chapter in the report and answers the second sub-question. It is broken down into four main sections which are dealing with circularity on the three different levels of the multi-level perspective in Aalborg and the answer section. Chapter 5 presents and compares two redevelopments in Aalborg (Spritten and Karolinelund) and thereby answers the third sub-question. Finally, the conclusion (chapter 6) answers the research question based on the findings of the first three sub-questions. The last chapter (6) also includes a reflection on the methods used and the research as a whole, as well as the opportunities for further research.

After the main chapters of the report, the references are presented in the bibliography. Last but not least, the Appendix is attached containing all interview guidelines, interview transcriptions and the SDG mapping of Aalborg.

Chapter 2
The importance, the concept and the transition to circular cities

This chapter introduces the theories used in the research in the context of urban planning and circular cities. It builds up a theoretical framework based on the literature reviewed. The sections explain what circular cities are, why they are important, what existing scenarios there are so far and how a city can transform into one. Finally, the chapter answers the first sub-question: *Why should cities be circular, how can circularity be planned for, and how can the transition happen through redevelopments?* using the theories and data collected from the literature review.

2.1 Circular cities and sustainability

This section defines the concepts and clarifies the relationship and differences between the way circular cites and sustainability is understood in this research as there seems to be a variety of understandings in the literature reviewed.

2.1.1 Sustainability

Today the Oxford dictionary definition of sustainable is being *"able to be maintained at a certain rate or level"* (Stevenson, 2010), but it can have many more meanings depending on the context it is placed in. The recent increase in emerging proof of global-scale environmental risks has put the concept of sustainability in a new light. Despite the fact that social needs are not met in many places of the world, the environmental impact of the never-ending need for growth is still too much of a burden to the planet. Therefore, shifting to a system with the necessary balance between the environmental impact and the provision of necessities is vital. In other words, we need: *"development that meets the needs of the present without compromising the ability of future generations to meet their own needs"* (MRCGP, 1988, p. 1).

There are three main branches of sustainability: environmental, social and economical. In a city, these branches are interlaced and can not be treated separately, yet it is important that all three sustainability types are met to keep the balance. However, currently, the structure of the cities and economies along with the systems and goals embedded in them revolve around economic growth with no or little environmental concern.

The doughnut of social and planetary boundaries

The idea of never-ending economic growth and mass-consumerism came from the last century through concepts like Rostow's five stages of economic growth (Rostow, 1960) leaving the generations of the 21st century with economies that have the need to grow no matter if they make people thrive or not (Raworth, 2017a). This political, financial and social addiction to growth, comes at an incredible price running on natural resources, which human well being heavily depends on. Overconsumption and overproduction can have side effects like climate change, ocean acidification, chemical pollution, biodiversity loss, overflowing unhandled waste, finishing resources and many more. (Raworth, 2017b) Contemporary economies are simply not sustainable; however, there are contemporary economists who have come up with a model where such sustainability is achievable.

Figure 2.1 presents The doughnut of social and planetary boundaries by Raworth (2017a). The middle of the doughnut represents the twelve social priorities based on the Sustainable Development Goals (SDGs) set by the United Nations (UN). These are life essentials no one should fall short of (yet many do). (United Nations, 2015) The outer ring presents possible disastrous outcomes if humanity puts too much pressure on Earth's most important life-supporting natural systems. The green area is where the economy should stay and thrive in a dynamic, fluctuating manner, staying above the social foundation (providing everyone with the necessities) but below the environmental ceiling (keeping our environment safe).

FIGURE 2.1: The doughnut of social and planetary boundaries by Raworth (2017b)

In achieving this Raworth (2017b) recognizes four main actors: the market (and its power), the states (and their partnerships to be held account), the role of the households (and their contribution) and finally the creativity of the commons (who's potential should be empowered). (Raworth, 2017a) Interestingly these are also the actors who city planners when developing future proof circular cities should concern according to those researching circular cities (see section 2.2).

The increasing system in which natural resources are used to create products which are then shipped across the world, used for a little while and then thrown away only to consume more, is not a way to stay in the safe and just space for humanity. As mentioned in chapter 1, cities are both significantly contributing to and threatened by climate change and resource scarcity (Parry et al., 2007). Consequently, it makes sense to plan cities for sustainability. In order to reach the ambitious goal of a sustainable city, many steps are needed to be taken, one of which is a shift from linear growth and linear use of resources (i.e. linear economies and cities), towards a circular form. Note, the circular economy concept does not equal that of the doughnut of social and planetary boundaries.

2.1.2 The circular city concept

The concept of circular cities comes from the concept of circular economy which was a reaction to the recognition of the limited materials on earth's along with the fact that the contemporary economy has linear characteristics needing unlimited resources to be sustainable forever, therefore, the development of the idea to transition to an economic system which aspires for a closed-loop system. Although the original motive of creating circular economies was not to achieve sustainability but to reduce the number of resources used along with the waste production and emissions of the current linear make-use-dispose system, it can be still be used as inspiration for the solution. (Geissdoerfer et al., 2017) In fact, some authors argue that a circular economy is an essential element of sustainable development (Läpple, 2007) and is absolutely necessary for sustaining economic output (Geissdoerfer et al., 2017). However, this should not be a reason to disregard other ideas as some researchers argue that it is a necessary but not sufficient solution and that other actions (e.g. change of lifestyle) must also be made in order to achieve a sustainable system (Nakajima, 2000).

The idea of a circular economy has been around since the late 1970s and has been developed and influenced further by economists like Stahel (1976), McDonough and Braungart (2010) and many more. One of the most recent and well-known definitions of circular economy was formulated by the Ellen MacArthur Foundation (2013): *"an industrial economy that is restorative or regenerative by intention and design"*. (Ellen MacArthur Foundation, 2013, p. 14) It was also this foundation who came up with the ReSOLVE framework, which is based on three principles (preservation, optimisation and system effectiveness) to help shift the economy to a more sustainable manner. (Ellen MacArthur Foundation, 2013) When scholars describe the circular economy, they often mention system supporting actions like maintenance, recycling, repairing, reusing, design and consuming for the long term, remanufacturing and refurbishing. (Geissdoerfer et al., 2017)

Such a concept can be a great inspiration when looking for an alternative way to design urban development. A circular approach implemented into the structure of the cities could help in tackling issues like waste production, resource scarcity, greenhouse gas emissions and many more (Williams, 2019). However, most researches on how to realise a circular economy focus on circular business models or product designs along with improvements in the efficiency of the environmental performance of the circular economy *"rather than taking a holistic view on all three dimensions of sustainability"* (Geissdoerfer et al., 2017, p. 765). When working with circularity in cities, it is generally inspired by the circular economy theories. Therefore, one must keep in mind that those conceptualisations are not focused on the cities, nor all three aspects of sustainability, and therefore they have to be re-framed to fit the desired context.

Williams (2019) took a critical approach to the ReSOLVE framework with an urban planning point of view to re-frame the circular economy concept to match the needs and goals of the city. She framed circular resource management in cities through three circular actions and four support actions built on the principal aims to reduce resource consumption along with waste production, preserve natural capital and design out negative externalities. (Williams, 2019)

The three circular actions are Looping actions, Adapt actions and Regeneration of the urban ecosystem and its services. Looping actions aim to close resource loops and thereby reduce the natural resource needs as well as the waste produced. These can be done through recycling, reusing and energy recovery. Adapt actions involve deliberative planning and designing for multiple and adaptable uses of larges structures and infrastructures to simplify their renewal, re-purpose and reuse along with reducing the resource needs of such actions. Regeneration of the urban ecosystem and its services has the goal of essential ecosystem service and natural capital preservation. These can be done by embedding green and blue infrastructure into the urban fabric. (Williams, 2019)

The support actions are: Localisation, substitutions, sharing and optimisations; and can be used to reinforce the circular actions explained above. The localisation of resource consumption reduces the energy and resources needed for transportation. This action is best when balanced with globalisation, meaning, those products, which have energy and resource consumption that is less when produced elsewhere (including transportation), should be imported, and those products, which can be produced locally, should be done so. Furthermore, localising production also localises impact which can encourage pro-environmental behaviour. Therefore localising actions not only supports the reduction of resource consumption but also helps to protect the urban ecosystem. Substituting non-renewable and non-recyclable resource consumption with renewable and recyclable ones supports looping actions by reducing resource consumption and waste production. Another form of circular substitution can be the replacement of resource-based activities with service-based ones. Sharing action also mainly support looping actions as their aim are to increase the use of specific equipment and structures and thereby reducing the need to produce more. Examples of such could be car-sharing, or co-housing. Optimisations are a vital way of supporting a circular transition, as is it eliminating the unnecessary resource consumption without compromising wealth of citizens and efficiency of activities. Furthermore, optimisation most often saves money on the long-run. (Williams, 2019)

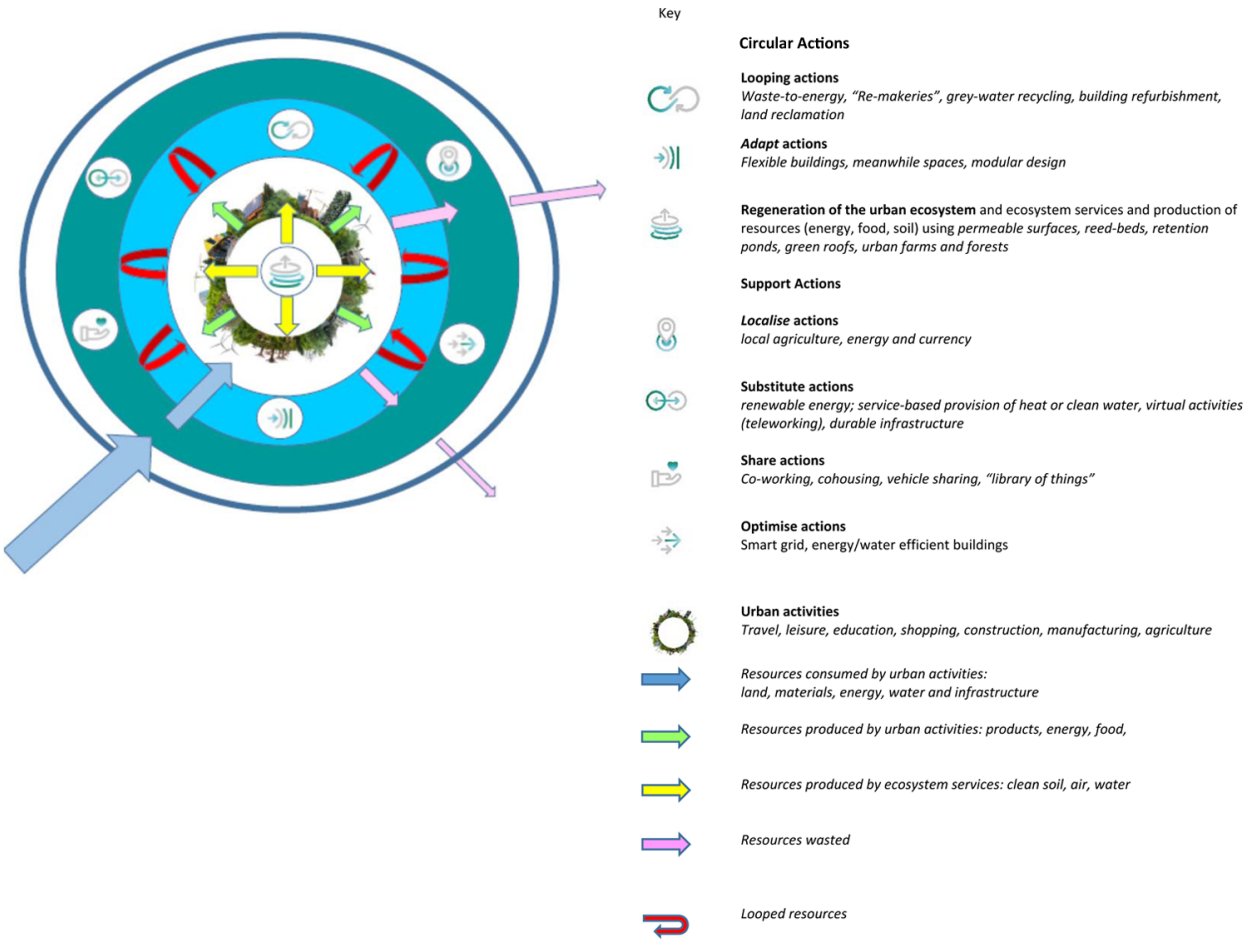

FIGURE 2.2: A circular approach to resource management in cities Williams (2019)

Both the circular and the supporting actions can be used in different combinations with different weightings depending on the city they are applied to. (Williams, 2019) This framework is visible in figure 2.2 and will be used to analyse circular city attributes in this research. Later in the report, it will be referred to as "Williams (2019) circular city framework."

2.1.3 Circular cities as a tool of sustainability

Although often used in the same context, the relationship and the difference between circular cities and sustainable cities seems to be understood in very different ways in cities around Europe (Prendeville, Cherim, and Bocken, 2018). The two concepts have many similarities, such as in both concepts, system design and innovations can be considered as main drivers. Additionally, cooperation between stakeholders and business model innovation are seen as essential. However, there are also very important differences, like the goal they are associated with. In the case of circular cities and circular economy the literature puts a focus on *"eliminating all resource inputs and waste and emission leakages of the system"* (Geissdoerfer et al., 2017, p. 764), whereas, in the case of sustainability, the goals are open-ended with a multitude of goals depending on individual (often powerful) actors' interest. Similarly, their motives also differ. Sustainability is generally motivated by diverse past trajectories and the notion of staying within the planetary boundaries in terms of environmental impact. In contrast, circularity is mainly driven by the notion that resources could be better used in circular rather than linear systems. (Geissdoerfer et al., 2017)

In some cities (for example in Amsterdam) circular economy is a goal alongside a sustainable city, in other cases, it can vary from being a strategic objective to being a niche concept consumed by smart city visions (Prendeville, Cherim, and Bocken, 2018). However, the most common understanding found in the literature reviewed and the way this research understands the relationship between circular cities and sustainable cities is as follows; transforming a city into a circular city and encouraging circular economy in a city are essential tools to reach the vision of a sustainable city yet might not be enough if other tools and approaches do not complement them.

2.2 The circular city

Now that the definitions and the relationship between circular cities and sustainability have been discussed and the goal of achieving circular cities has been argued for, it is legitimate to ask the question: how to get there? This section is presenting and comparing possible scenarios of circular cities as well as the concept of transition with a multi-level perspective (MLP) used in the research to understand how to achieve a circular city, and the role redevelopments can have in the transition.

2.2.1 Circular city scenarios

There have been many scenarios presented by architects, researchers, urban planners and cities' policymakers on how a circular city looks like. Most use the ReSOLVE framework by Ellen MacArthur Foundation (2013) as a starting point, yet still, end up with very different scenarios. An interesting observation made from the literature reviewed is how scenarios either take a technical approach using cutting edge technology to achieve circularity in the city or they take the exact opposite, having a social approach where activist change their behaviour and way of life radically to achieve circularity. Additionally, it was also understood that when the technical approach is taken, it is generally associated with a top-down process, whereas using the social approach is more often a bottom-up process.

For example, Masdar City, a zero-waste, zero-carbon city was developed by Abu Dhabi's renewable energy company. It aims to have the lowest environmental impact without compromising the high quality of life. Resource loops are closed within the city's boundaries, and the city was designed from scratch in the desert, close to the capital. (Marin and De Meulder, 2018) The design focuses on closing resource loops as well as resource efficiency, yet neglecting the interdependencies between resource loops and their hinterlands (Barles, 2010). However, it can

be argued that the occupation of a new piece of land in the desert can hardly be considered sustainable.

A different example could be the case of R.urban, a bottom-up urban resilience strategy originally from France. They are creating *"a network of locally closed ecological cycles linking economy, habitat, mobility, urban agriculture and culture and using land reversibly"* (*About R-urban*, p. 1) in European cities. This example also focuses on closing resource loops within its boundaries; however, their boundaries are more fluid. (Marin and De Meulder, 2018)

These examples take only one approach (technical or social) and therefore, are extreme cases of them. Such extreme cases are generally not as successful as initially hoped as some problems would be easier to solve using the neglected approach and therefore, are not good examples to copy. However, they are very useful in understanding the different scenarios of circularity and the pros and cons of the two different approaches. Meaning, they should be learned from. Moreover, there is also an interesting contrast in their focus. Masdar City puts the focus on maximally 'recycling' materials, whereas R-urban focuses on 'reducing' resource consumption. (Marin and De Meulder, 2018) Although it may seem contradictory at first, combining the two focuses and finding a balance between recycling and reducing consumption may end up with a more stable, future proof circular city.

Another aspect that is often considered when planning circular cities is the inclusion of circular economies. Some authors argue it is: *"evident that a circular city should include more than the sum or multiplication of urban circular economies"* (Marin and De Meulder, 2018, p. 1). Prendeville, Cherim, and Bocken (2018) found that a dual approach has been used by policymakers mixing collaborative public-private partnerships and initiatives with circular economy principle. The reason for the involvement of businesses is to handle the issues with financing circular innovation and therefore, supporting business-led innovation is used as a tool. As a conclusion of their article Prendeville, Cherim, and Bocken (2018) define circular cites as: *"a city that practices CE [circular economy] principles to close resource loops, in partnership with the city's stakeholders (citizens, community, business and knowledge stakeholders), to realise its vision of a future-proof city."*(Prendeville, Cherim, and Bocken, 2018, p. 187)

However, the approach which seems to be the most successful is striving for a multi-dimensional circular city representation. Such projects were found to be most often produced by urban landscape designers who can include input from a several disciplines *"ranging from industrial ecology's material flow analysis over participatory planning's co-creation strategies, political ecology's criticality, and ecological economics' business perspective."* (Marin and De Meulder, 2018, p. 19) Combination of different sustainability framings and collaboration of different disciplines are concluded to be curcial to unlock circularity's complexity. (Marin and De Meulder, 2018)

An example of the inclusion of a variety of disciplines is the Living Breakwaters project, combining risk reduction, ecology and culture. Creating a coastal resiliency infrastructure, in the state of New York after Hurricane Sandy, the project is linking in-water protective structures and on-shore resiliency as well as community engagement. The focus on the process (rather than the outcome) allows design-driven problem-solving, which not only helps communities but also includes them. Moreover, local communities are considered as experts and agents working in the ecosystems which they live in. The holistic approach to circularity allows the project to work with nature's capacities and thereby reduce the resources needed for construction. *"Living Breakwaters embodies a multi-scalar, place-specific, and context-based interpretation of circularity, working with available material and situational assets and resources connecting ecosystems across scales."* (Marin and De Meulder, 2018, p. 13)

Developing circular cities is a new concept with no perfect example to follow or planning process to implement. When implementing new concepts to complex systems testing theories

in practice is essential. Amsterdam's Strategic Advisor for Sustainability, for example, admits the need for space for experimentation to make the city *"future-proof"* (rather than sustainable) (Prendeville, Cherim, and Bocken, 2018). Such space could be, for example, provided by the process of incremental planning and incremental implementation where the projects are broken into phases. If the first phases are monitored by planners to learn from a better understanding of the interacting urban fabric can be gained and used to improve the later phases.

All in all, it is essential to keep in mind that when it comes to cities, consensus exists that place-specificity matters (Coenen, Benneworth, and Truffer, 2012) and this could be the reason for the very different approaches and scenarios for a circular city. Prendeville, Cherim, and Bocken (2018) found that cities in the transition to circular system need *"political leadership, building adaptable future visions, using experimental approaches (...), developing contextual knowledge about resource use, and engaging with diverse stakeholders"* (Prendeville, Cherim, and Bocken, 2018, p. 1). Overall, the literature found in the topic shows that cities can learn from each other's past experiments and planning a transition to a circular city.

2.3 Transitioning into a circular city

To have circular cities, the cities of today have to transform unsustainable infrastructure and change society's behaviour in consumption. Many researchers and theories are working with how cities and their embedded system could be transitioned to the desired state. The transition can happen through a bottom-up, through a top-down process or the complementary of the two. As transitioning to a circular city is a very complex and challenging task, in this research, both types of changes are investigated simultaneously and are considered necessary. Furthermore, the transition can happen through physical change and/or a through the process or system change, both of which is necessary to achieve a circular city as it is such a radical change. This section will explain how the research understands the process of transition and why it is essential to see changes in both the physical structure of the city and in the process that plans it.

The multi-level perspective

The multi-level perspective (MLP) distinguishes three analytical levels that provide different kinds of structuring and coordination of local activities (Geels, 2005). As presented in figure 2.3, the niches make up the regimes and the patchwork of the regimes make up the landscape. The three levels have a nested hierarchy between them, meaning that they are embedded in each other.

The meso-level (landscape) is the rule-set embedded in institutions and infrastructures including a *"complex of engineering practices, production process technologies, product characteristics, skills and procedures, ways of handling relevant artefacts and persons, ways of defining problems"* (Rayner and Malone, 1998, p. 340). In this research, the (to be) circular city, the authorities controlling it and other considerable (global) influences are considered as the landscape. Although this is not the original or the most common way of interpreting the landscape, it is possible to do so as the MLP is a heuristic concept.

The second level, the patchwork of regimes containing the sociotechnical systems include all social groups present in the landscape. The social groups have their own features and autonomy, yet are interacting with each other and, therefore, somewhat interdependent. (Geels, 2005) The level of regimes in this research are the (to be circular) businesses, actions and economies that are found in the city.

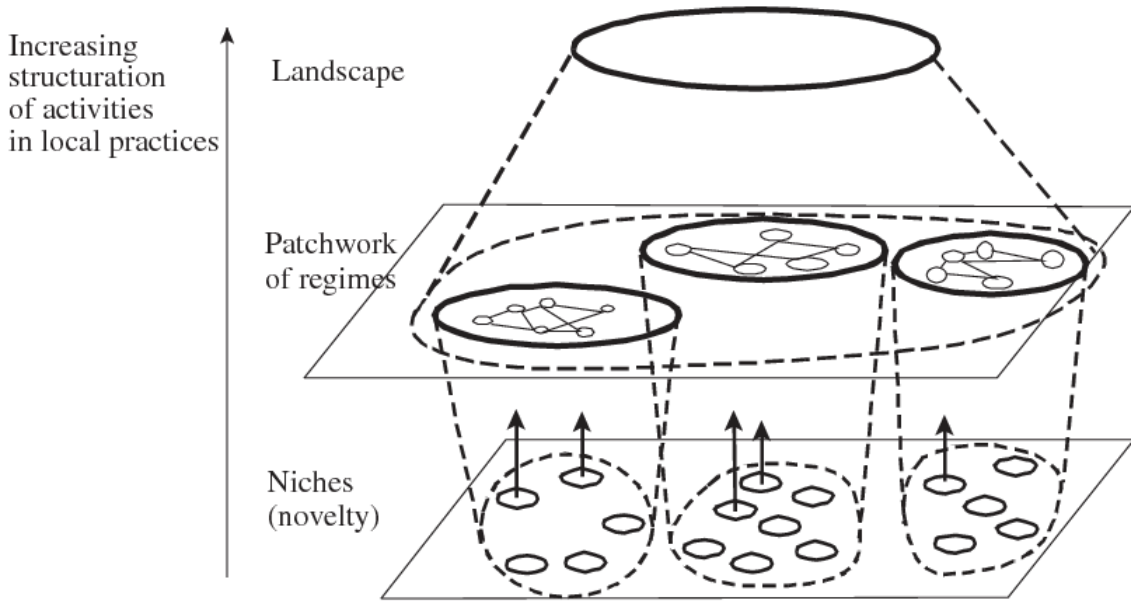

FIGURE 2.3: Multiple levels as a nested hierarchy Geels (2002)

Finally, the third level is the micro-level, formed by niches. This is the level where radical innovation happens, as niches provide protected spaces where innovation can be tested through learning processes. Furthermore, they provide space to develop a social network which can later support innovations. (Geels, 2005) In this research, small circular ideas and individual actions, that are yet to evolve to support the circular city transition, are the niches considered.

Overall, system innovation will be made possible by the interplay of the multiple levels through multiple phases (see figure 2.4). First, novelties appear on the micro-level, in the niches. The actors are still experimenting with their developing design, interacting and occasionally competing with each other. In the second phase, the new idea or design enters small market niches, where it is tested by users and improved by engineers. This learning process involves exploring new functionalities and developing the products own technical trajectory. In the third phase, the novelty has a breakthrough form the niche to the sociotechnical level, entering the mainstream market and thereby a competitive relationship with the regime it entered. The new technology's success not only depends on internal drivers (e.g. actors with interest, performance improvements or price) but also external circumstances, happening at the landscape level (e.g. if there is a need in the new technology, changing user preferences etc.). In the next phase, wider dimensional changes happen on the socio-technical level due to the old regime's replacement by the novelty. Finally, the new regime might end up influencing the landscape. (Geels, 2005)

The reason why MLP works well for transitioning contemporary cities into circular cities is that it does not consider a straightforward cause or driver, but instead considers a process with multiple dimensions. This is important in transitioning to circular cities as it is the holistic, transdisciplinary approach that is the most successful.

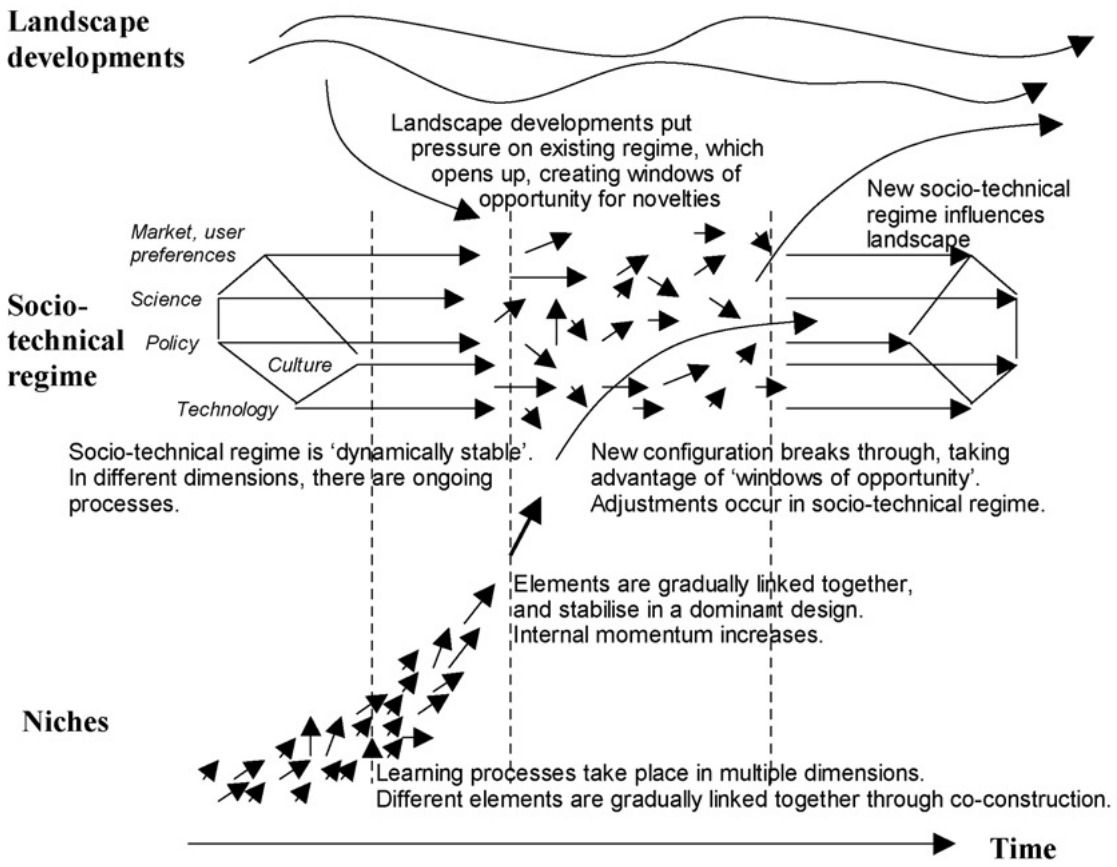

FIGURE 2.4: A dynamic multi-level perspective on system innovations Geels (2002)

Bottom-up change includes social innovation and movements such as communities, businesses NGOs and entrepreneurial activities (Krauz, 2016) (Pomponi and Moncaster, 2017). In the MLP model, bottom-up initiatives can be considered niches that find their way up to the regime.

Top-down change is institution-driven development or if looking at it in an MLP context, a change initiated by the landscape. In the case of cities, the institutions are municipalities, and local governments and their top-down actions can vary between action like new policies and public-private partnership projects. (Krausmann et al., 2009) (Pomponi and Moncaster, 2017) However, people working on the macro-level can increase the efficiency of the transition by reaching out to those inspired and motivated to start a niche and help them overcome some obstacles to elevate to the regime level.

Physical transition

Physical change is essential in the process of transition into a circular city because circularity often needs physical structures to close the resource loops. For example, rainwater can not be reused if there is no (separate) system to collect it, and there is no point of collecting organic waste separately if the is no place to compost it. Furthermore, certain physical spaces, such as community areas, are necessary for some niches to develop and some behavioural change to happen.

If the city is understood as a jigsaw of developments, then redevelopments can be explained as switching a piece of the jigsaw into a better piece that still fits the big picture. If redevelopments are replacements in the city that accommodate more circular actions, then step by step, a physical transition can happen. Therefore, redevelopments are a great tool to transition the urban fabric into one that is more accommodating for circular systems. Additionally, redevelopments have a potential to elevate novelties from niches to the level of regimes as redevelopments are interlinked

with the existing urban fabric, yet provide an opportunity for new implementations on a larger scale.

It is due to such potential in redevelopments that this research is the focus on how they could serve the transition.

Transition in the planning process

When planning for transition, it needs to be questioned whether the current planning process creates obstacles for the transition and if it suits the system aimed for needs to be considered. When aiming for such a complex, radical and long term transition as a circular city, the planning process needs to have the flexibility of changing as the city changes.

One way of implementing flexibility into planning is by conceptualising it as a system of roles, thereby shifting the focus to a dynamic process in interacting characters. This way, roles in transition can be examined besides transition roles. Meaning instead of only looking at roles that contribute to (or prevent) transitions, the process of changes also relies on possible necessary changes in the roles themselves. Overall, transition in planning includes flexibility in the existing roles and rethinking the relations between them. (Lamker, 2019)

Transitions are non-linear processes combining experimenting, learning, searching and adjusting and can need different institutional innovations to move forward in different phases. Seeing roles as temporary stabilisations, can help to deal with multiple uncertainties at the same time as temporality can provide a platform and means for improvisation. Although improvisation is not a planning approach, it is an essential part of planning that makes it more flexible. (Lamker, 2019)

To be able to challenge established concepts like the growth-orientation of planning, interrelated, dynamic and critical alternatives are essential. The transformation has the potential to achieve large system changes, and planning in transition should also change with the system to be able to keep its ability of fulfilling its goal. Using transition in planning within the process of planning can not only prepare the institutions to govern the changed system in the transformed city but also react flexibly in the different stages of the process of transformation. (Lamker, 2019)

2.4 Why should cities be circular, how can circularity be planned for, and how can the transition happen through redevelopments?

This section is summarising the findings of the literature review and answering sub-question 1: *Why should cities be circular, how can circularity be planned for and how can the transition happen through redevelopments?* The question is broken into three parts with separate answers.

Cities should be circular

Cities are currently significantly contributing to the climate crisis and are at least as much threatened by it. The cities and economies around the world need to shift to a sustainable system, in which their environmental impact does not risk the Earth's balance while still provides the needs to all. To achieve sustainability and reduce dependence on resource scarcity, higher resource efficiency is needed. Even though sustainability needs different means and a variety of strategies in cities around the world, implementing circularity and thereby reducing resource needs, waste production and emission is a necessary step everywhere. However, it is important to recognise that circularity in the different cities may take different forms. Moreover, it is necessary but not sufficient in order to achieve sustainability.

Planning for a circular city.

To plan for a circular city, it is important to understand what a circular city is. Circular cities have been defined in many different ways by different authors. Most mention the necessity of system supporting actions, such as maintenance, recycling, repairing, reusing, designing for long term use, etc. To make sure all aspects are considered, a holistic and relevant framework was chosen. Although more researchers use the ReSOLVE framework, it is created for circular economies and does not consider many aspects important to cities. The Williams (2019) circular city framework was adapted from the Ellen MacArthur Foundation (2013) ReSOLVE framework and is presented in figure 2.2.

The next step in planning for a circular city is the investigation of the circular actions aiming for a transition on each level of the MLP. Gaining an understanding of the current situation is essential as this is the information that can show the planners what is being done for the transition to happen and what areas need more/different attention. This research uses the Williams (2019) framework to analyse the projects and circularity of the investigated city. This is done in the empirical research phase. The method is described in section 3.2 and it is findings are presented in chapter 4.

Finally, when planning for a circular city, it is found to be important to learn from the lessons learned in other circular cities and to follow the guidelines collected. This literature review recognises the following guidelines:

- **Gathering data on the city:** Understanding the processes happening in the city can help in understanding the biggest problems and help choose the best solutions as the planners will have a better knowledge on the processes and interdependencies within the city.
- **Considering the existing urban fabric:** Circular cities must be implemented in cites that are existing. A circular city which is detached from the existing urban fabric (like Masdar City) might relieve the planners from restrictions of the existing, yet it wastes untouched land and resources, which is against the circular principles.
- **Finding a balance between technical and social solutions:** Choosing one or the other can end up in extreme cases, whereas balancing the two types of solutions can result with an end product that is not only easier to realise, but the circular system will be less dependant on single resource types (e.g. money or willingness of activists).
- **Including circular economies:** Partnership with private actors can help stimulate and finance circular innovation. It is also a more inclusive planning approach in which the power of the different stakeholders can also be used for the common good.
- **Taking a holistic and multi-dimensional approach:** Due to the interdependencies in the complex system of resource flows in a city, focusing on one element will most probably not give the best solution. Therefore, it is important that the design method is holistic and includes many relevant disciplines.
- **Including local communities:** A change in consumer behaviour is also needed and achieving such is most effective when local communities are also involved as (learning from Living Breakwaters) they are experts of the ecosystem the inhibit. Furthermore, this way, positive niches can be recognised and empowered to help the transition.
- **Space for experiments:** As cities are very complex, there is no guarantee that a project will be successful before it is implemented. Providing spaces for experiments can limit the risk of spending resources on unsuccessful projects.

Transition to a circular city

The process of transition is understood through the multi-level perspective, as it gives a holistic view, considering the process of transition as a never-ending dynamic phenomenon. There are two aspect pair of transition considered. One is the complementary interplay between bottom-up and top-down initiatives to motivate the transition on the regime level from both directions. The other pair is the combined need of physical transition as well as a change in the planning process to adapt the city's material and governing structure into one that not only accommodates but also encourages the circular and sustainable elements.

All in all, the circular city concept aims to improve resource efficiency and therefore is a necessary but not sufficient tool to achieve sustainability. Different cities have different resource flows. Therefore circularity can take various forms. To investigate the circularity in Aalborg and the process of transitioning to it, a multi-level perspective is used. Experts working on each level were interviewed in the empirical research phase to gain insight on how the circular actions are present on the different levels. The perspective is also used to analyse the empirical data, to understand how circularity is present in the different levels of the city and the complexity of the transition. The Williams (2019) framework is used to analyse the circular actions found through the empirical data collection and see which aspects are missing from the city's strategy. The guidelines collected are to investigate whether the planning process is contributing to the transition or not. Before the analyse and the findings of the empirical data is presented in chapters 5 and 6, the methods of data collection are explained in chapter 3.

Chapter 3
Methodology

This chapter presents the methods used for data collection in the empirical research phase. The methods are document analysis and interviews. Each method is explained and reasoned.

3.1 Document analysis

Document analysis was used for three main reasons. First, to gain a general knowledge of Aalborg to be able to present the city. Second, to find out which interviewees to contact and what to ask them to gain the most and relevant knowledge in the given time. Finally, it was used to back up the data collected from the interviews and increase the precision of the data presented in the analyse (chapter 4) and the discussion (chapter 5).

When answering the second sub-question, the Sustainability Strategy was the primary document used, alongside the website of Aalborg Municipality and the SDG mapping (see Appendix K). Other relevant websites and videos complemented this. When answering the third sub-question, the local plans of the two redevelopments were mostly used alongside the website of the Municipality. As most of the documents are only in Danish, to comprehend them, Google translate was used.

3.2 Interviews

There are some connections that can not be found solely relying on reading documents. Therefore, qualitative semi-structured interviews have been conducted to gain insight into the system behind the analysed documents. To understand the behaviour, the actions and the situation, using unstructured interviewing is particularly useful (Bryman, 2012). As the process of transition is understood through the multi-level perspective, interviewees were chosen from each level, to ask how they work for the transition and what obstacles they are dealing with. Furthermore, interviewees were also chosen to get a better understanding of the two redevelopments investigated in sub-question 3.

NAME	DATE	APPENDIX
Kolbrún Gunnarsdóttir	17.04.2020	Guidelines: A Transcription: B
Sebastien Pedersen Bouchara	21.04.2020	Guidelines: C Transcription: D
Anders Du Mont-Thygesen	14.05.2020	Guidelines: I Transcription: J
Anne Juel Andersen	07.05.2020	Guidelines: G Transcription: H
Thomas Birket-Smith	04.05.2020	Guidelines: E Transcription: F

TABLE 3.1: Date of interviews and where to find them in the Appendix

As the research was conducted during a pandemic (COVID-19), all interviews were conducted through an online platform for safety reasons. All interviewees were asked if it is okay to record the interview, if it is okay to make the information public which they share, and if its okay to

use their names in the report. They all agreed to all three questions. The recordings were transcribed to make sure that the information gathered is accurate and not distorted by the memory of the researcher. Table 3.1 summarises the date and goal of the interviews with the name of the interviewees.

The interviewee representing the niche level was Kolbrún Gunnarsdóttir, who is an environmental and animal rights activist. She is practising a vegan, low-waste lifestyle in Aalborg and has her motivation from the idea of leaving this place in a better way than she arrived. Her insights are not only useful because due to her mindset she has a clear understanding on what an individual can do to live a sustainable life in Aalborg, but also because she is striving to be part of the transition to a sustainable city through working on opening Aalborg's first zero-waste vegan food-trailer. Furthermore, she does her best to inspire others to follow her actions through online influencing and participates in different demonstrations. The interview with her happened on the 17th of April, through Skype. The guidelines prepared for the interview can be found in Appendix A, and the transcription can be found in Appendix B.

The regime level was represented by Sebastien Pedersen Bouchara, who is the Project manager for Circular North Jutland in Network for Sustainable Business Development Northern Denmark. His (and the network's) role in the circular transition *"...is to help the cooperation between the municipality and the projects to work closer together..."* (02:07, Appendix D). Moreover, he helps companies to find their own way to be sustainable. His answers provided useful insights on how companies and municipalities work together to achieve a circular region. The interview happened on the 21st of April, through Skype. The guidelines made for the interview can be found in Appendix C, and the transcription can be found in Appendix D.

To gain insight into the landscape and the Municipality's approach to the circular transition, Anders Du Mont-Thygesen was interviewed. He has been working with sustainability in the Municipality for the last decade. Initially working on international sustainability, he later on joined the Centre for Green transition when it was established in 2013. He has experience with the creation of the Sustainability Strategy and was one of the inventors of the Sustainability Festival. His answers are knowledgeable and provided insight on the Municipality's strategies and actions taken to transition Aalborg into a sustainable city. The interview happened on the 14th of May, through Microsoft Teams. The guidelines made for the interview can be found in Appendix I and the transcription can be found in Appendix J.

To answer sub-question 3, two planners from the Municipality were interviewed, one working on each project. The redevelopments are considered to be platforms for the interaction of the different levels. Overall, the change is seen to be made on the regime level by the actors of the landscape and the regime. Thomas Birket-Smith is a planner currently working on the Spritten redevelopment and has more than a decade experience of working on the harbourfront of Aalborg. His answers helped to gain a deeper understanding of the concept of Spritten redevelopment as well as its potential and current contribution to the circular transition. The interview happened on the 4th of May, through Skype for Business. The guidelines made for the interview can be found in Appendix E, and the transcription can be found in Appendix F. To collect data about the Karolinelund redevelopment, Anne Juel Andersen was interviewed. She is currently working on the reopening of the Østerå stream which is to run through Karolinelund and will give the park a whole new look. Her answers gave insight into the concept, drivers and possible impacts of the opening of the stream and the Karolinelund redevelopment as well as how it contributes to the circular transition. The interview happened on the 7th of May, through Skype for Business. The guidelines made for the interview can be found in Appendix G, and the transcription can be found in Appendix H.

NAME	ROLE	FOR	DATA COLLECTED
Kolbrún Gunnarsdóttir	Environmental and animal rights activist living in Aalborg, who is working on opening the first zero-waste vegan food-trailer in the city	Niche Level	An understanding of how a sustainable lifestyle looks like in Aalborg, what are the biggest difficulties, what possibilities the city provides and what is missed.
Sebastien Pedersen Bouchara	Project Manager for Circular North Jutland in the Network for Sustainable Business Development Northern Denmark	Regime Level	An understanding of the role of the Network for Sustainable Business Development Northern Denmark in the circular transition, what ongoing projects there are to improve the circularity of the city (and region) and what the circular region cooperation consists of.
Anders Du Mont-Thygesen	Project Manager at Aalborg municipality in the department of Center for Green Restructuring, inventor of the Sustainability Festival, currently working on the new Sustainability Strategy of Aalborg.	Landscape	An understanding of Aalborg's sustainability strategies and the steps taken for a circular transition.
Anne Juel Andersen	Planner from Aalborg municipality working on the opening of Østerå stream	The interactions of the levels in Karolinelund redevelopment	An understanding of the Karolinelund redevelopment and the role of the Østerå stream with the potentials of the redevelopment to contribute to the circular transition.
Thomas Birket-Smith	Planner from Aalborg municipality working on Spritten redevelopment and expert in waterfront redevelopment of Aalborg	The interactions of the levels in Spritten redevelopment	An understanding of the Spritten redevelopment in general and potentials of the project to contribute to the circular transition.

TABLE 3.2: Summary of goal of interviews

By conducting interviews with experts participating in the work to achieve the transition and planners directly involved in the projects investigated in sub-question 3, it was possible to gather relevant and updated information of the processes and drivers. The interviews were the primary method for the qualitative data collection conducted and the expertise of the interviewees ensure the reliability and validity of the data collected. The information gathered was analysed in accordance with the theoretical frame established in chapter 2 in order to generate knowledge and answer sub-questions 2 and 3.

Chapter 4
Circularity in Aalborg

This chapter presents a general picture of Aalborg and then analyses the actions taken for a circular transition on each level of the MLP. Finally, the chapter answers the second sub-question: *How is circularity present in Aalborg on the different levels of a multi-level perspective and what is needed to further increase the circularity?*

4.1 The city of Aalborg

Aalborg is the third-largest city in Denmark after Copenhagen and Aarhus and is located in Jutland, Aalborg municipality. The population of the city is a little over 200 000 and is found to be the happiest city in Europe. Due to its location beside the Limfjord, it has a robust industrial harbour heritage. However in the past decades, the city's image has transformed to a modern smart city mainly due to the waterfront redevelopments. Another driver of the transition was Aalborg University attracting over 21 000 students to the city of which little under 4000 are internationals. The city accommodates cycling very well and also has an airport. (Aalborg Kommune, 2015)

In terms of sustainable and circular transition, several steps were made in the city to take action. Released in 1994, the Aalborg Charter was the most comprehensive document in Europe on sustainability followed by the Aalborg Commitments in 2004 which contains a list of commitments that the city has agreed to fulfil (Aalborg Kommune, 2016b). *"Aalborg is home to several smart energy clusters where companies, world class researchers and local authorities work together in developing the smart energy solutions of the future."* (Aalborg Kommune, 2015, p. 14) The Municipality has a Department of Environment and Energy which, handles waste recycling, climate and wastewater among other areas that have a potential role in a circular transition. This department also has a Centre for Green Transition which has three main focuses; the Green Agent project, developing the Municipality's Sustainability Strategy and organising the annual Sustainability Festival (Aalborg Kommune, 2020a) (Aalborg Kommune, 2016b).

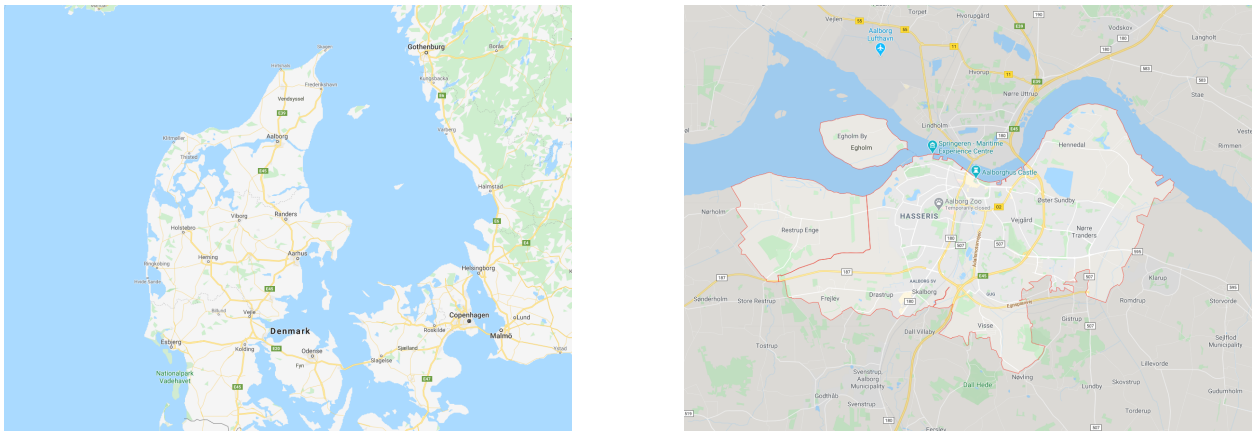

FIGURE 4.1: Aalborg on different maps. The first map shows where Aalborg can be found within Denmark; the second map shows the city of Aalborg. The images are from (Google, 2020)

4.2 Circular niches in Aalborg

In this research, niches are considered to be small initiatives, actions and behavioural changes which are often promoted by environmental activists and can contribute to the circularity of Aalborg if made popular in the city. To learn what these are in the researched area, an environmental and animal rights activist, Kolbrún Gunnarsdóttir was interviewed. The information gathered is analysed and organised according to the Williams (2019) circular city framework.

4.2.1 Circular Actions

In the Williams (2019) circular city framework presented in chapter 2 the group of circular actions contain three actions which make circularity possible in a city. These are looping actions which focus on closing (currently liner) resource flows, adapt actions which aim to make the urban fabric more flexible for reuse and multiple purposes and finally regenerative actions for the urban ecosystem which not only aim to provide a space for wildlife and biodiversity in the city but also to replace man-made systems by natural systems (for example rainwater handling).

Looping actions in Aalborg

An emerging behaviour found which is necessary to carry out large scale looping actions in the city is sorted trash collection. It has been introduced to for the citizens by the Municipality. This not only makes the life of those who were already sorting trash significantly easier but also simplifies the task for those who did not have the time or opportunity to sort it earlier. (Appendix B) (Appendix K) This change is happening on such a large scale that it has aspects on all levels of the MLP. The aspects relevant to the regime level are described in section 4.3, and the aspects relevant to the landscape are elaborated on in section 4.4.

Another, looping action happening on the niche level is the work of second-hand shops (Appendix B). Extending the period that products are used, reduces the demand for new products and thereby reduces the resources needed to make those new products. This action is often used to 'boy-cot' fast-fashion and fast-furniture companies which are extremely harmful industries. (Inc., 2017) In the city there are many second-hand shops present, but applications are also available to switch clothing between citizens or sell used items. (Appendix B)

In some cases, it is more sustainable to eliminate a product from the system, rather than loop it. Such products are, for example, single-use packages which in most cases of low-wasters are especially focused on to be eliminated. There are also zero-wasters who aim to eliminate all waste production from their household. (Appendix B)

Adapt actions in Aalborg

There were no adapt actions found on the niche level. This is possible because adapt actions are about creating flexibility in the urban fabric to be less dependant on outdated infrastructures. Generally, the niches do not have the power to make such change or such actions therefore, the fact that there were non found on this level of the MLP is not surprising, but an important recognition.

Regenerative actions for the urban eco-system in Aalborg

Although, initially starting as an ethical and anti-spaciest movement, veganism (or just the reductions of the consumption of animal products) as an emerging niche has a genuine potential for helping circular transitions. There are many farmlands dedicated to growing crops to provide food for farm animals. Overall, there is not enough land to feed enough animals if the whole human population (which is still increasing) would decide to or would be able to afford to live off

of animal products. Currently, there are vast areas of lands taken constantly away from forests and wilderness to be dedicated to feeding animals on industrial animal farms. Furthermore, the production of animal products require a significant amount of freshwater and produce a lot of CO_2. By promoting a plant-based (or a more plant-based) diet, a reduction in animal product consumption can be expected, which consequently reduces the number of animals kept and the farmland needed of their feeding. Thereby, veganism on a large scale can contribute to the regeneration of wildland and forests in the countryside, even if it is not necessarily a local influence. (Andersen, 2014) This corresponds to the idea that circular cities should be regenerative by design.

In Aalborg, besides diet change of a few citizens, vegan and vegan-friendly restaurants started to open and plant-based substitutions of animal products appear in the stores (for example plant-based milk and cheese) (Appendix B). Furthermore, the Environment and Energy department in the municipality introduced meat-free Mondays which, according to their calculations, saves yearly over 15 tonnes of CO_2. Recognising the significance of such small action they have created a blog on grontaalborg.dk (Green Aalborg) website which contains tips and guides on how canteens and home kitchens can reduce their environmental impact. (Aalborg Kommune, 2020c) Here it is important to mention that cutting meat consumption is not sufficient as the meat and the dairy industry are so interlinked (Appendix B).

A different approach to changing the meat industry has been presented in Hasseri's Medows, where the farmer makes his cows available to citizens to take care of. This supports interaction with nature, local meat consumption as well as an organic and a more humane meat-production. (Aalborg Kommune, 2020c) However, it is still meat production which still has both environmental and ethical concerns. Furthermore, this can not be a sole solution to the issues of the meat industry, as there would not be enough land to raise as many animals which could fulfil the current demand for meat (Andersen, 2014). Still, this initiative is providing a more sustainable option for those who can not give up the consumption of animal products.

Although the reduction of meat consumption is off to a great start, there is still a long way to go as the consumption of animal products is deeply embedded in western culture. Furthermore, the there are activists in Aalborg, like Kolbrún, who is happy to work on sustainable projects, such as her vegan zero-waste food-trailer, yet is continuously held back by the obstacles created by the rules and legislation in the Municipality (Appendix B).

Another regenerative niche that is emerging in Aalborg is urban gardening. In some cases, this takes form in a back yard which is made possible by the density of Aalborg (Appendix B), and in some cases, it is in the form of community gardening (see more in section 5.1). Although, there seems to be an overlap between those who compost at home, have a plant-based diet and do some sort of gardening in the city, this is not a proven connection from the data collected. Gardens in the city are important because they often reuse organic waste and rainwater and are regenerative green patches in the urban fabric which boosts biodiversity. However, keeping up such niches might be more difficult if Aalborg keeps on increasing in density in the current state. Possible solutions could be roof-top gardens, which are slowly emerging in the city (for example on the Salling rooftop) and vertical farms.

4.2.2 Support Actions

In the Williams (2019) circular city framework, support actions are the ones that increase the efficiency of the circular actions. They are the following: Localisation of consumption to support local production and reduce the dependency of the unnecessary part of worldwide shipping. Substitution of unsustainable systems to sustainable alternatives (e.g renewable) in order to reduce the environmental impact of essential systems. Introducing shared economies to reduce consumption and increase the utilisation rate of the products or places. The final support action is optimisation,

which also increases utility as well as eliminates the leaks in the circularity of the resource flows and the city.

Localisation

Farmers' market is a popular example of a niche promoting localisation in the city. They are held a few times in the week around the city and allow local farmers to sell their locally produced products. This is positive, as these purchases do not promote shipping products across continents to be sold. However, there are many products on these markets too which are clearly not locally produced, for example, the tropical fruits. (Johansen, 2019b) Furthermore, the idea of 'soil to table' food consumption is promoted by the Municipality helping local productions to be consumed locally (Appendix K).

Substitutions

On the niche level, it is the zero-waste and the quality over quantity mindsets that can help households make substitutions that promote a circular transition. Such substitutions can be mainly done by using tools and accessories that are reusable rather than single-use. Another substitution citizens have the opportunity to take is switching to renewable energy suppliers. These substitutions often come with some sort of minor inconveniences (e.g. remembering to take the bag with you) but are also more affordable in the long run. (Johansen, 2020)

Sharing

Bike renting is made possible by the Donkey Republic in Aalborg, and thereby their service promotes bike-sharing (Donkey Republic, 2020). This can be considered a circular niche because there are many people (students) who move to the city for only a few years and would need a bike for only this period of time. Moreover, their bikes would not be used all the time. Bike-sharing allows people to use bikes without owning one and thereby, reduces the need for consumption while optimises the use of each vehicle.

Optimisations

Although it is not a niche that can efficiently grow into a regime, activists often do dumpster-diving to reduce food waste of big groceries stores. Unfortunately in Denmark supermarkets are motivated to throw out the unsold food rather than give it away to the poor by the law, as they would need to pay taxes on the food they would give to charity. This is one of the reasons why their trash bins are filled daily will food that is still edible. (Appendix B) Although dumpster-diving can not solve the problem, it does reduce the food waste and therefore can be considered as optimisation in the city.

Some citizens are optimising the resource consumption by fixing, recycling, upcycling and 'DIY'-ing old things at home. For example Kolbrún in creating a greenhouse in her garden made from old windows (Appendix B). Such projects are a great way of recycling and could be shared to serve as inspiration for others.

Overall, the findings show the presence and the efforts for the transition on the niche level on almost every category. This can be a reason for optimism as it shows that the citizens of Aalborg are creative enough to find a wide range of ways to improve their sustainability. The next step could be to distribute the knowledge and motivate behavioural change on a larger scale in the community, which is worked on by the Green Agent (see section 4.4).

4.3 Circularity on a regime level

In this research, the regime level consists of large groups, collective actions, values and attitudes present in the city, which have a big influence on the systems in the city. Large companies, significant communities and widely practised ways of thinking can be all part of the regimes if they have a recognisable influence on the systems and processes of the city.

In terms of circularity, the Network for Sustainable Business Development Northern Denmark (NBE) is a significant actor working on the regime level and its connections to the landscape to achieve a societal structure where sustainability pays off. The network is a public-private collaboration, having 11 municipalities and more than 130 companies as members. It not only brings together the private and the public sectors to work together, but also helps members to get new ideas on how and what they can change to take responsibility and decrease their environmental impact. One of their biggest ongoing projects on the regime level is the Circular Region of Northern Denmark which involves many municipalities (as well as Aalborg) and private companies. (Appendix D)

Although today it is a private organisation, the NBE was originally initiated partly by Aalborg Municipality. In the Municipality it is the Environment and Energy Department's task to check up on businesses whether they are following the rules and regulations. Such checkups provide enough useful information about how these companies run to invite them into the Network of Sustainable Business Development where the rest of the network can come in and create a sustainable screening of the new companies. This process can help the companies to recognise where they can save energy and how they can do better in terms of sustainability. Then the network can help to make the next steps and substitutions. (Appendix J)

The reason the project not only focuses on Aalborg is that the cities in Northern Denmark are relatively small (Appendix D). The whole region's population is around 600 000 people (Radboud University, 2018). Taking the whole region into consideration does not only have an impact on a bigger area but also ensures the network to have access to enough resources and companies participating. Furthermore, the region is already working together in many ways, so the good communication and relationship between the municipalities have been already established. (Appendix D)

The Circular Region project mainly focuses on implementing looping action and optimising them. More specifically, the goal is to *"...redirect the flow of materials away from incineration and towards reuse. (...) So, we get less materials incinerated, and a higher per cent reused."* (01:52, Appendix D). This is done through smaller projects which are more focused on the recycling of specific materials and through the sharing of ideas implemented in the different companies and different municipalities. The latter is essential because raising awareness that certain circular actions are taken in a similar environment simplifies the process to implement that circular action elsewhere. (Appendix D) (Appendix K)

One of the efforts considered successful by experts and made with the goal of closing resource loops is Reno-Nord's work. The company has machines that separate the selectively collected post-consumer plastic waste even further and makes it possible to sell the used plastic as a resource. Recently the company has also found a way to handle soft plastics, so the company has a high impact on the plastic industry in the region. *"...the next step for Reno-Nord is to see if we can downsize some of these big chunks of plastic so their machine can handle it."* (13:50, Appendix D) This would make it possible to also take left-over plastic from the recycling stations which at the moment is sold to Germany and the Netherlands as stations that can handle big chunks of plastic is unprecedented in Denmark so far (Appendix D). Although the effort was made in establishing a system to recycle plastic is a success, here it is important to mention that plastic can be only recycled 1-3 times and new plastic has to be added to it because it otherwise degrades in quality (Johansen, 2019a). This means the creation of a product from recycled plastic also creates

a demand for the creation of new plastic and therefore in the case of plastic, recycling can not be the only and a long term solution. Efforts need to be made to reduce the demand, production and consumption of plastic.

Another example of looping resource flows in the region is the collection and handling of organic waste. However, not all municipalities implemented this action yet, and unfortunately, Aalborg Municipality is not one of them either (Appendix D). Therefore, at the moment, organic waste is only recycled in home composts by very few citizens in the city (Appendix B). On the other hand, regulations by the EU require the establishment of systems that collect organic waste separately and recycles it, so this linearity in the system is soon to be handled (Appendix D). Furthermore, work is being done by the NBE on the establishment of biogas plants, marketing of animal manure for biogas plants as well as the establishment of solar cells and energy savings (Appendix K).

Steps were taken to optimise the existing circular systems increase the amount of waste entering the looped resource flows. To do this, NBE works closely together with the waste managing and recycling stations. For example, motivating the waste managing stations to collect the different types of waste in a similar way can simplify the sorting task in the kitchen and thereby motivates the citizens to sort their trash allowing more waste to be recycled. (Appendix D)

In order to rely on recent and locally conducted research, there is a collaboration with Aalborg University (AAU) and UCN. These collaborations provide data and knowledge about the systems, resource flows and other relevant aspects of the city for the companies to help them make decisions and implement sustainable changes successfully. To enhance this form of collaboration, NBE participates in the mega-projects of AAU, but this strategy still needs some perfecting to gain sufficient knowledge which the network and its members can actually rely on. (Appendix D)

A big challenge of circularity on the regime level is that waste form companies is privatised. This complicates the waste managing system and can prevent waste from companies to be handled by the Municipality's waste managing station even if they would have the capacity to handle it. Although there are currently small changes made to this system, it will be an obstacle until the problem is resolved. (Appendix D)

Overall, there are very important initiatives and changes found to be happening on the regime level. It is interesting how this level is mainly focusing on circular economy and resource flow looping, which in itself is not sufficient as concluded in chapter 2, yet is a crucial part of the transition. Furthermore, this level clearly presents the importance of partnerships in the transition to both circularity and sustainability. Finally, the motivation of working towards a societal and market structure where sustainability pays off is very positive, as well as the hope of reaching *"the point where you can do a very good business and make a lot of money without it have to be damaging to the environment."* (26:30, Appendix D) However, there are concerns whether, sustainability is enough if there is a limit to capitalisation without harming the environment. (Appendix D)

4.4 Circular actions made by the landscape

In this research, the landscape consists of all 'higher power' influences on the city of Aalborg that governs the socio-economic as well as the physical structures of the city. The most direct influence is practised by Aalborg Municipality; therefore, this is the actor which was most closely investigated, but national authorities, EU regulations, the UN and their SDGs are also influencing on this level of the MLP.

Since 2013, in the Environment and Energy department of Aalborg Municipality has a Center for Green Transition which has the main focus of sustainability through projects working with citizen participation, partnership with local companies and knowledge institutions. Their main projects are the Sustainability Strategy, Network for Green Retail, the Green agent, the Sustainability Festival, introducing a sorted waste system and circular substitutions. (Aalborg Kommune, 2020a) (Appendix J) This section aim's to collect those actions which are circular or contribute to a circular transition.

Sustainability Strategies

One of the documents done by the Centre for Green Transition is Aalborg's Sustainability Strategy 2016-20. It is created through the *"consultation with citizens, associations, companies, and educational institutions"* and includes *"visions, strategies and objectives that promote an environmental and sustainable green transition for the benefit of local citizens, business, and the environment."* (Aalborg Kommune, 2020a) The goal of the document is to create a holistic strategy to transition the city towards sustainability using the UN SDGs. (Appendix J) It sets a framework to the Municipality's planning strategies in environmental and nature areas with both short and long term visions. The Sustainability Strategy has 88 focus areas of visions. The Sustainability Plan 2017-20 was created, which focuses on the actions needed to achieve these visions. (Aalborg Kommune, 2020f)

Recently the Municipality has carried out a study on how well the transition is doing in the city by mapping the fulfilment of the 17 SDGs (see report in Appendix K). The knowledge from the study was used to figure out which goals need further action and which partners need to be engaged. These actors were then engaged to have a discussion on *"what are their thoughts on our* [Aalborg Municipality's] *initial strategies, visions and points in the strategy and how do we mould them into something we can help each other with."* (09:39, Appendix J) Furthermore, a Council for Sustainable Development was created, consisting of actors representing the different parts of the society (NGOs, youth organisations, Aalborg University, ect.). The creation of the council shifts the enforcement of sustainable actions from a top-down initiative into a bottom-up initiative which is empowered by the Municipality. (Appendix J)

All the inputs collected through these actions now serve as a foundation for a revised version of the Sustainability Strategy, which is to refocus the efforts and keep the relevance of the Strategy. Interestingly the Strategy does not focus on all SDGs. The UN goals are divided up to three main groups by the Strategy, of which one is called the 'Planetary Goals'. This group is considered the most important as unless these goals are achieved, humanity puts such a burden on the planet that irreversibly results in catastrophe, and the rest of the goals (e.g. the 'Social Goals') will not matter any more. The 'Planetary Goals' are goals: 6. Clean water and sanitation, 7. Affordable and clean energy, 12. Responsible consumption and production, 13. Climate action, 14. Life below water and 15. Life on land, with the addition of 17. Partnerships for the goals, which is an essential part of the Strategy in the shift it from a municipal strategy, to a social strategy. The rest of the goals are based in different departments of the Municipality. Overall, the concept is that the Sustainability Strategy is the core of the sustainable transition in Aalborg and all the other strategies feed into it. (Appendix J) (United Nations, 2015)

To carry out and measure the success of the new Sustainability Strategy, the same process is planned as done for the strategy's first version. The other six departments will have to make an action plan on how they plan to handle their part of the transition. During the period the strategy is set, the departments report back to the Centre for Green Transition on how far they are. This way, modifications and actions can be taken in time if something is behind schedule on the action plan. (Appendix J)

Network for Green Retail

The Network for Green Retail is targeting stores who want to start to or further develop their level of sustainability. This network helps retail shops to reduce their energy and resource consumption as well as to implement the SDGs. This can happen through presenting sustainable alternatives, but also by connecting the stores to people or companies who can help them in a more specific way to their case. (Appendix J)

Green Agent

The Green Agent is a role in the Municipality which aims to help citizens to change their lifestyle and to implement a sustainable project which leads to a green change. It goes under the motto 'it must be easy to be green in Aalborg' (Aalborg Kommune, 2020e). The help provided can include contact to partners, recruitment of volunteers, help in applications for funds, counselling in project development, among other services. (Aalborg Kommune, 2020b) In a way, the Green Agents are to connect the sustainable citizen-driven projects with knowledge and contacts they need to be (more) successful (Aalborg Kommune, 2020e). (Appendix J) (Appendix K)

The Green agent also has the role of educating citizens on how to be more sustainable. One example of such education is the Green family activities, which are organised weekly with a topic chosen from 20 green activities each week. The 20 collected activities are based on an everyday task like garbage sorting, how to avoid food waste and reducing energy consumption in various ways, but sometimes also contain some more advanced activities like composting, rainwater harvesting and the creation of an edible garden. (Aalborg Kommune, 2020c) Another form of education is the Green Flag program which is a tailor-made training course on sustainability for school students with the collaboration of NBE. By putting sustainability on the school schedule, the children are motivated to become active citizens who can take care of nature and the environment. (Aalborg Kommune, 2020c) (Appendix J) (Appendix K) Finally, grontaalborg.dk (Green Aalborg) is a website where citizens can find further information on how they can contribute to the sustainability of the city. (Aalborg Kommune, 2020c)

The Green Agents are a part of multiple citizen participatory projects which are circular, for example, the efforts made to make a difference in the impacts of meat consumption. However, these are mainly projects on the niche level; therefore, they presented in section 4.2. Furthermore, the Green Agent also contributes to the community gardens and the sustainable kindergarten in Karolinelund, which are elaborated on in section 5.1.

An exciting branch of citizen engagement initiated by the Green Agent happens through Housing associations. Himmerland Boligforening and Alabu provide accommodation for many citizens of Aalborg and therefore have a lot of contact with different communities. They have a better knowledge of what different communities are in need of or what they can do to contribute to the sustainable transition. Through the partnership with the housing associations, Aalborg Municipality can directly focus the introduction of city gardens, shared economies, a bigger focus on sorting waste or whatever is relevant on areas of the city where it is needed and the citizens are open to it. (Appendix J)

Sustainability Festival

The Sustainability festival takes place on the harbourfront yearly at the beginning of autumn. It was an initial role in 2013 was to educate citizens on what sustainability is and showcase Aalborg Municipality's efforts made for the sustainable transition. Today, it is a platform for local businesses, organisations and initiatives to present their products and efforts. Today people already know what sustainability is and why it is important, which also shifted the knowledge sharing discussion to more concrete and everyday topics and how sustainability can appear in the everyday lives of the citizens. Moreover, it is also an opportunity for inspiration and the creation

of new partnerships. (Appendix J) (Aalborg Kommune, 2020a) (Appendix K)

Introducing a sorted waste system

As mentioned earlier in this chapter, the municipality has implemented a selective trash collecting system which had a very positive impact in many ways on both the niche level and the regime level (Appendix B) (Appendix K). Additionally, there are efforts made by the municipality to optimise waste collection and transport, including using digital systems and fillers in containers (Appendix K). However, there is still room for improvement. First of all, unfortunately having trash collected in a sorted way, does not mean that everyone will start sorting it in their homes. Although the system is a great success in neighbourhoods with single-family detached houses, for some reason, it is not so successful in apartment buildings. Moreover, the system does not separate all kinds of waste for recycling. There are only plastic, metal, clean cardboard/paper and electronics/batteries; the rest is collected together and burned in the incineration plant. (Appendix B) (Appendix K)

On a landscape level, this matters because although the separately collected waste and the remaining trash are both ending up in a resource loop, there is still a large amount of waste that could be recycled, yet ends up burned due to the lack of separation and lack of facilities to deal with them. Unfortunately, waste to energy plants sill leave some waste product behind and do not provide green energy like renewable energy sources do (Johansen, 2018). Overall, in ideal circularity, waste to energy plants should only burn waste that is inevitable to create and not possible to (further) recycle. As a reaction, some activist takes waste separation one step further. For example, use homemade composts to recycle their organic waste into soil. (Appendix B)

Circular Substitutions

The main substitution the Municipality is working on in terms of energy is the transition of the power-plant near Vodskov. The Municipality bought the power-plant recently which currently runs on coal. Alternative systems are already experimented with in order to make the power plant independent from coal by 2028 and CO_2 neutral by 2030. Additionally, waste heat systems have already been introduced as the excess heat created through Portland's production process is fed into the heating system, and more companies are to join the system. (Appendix J) (Appendix K) Furthermore, a comprehensive strategic energy plan has been prepared for the municipalities in North Jutland, which will be adopted in 2020 and coordinated with the municipalities' own energy plans (Appendix K).

Moreover, large lakes are planned to be used for storing excess heat produced in the summer. Finally, the substitutions of previous meals to organic, sustainable and local meals in the municipality is also an ongoing project. The idea is that through the introduction of organic food to the Municipality, an organisation with over 20 000 employees which additionally has control over schools, kindergartens and canteens it might increase get the prices to drop making it more affordable to other citizens too. Not to mentions, the intensity in which this size of support can help organic and sustainable local agriculture. (Appendix J) (Appendix K)

Handling water and improving it is quality

There are many steps taken in the Vandforsyningsplan (Water Supply Plan), the Spildevandsplan 2016-27 (Wastewater Plan 2016-27) and the Indsatsplaner for grundvandsbeskyttelse (Groundwater protection action plans) to improve the sewage system and reduce water pollution. One of the steps actions taken is the separation of the sewage system from the rainwater-collection system. The separate sewage treatment will reduce the discharge of unclean wastewater into the Limfjord which improves the aquatic environment. Another action taken is groundwater

protection, which prevents the contamination of drinking water. Additionally, there are climate adaptation projects, some of which focus on handling surface water in a regenerative way that also supports an increase in biodiversity and the development of recreational areas. One example is the restoration of the Østerå valley, and the re-opening of the Østerå stream, in order to restore natural hydrology, where climate, environmental and natural considerations (see more in section 5.1). These actions are important in the regeneration of the urban eco-system as water pollution can be a big obstacle the work to increase biodiversity. Furthermore, the reparation and increased maintenance of the pipes and thereby reduction of water leaking can be considered an optimise action which supports the resource looping as it reduces wasted water. Finally, there is also a Grøn-Blå Struktur (Green-Blue Structure) document which provides guidelines to the redevelopments, local plans and municipal plans in the city on how to improve and plan the blue and green qualities of Aalborg City. (Appendix K)

4.5 How is circularity present in Aalborg on the different levels of a multi-level perspective and what is needed to further increase the circularity?

Overall, circularity can be seen in two aspects of Aalborg. The more obvious aspect is looking at the actions taken and comparing them to the Williams (2019) circular city framework. The other aspect is looking a the process and the transition behind the actions taken. In other words, looking at what motivated the actions and if that could be done differently, possibly better. This will be compared to the guidelines collected in section 2.2. Therefore, sub-question two will be answered in two parts: circularity in the actions and circularity in the process, each containing points on how circularity is present and needs to be further developed.

4.5.1 Circularity in the actions

According to the empirical findings, the looping of resource flows is the action which has the most significant focus and presence in the city. It can be clearly detected on every level of the MLP and is particularly governing the transition on the regime level. As the transition to circular resource flows is a relatively new idea, there is still a long way to go in closing all resource loops, but this is only natural as a transition is a long process especially when it considers the whole economy. The next steps in this field of actions could be introducing more types of trash in the sorted waste collecting system, like an organic waste. Furthermore, an important step would be introducing a bigger focus on eliminating plastic from the system instead of just recycling it since the very act of recycling plastic (which can be only done 1-3 times) leads to more substantial dependence on the consumption of more plastic (see section 4.3).

In terms of regeneration of the urban eco-system, there have also been quite a few initiatives found. These initiatives happen mainly on the niche and the landscape level. This is possible because the landscape has the means and resources to create and upgrade parks and green areas, which does not concern the regime level, and a more plant-based diet (or veganism), the niche would have the potential to enter the regime level is still struggling to overcome the obstacle of cultural perception of animal product consumption. This being said, it is clear that the initiative taken by the Municipality to reduce meat consumption has excellent potential to pull this niche on to the regime level. Considering the size and density of the city concerning the green areas in it, the state of the urban eco-system might not be facing such atrocities as in larger, denser and more 'concrete' cities, therefore the physical aspect of regeneration, although it is not less important, but might not need as much attention and effort put into is as other aspects. Generally, the current amount of effort seems sufficient, but needs to be kept up.

Unfortunately, there has been little found about the presence of adaptation of urban structures in either level of the MLP. Later on in the report, in section 5.2 it is explained that there is a general goal of reusing old buildings when it is possible in redevelopments done by the Municipality, but there were no thoughts of planning deliberately flexible structures and prioritising more adaptable design options. This might be because the planners in the city seem to be more familiar with the circular economy concept and less familiar with the circular city concept. Adapt is a very important circular act in the Williams (2019) circular city framework for many reasons, and therefore it should be considered to be more incorporated in city planning.

The supporting act of localisation was found on every level of the MLP. Naturally, there is a higher amount of local services than local goods in the system as services are often more challenging to be globalised than the shipping of products. On the niche level there are many green stores and local sustainable products. The recourse flow looping on the regime level is working mostly with the services of local companies, and there are also a few initiatives (like the annual Sustainability Festival) on the landscape which prioritises and provides a marketing platform for local sustainable companies.

Substitutions are also present on all levels. On the niche level, there are more and more emerging products that are suitable to substitute their polluting equivalent. The participants of the zero-waste and the low-waste movements started to choose reusable products instead of disposable ones deliberately. On the regime level, the NBE is making a great effort to help companies in North Denmark to make sustainable substitutions and is a significant actor in the substitution of linear economies to circular ones. On the landscape, exciting experimental projects are ongoing to transition to renewable energy use and the reuse of production heat. There is of course still a long way to go, but the transition seems to be on the right track in this sense.

The implementation of shared economies seems to be in a very early phase. There were only a few initiatives found in the topic. Their main source is the Municipality's partnership with housing associations. This means that even though the landscape introduces them, they still seem to be stuck on the niche level.

Finally, optimise actions are also found on all levels. There are actions like second-hand shopping on the niche level, there is much effort done to optimise the running of companies on the regime level, and there is constant work on optimising the established systems on the landscape (e.g. the constant promotion of waste sorting). Additionally, the temporary use of areas which are to undergo redevelopment is also a way of optimising the way the land is used (see more in section 5.2). The optimisation can mostly be done on established systems whereas the circular transition is relatively new, and there is still many changes are needed in the system to give optimisation such a priority which it will probably have later on in the process.

All in all, most support actions are sporting the circular actions in the transition. Localisation and the present shared-economies, for example, is only supporting circular actions. Substitutions, on the other hand, also have a positive impact on the regeneration of the urban eco-system, as the substitution of meals made with animal products is gradually being replaced with plant-based meals. Optimisation is also mainly supporting the circular and the regeneration of the urban eco-system. This is possibly due to the lack of adapt actions, as to be able to optimise an action one has to establish the system first. However, the temporary use of transitioning sites is also a minor adopt action.

4.5.2 Circularity in the planning process

To evaluate the planning process of circularity in the city, the guidelines collected in section 2.2 are used. Mainly the actions taken on the landscape are weighed as it is the responsibility of the Municipality to do the city planning.

Gathering data on the city is important to understand where actions are needed to be taken. This is found intensely present in the planning process as the Municiplaity is gathering data from many sources. Such sources that are found are, through the NBE and the sustainability screening they do on companies, the partnership (or more reliable connection) with the waste management plants, the collaboration with the knowledge institutions like AAU and UCN and most importantly the investigations they do themselves like the project mapping of the SDGs which served as a basis for the revised Sustainability Strategy.

Considering the existing urban fabric is practically inevitable in Aalborg since the Municipality has decided that the area of the city is not to grow, even though the population is growing. Consequently, the new developments all have to be redevelopments which are already embedded in the urban fabric.

The balance between technical and social solutions is different for every city. In Aalborg, this is generally found and fulfilled as the Municipality is engaged both with the regime level and the niche level of the city through which it can find and empower social solutions (on the niche level through citizen engagement) and technical solutions (on the regime level through their collaboration with the knowledge institutions and certain companies working with sustainable innovations). This prevents Aalborg to transition into an extreme case of circularity, which only relies on one type of the two solutions.

Including circular economies happens very thoroughly through the participation in the Network for Sustainable Business Development and other similar (sister) networks. These networks have a strong focus on the development of circular economies. The partnerships have an essential role in financing circular innovation and create a more inclusive planning approach.

By having such a strong engagement with the public on both niche and regime level, the Aalborg Municipality is taking a holistic and multi-dimensional approach from a social consideration. The holistic approach also seems to appear in the circular actions taken in the city, but it does not seem to appear in all action forms of a circular city. It seems like the planners in the municipality do not have a circular city on the agenda, are not aware of its role and definition, yet aim to achieve a sustainable city. However, if circularity is an essential strategy to sustainability, which they seem to agree with because they work a lot on circular economies, then why should not those aspects that are specific to the circular cities concept be also considered in the city's Sustainability Strategy?

As mentioned several times earlier, including local communities is also clearly present in the planning process. This is important because it changes consumer behaviour. However, here it is important to mention the importance of transitioning in an involving everyone type of manner and with keeping in mind that sustainability looks different for everyone. What might be a simple switch for the majority of the people might also create an obstacle for certain minorities. For example, the use of straws (especially plastic ones) is an act of unnecessary waste production for the many but might be to the only simple way of drinking for people with certain disabilities. Sustainability and circularity should not be difficult, of great inconvenience and especially not prioritised over health (both physical and mental). This means that it is crucial to keep in mind that not everyone has the same possibilities when trying to motivate the many to change their behaviour.

Aalborg does have a few temporary projects which provide space for experiments but possibly could have more. Although the city only has a little over 200 000 inhabitants, it is still very complex. Therefore experiments allow the planner to test ideas before putting a lot of money and effort in it.

Overall, Aalborg Municipality has developed a planning and transition process that is doing well in the guidelines collected from the experience of other circular cities working. Their strategy is not only holistic but has a very strong presence on every level of the MLP. It is pleasant to discover that Aalborg Municipality already implemented the strategy of the found circular city

examples and took it one step further. They have built a system which nurtures circular niches and empowers them to be more successful in elevating to the regime level which is key for the transition in a multi-level perspective and is something that could be shared as a good example for other cities. On the other hand, there are still many gaps to fill in the actions taken and a long way to go to reduce the environmental impact of their citizens as according to Statistics Denmark (2020) *"Denmark's resource footprint per capita is considerably bigger than the EU average. Our consumption and investments etc. required the extraction of 22 tonnes of raw materials per capita, whereas the EU average was 14 tonnes."* One way to reduce the amount of raw materials needed is the implementation of the efforts done so far in a broader scale. However, more effort is needed to 'fill the gaps in the transition'. Considering the circular city concept and not only focusing on circular economy and sustainability is necessary for a holistic circularity.

Chapter 5
Spritten and Karolinelund

This chapter presents two very different ongoing redevelopment projects in Aalborg. One of them is Karolinelund, a public park with the reopening of the Østerå stream. The other project is Spritten, a private redevelopment that focuses on art, culture, residential areas, and waterfront redevelopment. Through the comparison of the two projects, the final sub-question is answered, which goes: *How do redevelopments like Spritten and Karolinelund contribute to the circular transition of Aalborg and what could they do more?* The answer to the question also uses the MLP and the findings of the previous sub-questions.

5.1 Karolinelund redevelopment

Karolinelund is a park in the inner city of Aalborg. It was through many years used as an amusement park until 2010 when it was closed, and the entertaining facilities were sold. The Municipality owned the land, so after the closing of the amusement park, a light regeneration was done to make the area available for the citizens. This process was started and run by the Municipality – in close cooperation with an association called Karolines Venner (Friends of Caroline) who are still engaged in the use and the future of the park. In the light redevelopment, the surrounding wall was broken to make four entrance along with the creation of opportunities for skateboarding, gardening, pétanque and graffiti. After a few years, a large public participation process started in order to figure out what the future of the park should be. The result of this process was the current local plan which was built upon an overall plan created by COBE Architects (see figure 5.1). The local plan is the document which permits the opening of the Østerå stream, forbids the placement of housing, decides to have a kindergarten in the park and declares that the park should be a public park. (Appendix H)

Today most of the park has the same looks and facilities as it had after the light redevelopment. Karolinelund has developed into a green area with increasing biodiversity. It is often a location for concerts and has a re-purposed freight-train station which was turned into a bar. (Aalborg Kommune, 2020d)

The kindergarten in the park opened in 2017 as Denmark's first sustainable kindergarten and has platinum DGNB certification. In terms of circularity, the environmentally cautious wood and the green roof contribute to the regeneration of the biodiversity, while the low and green energy consumption, the waste sorting and the recycling activities are contributing to looping resource flows. Furthermore, the kindergarten educates the next generation at a young age on why and how to behave sustainably. (Aalborg Kommune, 2020c)

In the park, there is also a possibility to have access to community garden slots for free upon request. Such gardens not only provide the possibility of gardening for those living in apartments but also is a very regenerative form of land use that creates a greener environment while providing a platform for social interaction and self-cultivation of gardeners. Therefore, the support of the Green Agent project by the municipality. The community garden in Karolinelund has only been there for a few years, but a growing diversity in insect, bird and plant population is already visible. (Aalborg Kommune, 2020c)

FIGURE 5.1: Illustration of the overall plan of Karolinelund by COBE Architects (Aalborg Kommune, 2016a)

As the years passed, the interesting park as it was when it opened had worn down. The redevelopment aims to change this by further opening up the wall around the park and creating it even more into a green meeting point and node for pedestrians, but most importantly, the

plans contain the opening of the Østerå stream which is to run along the western side of to park. Although the activities which can be found there today are to be kept, the park will be needing a rearrangement to give space for the stream. The facilities that are present in the park will not be changed, just replaced. The reuse of the old structures is planned to be done but unfortunately not all structures will be reusable (e.g. the skate park is made of cast in place concrete). (Appendix H)

The redevelopment of Karolinelund is to lift the quality of the park environmentally and recreationally. It will enhance soft mobility (especially pedestrian) in many ways. Firstly, it will connect the new bus rapid transit (BRT) station at Bornholmsgade to Nordcraft and the House of Music. Secondly, with an upgrade containing lighting, the park will be more attractive at night so people will not have to walk alongside Karolinelundsvej, which is a quite busy road. Finally, it is planned to be a place which is attractive to have a walk or a run in. With the stream, the park will have an attractive green-blue structure that has richer biodiversity and regenerative nature. (Appendix H)

Another important aspect of this redevelopment is that it is a climate adaptation project too, meaning when there are *"extreme rain events, Østerå stream will have more capacity than it has today so we can get rid of the water into the fjord."* (16:49, Appendix H) Currently, there is a big ongoing project in the city to separate the system handling the sewage from the households from the system that is handling the collected rainwater. The opened Østerå stream will be a part of the rainwater system and replace otherwise necessary basins which would clean the water. (Appendix H) (Appendix K)

As the redevelopment is a public project, the municipality needs to allocate the money. Kloak, the sewage company will be able to add the money it would otherwise have spent on basins to delay the rainwater from heavy rain, and a housing project at Østre Havn have also co-financed the redevelopment as it would significantly increase the value of their apartments. However, unfortunately, the project is currently scarce on funding which is a possible threat to it. (Appendix H)

Another threat is contamination. Just across Karolinelundsvej lies Tulip which is a high-risk meat processing plant. When redeveloping the park, pollution is an important aspect to consider. Currently, there are ongoing investigations on the extent of contamination of the soil. *"If the soil is more contaminated than we expect, then it will cost more money, and that is always a threat to a project."* (41:25, Appendix H)

Overall the project has a big focus on sustainability and therefore has fundamental circular aspects. The care for the land and water environments to allow biodiversity to flourish and the creation of a space where nature can do its job in the inner city is a regeneration of the urban eco-system and its services which is one of the three main circular actions in the Williams (2019) circular city framework. It will lift the park's quality in both, recreational and environmental sense while providing a space for citizens to reconnect with nature without leaving the city. In the future, the park will be connected into the green network which will run across the city. The park also contributes to the city's growth agenda as it will be increasing the liveability and thereby the attractiveness of Aalborg, both for new residents and more visitors.

5.2 Spritten redevelopment

Spritten is a redevelopment on the western harbourfront of Aalborg which is to be the location of vibrant city life with high-quality urban spaces, cultural institutions and an essential part of the recreational mobility system created along the waterfront. The site was initially used by the Spritten factory (hence the name) which was producing the Rød Aalborg snaps and *"...was actually a very important self-understanding of the industrial city of Aalborg."* (13:15, Appendix F) Aalborg has been going through a transition from an industrial city to a cultural city. The closing of the Spritten

factory in 2015 was the closing of an icon of the old industrial city. Due to the previous function's significance, many buildings on the site were listed by the heritage foundation in Denmark. They are allowed to be adapted for further use in accordance with the heritage foundation, but can not be demolished. This makes the site *"the largest listed industrial site in Denmark."* (04:27, Appendix F)

FIGURE 5.2: Illustration of the overall plan of Spritten by Henning Larsen Architects (Aalborg Kommune, 2017)

Altogether, there are four main actors with four different focuses working on the redevelopment of Spritten. The site was bought by A Enggaard, a developer company, who is now working on the project in collaboration with Martin Nielsen, a Danish investor and art collector.

The buildings in the plan (see figure 5.2) were divided into two groups where Martin Nielsen is responsible for developing the existing buildings and a new building called Harbourgate, the rest of the buildings are A Enggaard's responsibility. Martin Nielsen decided to dedicate his area to art and culture to complement the historical focus of the development. A Enggaard, on the other hand, is planning housing on his area, the western part of the whole site and has demolished the existing buildings as they were *"not listed, old concrete production buildings, which was kind of generic concrete buildings (...) of no special interest"*. (04:43, Appendix F) Furthermore, there is a third area in the redevelopment, which is the harbourfront of the site, owned by the Municipality. Redeveloping the rest of the harbourfront was crucial in the transition of the city's identity and the creation of a recreational promenade in an east-west direction. Therefore, the harbourfront of this redevelopment is also treated with care in this sense. Finally, two foundations have joined the project recently, which are responsible for the Art Centre and the Cloud City artwork done by Tomás Saraceno. The roles of the foundations follow the successful example in the case of House of Music (a cultural institution also located on the harbourfront). One of the foundations is working on the construction while the other foundation will be doing the daily operations and maintenance once the constructions are finished. (Appendix F)

Due to its location, by the fjord and its low waterfront, Spritten is also a climate adaptation project. Currently, there are problems with flooding, especially in the winter. *"When there's a storm, the fjord water will rise and flow all over the (...) Spritten area. So, in in the redevelopment of the harbourfront we will raise the level above sea level to 1.90"* (36:57, Appendix F) as it has been done on the rest of the redeveloped harbourfront. Additionally, the new buildings are raised to 2.50 meters above the current sea level to protect them from future sea level rises. (Appendix F)

Generally, there is no public participation involved. The developers make the decisions. There is a big focus on high-end cultural life, and therefore there is an idea to move the theatre to the site, which would add to the string of cultural institutions along the waterfront, but this is still work in progress. (Appendix F)

Unlike in the case of Karolinelund, Spritten is a private redevelopment. Although the planners from Aalborg Municipality have suggested to use DGNB certification for the new buildings and to put sustainability on the agenda, the developers do not want to focus on either. However, there are still a few circular elements which are important to recognise. In terms of contributing to the regeneration of the eco-system, a few green roofs are planned along with a green transition in the texture of the site. More specifically the western edge of the site meets with a green park and railway tracks, while the eastern edge is neighbouring the hard city; therefore the site will serve as a transition between the two textures and have a significant amount of greenery, especially on the west residential areas. Also, there are heritage buildings which are to be preserved on 16.000m^2 of the site, where the developers have no choice but reuse and re-purpose these buildings. This restriction saves a significant amount of demolition waste as well as construction materials while contributes to social sustainability and the identity of the area. (Appendix F) The reuse of these buildings can be considered as looping actions in the Williams (2019) circular city framework. Finally, the area is very well connected in terms of public transportation. There is a train station just beside the site, the BRT has two planned stops nearby, and the promenade is a very successful recreational connection along the waterfront. Therefore, the planners try to motivate the users of the area to use the shared economy of public transportation by providing less parking spaces.

Additionally, there were a few temporary projects during the planning phase, between closing the factory and the beginning of the constructions. One of them was a 'Box City' experiment in the south-east corner of the site. The concept was to make a little container city with a food market and musical venues, but it only lasted for a few years. Another temporary initiative was a disco called Wonderland in one of the demolished buildings, which was quite a success while it lasted. There were also other small initiatives and ways to use the area, like a flee market, but they all stopped since the constructions started. (Appendix F) Such temporary uses can be considered

as the supporting action of optimisation as they try to make use of land and buildings while the planning is done in the background.

Overall the redevelopment is mainly driven by private interest and aims to create a vibrant city life with an urban density and emphasis on culture. The project is an essential part of the city's transition to a cultural city as well as in the east-west recreational connection along the harbourfront. Although not intentionally, but the project has many coincidental circular elements, however, these do not fulfil the potential of how circular the project could be. There is a hotel planned on the, and the Cloud City artwork is to be a tourist attraction. The project also contributes to the city's growth strategy as it aims to create an attractive area with vibrant city life.

5.3 How do redevelopments like Spritten and Karolinelund contribute to the circular transition of Aalborg and what could they do more?

When comparing the two redevelopments to each other, there are three main areas they differ. First, they differ in the way they approach sustainability and the way they contribute to the circular transition. Second, Karolinelund is a recreations park's redevelopments, while Spritten is a very urban redevelopment with public buildings as well as residential areas. Finally, Karolinelund is an entirely public project that used public participation to make sure that the redevelopments serve the citizens' needs as much as possible. In contrast, Spritten is mainly a private redevelopment with a strong economic interest and with consideration to what attracts consumers rather than what the citizens might need.

Karolinelund's redevelopment focuses on the opening of the Østerå stream, and therefore it is a contribution to the circular transition revolves around the regeneration of the urban eco-system. As Aalborg Municipality does the project, the decision of opening the stream has no direct economic interest. Instead, it is driven to push the sustainable transition in the city forward, and with consideration to improve the city. However, it does elevate the quality of the neighbourhood resulting in land value increase for many developments nearby. The finance of the project limits the possibilities in which the redevelopment can contribute to circularity, yet maximises the extent it is potential is fulfilled.

To be able to have new ways in which Karolinelund could further contribute to the city's circular transition, the inclusion of higher diversity in functions and/or elements which produce profit would be necessary. The diversity of functions could be helpful because what one function produces as waste, the other can use it as a resource. Whereas the profitable elements could ease the financial burden of the project.

In contrast, Spritten has three focuses (culture and heritage, residential area, and waterfront connectivity), where none of which is chosen deliberately to contribute to circularity. On the one hand, the presence and re-purposing of the heritage buildings can be considered as a looping action as the buildings present on the site are in a way 'up-cycled'. Furthermore, the western area is to have a significant amount of greenery to improve the quality of the residential area and thereby can contribute to the regeneration of the urban eco-system. Note that this circular action is an investment to increase economic value and not made for its circular attributes. On the other hand, planning to have green patches in itself does not assure that it will be a regenerative area (planing one or only a few species of plants will not boost the biodiversity). Additionally, the heritage buildings only take up around one-third of the redevelopment, meaning that the 'up-cycling' of buildings does not happen everywhere.

Having a redevelopment with such diverse functions opens the possibilities in which the redevelopment could contribute to the circular transition, yet the decision process only favours

circularity if it is necessary or economically beneficial. Although, forcing the developers to put sustainability or circularity first, is not a possibility, exploring possible ways to bargain with them or motivate them might be.

To achieve a circular city, acting on a social level is not enough. The urban fabric also needs changes that make circularity possible on a more embedded level of the city. Transforming urban fabric can take decades; therefore, it is vital that the changes made actually serve the transition. One of the discoveries of sub-question two (chapter 4) is the lack of adapt actions in the city, which interestingly is also the case in the investigated projects. However, in Spritten, the adaptability of the new buildings might even make sense, as it reduces the risk or the investment. Meaning, if, for example, the residential buildings are designed to be adaptable, and there is a lack of interest in the apartments, the investment can be still 'saved' by its adaption to a different function.

In terms of support actions, another similarity between the ways the two redevelopments contribute to the circular transition was temporary use. Both sites were in use until the constructions started, which optimises the utilisation of the land in the city and increases the neighbourhood's liveability. However, the temporary use of a site is not necessarily an experiment. To improve the usefulness of the temporary projects in Aalborg, the example of Amsterdam could be taken and learned from. Karolinelund also has the substitute action of reducing the need for basins in the sewage system with the opening of the stream. However, these are the only support actions the two redevelopments take. Possible ways they could further have support actions is through implementing localise and accommodate sharing actions. For example, by using local recycled materials in the construction and by accommodating shared economies (e.g. including a shared bike stand or a co-working office in the plans).

Overall, the redevelopments mainly contribute to the circular transition through circular actions linked to the landscape level, have little interaction with other efforts on the regime level and varying interactions with the niche level.

On a niche level, Karolinelund has multiple ways of interaction as it is a development which includes public participation, offers community gardening and has a sustainable kindergarten teaching kids how to be responsible citizens. Both of the redevelopments provide a temporary location for citizen initiatives, however, this is the only way Spritten interacts with the niche level in terms of circularity. This could be improved by increasing the number of small actions implemented (like introducing the support of shared economies).

It is interesting how although the redevelopments can be considered to be on the regime level (as they involve many actors and have significant influences on the city), they still do not involve circular efforts made on the same level. Possible ways to improve this could be by using local and circular materials and/or sending the recyclable construction waste to recycling facilities to support the local circular economy. Another possibility could be the establishment of a similar network as the NBE for redevelopments.

Both redevelopments have stable connections to the landscape. In the case of Karolinelund, this is quite obvious as it is the Municipality leading the project, and they have a strong focus on sustainability, the inclusion of citizens and future-proofing the city. It is also a part of their agenda to have regenerative projects and increase the biodiversity in the city, which is the main driver behind the circular actions planned in Karolinelund. On the other hand, Spritten is mostly a private redevelopment, however, the most significant circular action (keeping and re-purposing many buildings) is linked to the landscape. Even though the primary purpose of the obligation of keeping heritage buildings is not to increase circularity in the city, it is still a force from the landscape that resulted in a circular action. Finally, both projects are turned into climate adaptation projects by the efforts of the Municipality. This effort extends the 'life expectancy' of the redevelopments (they can be used for longer) and that of other structures in the city which

they protect. This aligns with the idea within the circularity concepts that promote using longer lifespan products to reduce resource consumption.

All in all, redevelopments like Spritten and Karolinelund contribute to the circular transition of Aalborg through the implementation of circular actions specific. This is more present in the case of Karolinelund, as it is a public project, but could be done in a larger variety of ways in Spritten due to the diverse functions planned in the redevelopment. Also, circularity is done deliberately in Karolinelund and is only a side effect of the decisions in Spritten. The two projects could do better in many ways, but both have their restrictions. The primary source of restriction found in the redevelopments to further support the circular transition is how their primary purpose is still to support the growth strategy. In the case of Spritten, growth governs the redevelopment and overrules the possibility of a circular agenda. In Karolinelund, although the actions focus on regeneration, the overarching goal is the improvement of the neighbourhood which is also linked to the growth strategy, yet is too distant from the project to ripe its benefits. Meaning, the growth made possible by Karolinelund does not help the redevelopment process in return.

Chapter 6
Conclusion

This chapter summarises the findings of the sub-questions and then answers the main research question: *How can urban planners use redevelopments to transition Aalborg into a circular city?* This is done in two parts. First, the question is answered in a general way, building on to the actions taken so far and how they could be present in redevelopments. Second, the answer aims to look at more significant obstacles that the circular transition faces and aim to explain ways redevelopments could take a role in overcoming these obstacles. Next, the chapter reflects on the research conducted and evaluates the data collection process, the research methods, possible limitations, ethical consideration, reliability and validity of the project. Finally, the chapter closes the report with the reopening of the topic.

6.1 Summary of sub-questions

In chapter 2 it has been presented that circular cities are an essential part of the sustainable transition, as cities in their current state are a great contributor to the climate crisis and using a circular strategy is necessary (but not enough) to achieve sustainability. It was also explained that although the circular economy and circular city are both concepts of a circular strategy, they can not be approached the same way as cities have many layers and aspects that economies do not. To make sure that the research is taking the right approach, instead of using the popular ReSOLVE framework (created for circular economies), the Williams (2019) circular city framework was used which is a reinterpretation of the ReSOLVE framework for cities. This framework was used to analyse and categorise actions found in Aalborg that contribute to a circular transition. Additionally, guidelines were collected from the way other cities approach to plan for circular cities which were used to compare to the planning process and planning approach in Aalborg. Finally, the MLP was presented as a way of understanding the city and the transitions developing in it.

The first part of the empirical research phase was answering sub-question two in chapter 4. Here the findings were collected and explained on each level of the MLP. In terms of actions taken towards circularity, they were categorised according to the Williams (2019) circular city framework into circular actions and support actions. The findings explain that looping actions have the most significant focus in the city being present on all three levels of the MLP. Regenerative actions are also worked on but mainly are present on the landscape and the niche levels. Finally, adapt actions tend to be missing from the city's strategy. Support actions are generally found to be less present in the city. Although localisation and substitution are both present on all three levels of the MLP, not all actions were successfully carried out yet, and little shared economies and optimise actions were found. Overall, the actions show that much effort is made for circularity and sustainability, but the transition is a long, complex and radical process which is in a relatively early stage.

The planning process and approach behind the transition was found to contain every aspect of the guideline collected from lessons learned in other circular city cases. Aalborg Municipality has a holistic approach which includes citizens and companies in the transition, considers the existing urban fabric and includes circular economies. Additionally, they are constantly gathering data on the resource flows and the changes in the city, use both technical and social solutions and have experimental projects. Moreover, the planning process is designed to boost the transition by helping citizens initiatives and niches to thrive. This is key for transition in the MLP. However, from the interviews conducted with those working in Aalborg Municipality, it was found that

circular city is not on the agenda of planning. This is understandable as it is a relatively new concept, but it should not be left out in the long run. The city already focuses on sustainability, waste reduction and circular economies and is transitioning into a circular city. Adding the vision of a circular city into the visions and planning documents would help to unleash the full potential of the circular strategy in an urban context and help planners to resolve potential limitations of the current approach.

In the second part of the empirical research phase, Karolinelund and Spritten, two opposing redevelopments were investigated. It was found that the public project has a very deliberative focus on circularity (among other important focuses), whereas, it is not on the agenda in Spritten and therefore circularity only appears as a side-effect of some of the decisions. Although adapt actions can be most present in redevelopments, neither of the projects had a consideration to create adaptable structures. The general conclusion in this research phase is that although public redevelopment has a strong focus on circularity, private redevelopments are not and it is, therefore, dependant on the landscape's influence whether there are decisions made that contribute in the transition. Furthermore, it was also found that the city scale goal of both projects supports the growth strategy rather than the sustainability strategy.

6.2 How can redevelopments serve the transitioning of Aalborg into a circular city?

On a general note, redevelopments can contribute to the transition in three phases; planning, construction and utility.

In the planning phase, most of the decisions on what will be on the site are made. Whichever decision-making process is used, if circular actions can be designed into the new (or renewed) buildings, then that redevelopment already made a permanent circular change. Redevelopments are like changing puzzle pieces in the urban fabric. This means that if the Municipality carries on their work, they could be able to achieve a circular transition on the urban fabric redevelopment by redevelopment. However, it also means the redevelopments bring long term change either way and if they are not aligned with the vision (like circularity), then they might even work against the overall goals. Therefore, it is crucial to find possible ways to pressure private redevelopments to contribute to the transition.

In the construction phase, many materials are used and discarded. Involving circular economies in the construction process and the use of local, sustainable materials should shift from luxury to normal. Using local, recycled, and recyclable materials are ways to introduce circularity into the construction phase of redevelopments and a way to support circular economies that revolve around building materials.

The redevelopment site is often used in two ways. First, it can be used for temporary activities until the construction starts. This can provide some financial support to the developer, but more importantly, it is a way to use the space what the city has and to experiment with ideas that are too risky (or not yet possible) to implement permanently. The second way it is used is when the construction is finished, and the developments open for long term use. If the design accommodates infrastructures which support circular actions during the utility of the site, the redevelopment can contribute to the circular transition just by functioning the way it was designed. For example, if gardens with composting are included in the design, the site will produce less waste by default as residents can leave their organic waste in the composts.

On a more complex level, learnings from the findings of the three sub-questions, besides the fact that time is needed to increase (or achieve) the results of the current efforts, there are two main obstacles that the circular transition is facing in Aalborg concerning the redevelopments. One is

the conflict of growth and circularity, and the other being the absence of circular city on the city's agenda and thereby the absence of adapt actions.

In terms of adapt actions, redevelopments are the prefect the tool to introduce them into Aalborg. Adaptive infrastructure that facilitates circular economies is especially relevant in the urban eco-system. Currently, there is limited adaptive capacity in Aalborg (and cities around the world). *"In the developed world, the core physical structures that define our infrastructure have often not changed for long periods. These systems may have been upgraded using new technologies, but the core structures have been used for decades. Some infrastructure is old and in need of rehabilitation or replacement. Some is new and likely to last into the longterm, making change difficult, whilst some infrastructure is yet to be built. The latter could provide an opportunity for affecting design and encouraging adaptiveness."* (Williams, 2019, p. 2753) Increasing the flexibility of the urban fabric reduces the resources needed for change in the long term as well as reduces the dependency on old systems and infrastructures.

The struggle of transitioning to a sustainable city through the implementation of circularity contradicts with growth. As in most parts of the world, Aalborg was and still is growth-oriented in its visions in many areas. Similarly to the Sustainability Strategy, the Urban Growth strategy, and the concept of the growth axis is also a significant driver in the planning of the city. However, the two documents seem to be pulling the transformation of the city in different directions rather than having a hierarchy. Although many circular economy theories suggest that unlimited growth is possible if following its' set of rules the further the transitions go towards the ideal circularity, the more experts start having concerns that there will be a limit to how big a company can grow and how much people can consume without harming the environment. Sebastien mentioned in the interview: *"My concern is that it is not enough to be sustainable, there is a limit to capitalisation, there is a limit to how much money you can earn and how much the environment can cope with. So, you can not make unlimited money without also hurting the environment."* (26:17, Appendix D). On the other hand, Anders said: *"We need growth we're just figuring out what kind of growth is it. (...) Here the circularity of the economy (...) is, of course, important."* (17:53, Appendix J)

The constant necessary decision between growth and sustainability is also what can be seen in the cases of the two redevelopments in chapter 5. Spritten is a redevelopment with the spirit of growth. The developers do the project relying on expected visitor and population growth with the hope of economic growth (profit). Although the Municipality as a developer of the waterfront area does have a focus on sustainability (for example in the flood protection) but their driver in this redevelopment also fundamentally relies on growth as a goal of the project is to make the city more attractive by adding to the recreational connection and string of cultural institutions a new area. It seems like if there were more focus on circularity, the project would have to make a compromise which might end up increasing the risk and reducing the expected profit. On the other hand, Karolinelund is a regenerative and thereby circular project which is struggling with the finances yet still serves the growth of the city by making it more liveable and attractive (which is not necessarily wrong). This type of risk and mentality naturally is not worth it for any private developer as they are generally in for financial return which can not be expected from such a project.

To resolve this contradiction, more research is needed. Currently, there is no consensus whether growth is something that should be minimised as there is no way to grow without putting to much burden on the planet or whether growth needs to be redefined as it is necessary but should only be used in the 'right way'. But then what is the 'right way'? Redevelopments can contribute to such researches by providing space for experiments in temporary phases. Experimental redevelopments could explore what happens when the reason of a project initially aligns with circularity and only considers the possibility of growth? What happens when redevelopments do not rely on population and economic growth and only handle them if they happen organically? If circularity

would be the priority, would that still attract people without intention? Currently, redevelopments are used as tools to drive growth and are often dependant whether they are successful at it. This is an important recognition as it is not necessarily obvious, and therefore, it is also more complicated to act on it. Overall, for Aalborg to be circular, it will have to change the way the city uses redevelopments and reconsider the growth strategy and its priority. Most importantly, the city needs to find a way to thrive without the growth like the economy presented in the doughnut of social and planetary boundaries by Raworth (2017b)

6.3 Reflections on the research

When conducting research, the limitations of it must be recognised. Circularity is a difficult subject to investigate in the context of a city. This is partly because the circular economy and circular city are still two evolving concepts (especially the latter) and partly due to the complexity of the cities. To investigate and categorise the actions found the Williams (2019) circular city framework was used, which was chosen because it was found more reliable and relevant to this research than other frameworks. In the case of investigating the planning process behind the circular transition, a set of guidelines were collected based on the literature review. The circular city framework and the guidelines gave the theoretical foundation of the empirical research phase, making the results very dependant on them. Possibly if another framework were chosen, then the conclusion of the report would have differed. However, the research trusts the literature review and has good reasoning to choose the framework and guidelines it chose as these are the most relevant, trusted and updated found.

Although Aalborg is not a large city on a worldwide scale, and the understanding of the city was simplified to the three levels of the MLP, there is no way that a single researcher can investigate all circular happenings on every level of the MLP in the city in four months. This means that there are probably some efforts, initiatives and actions which the researcher did not find through the data collection process, and this might have influenced the results of the research. Nevertheless, the research aimed to explore the most significant actions and to understand the general process of the transition in order to find out how redevelopments can fill in the gaps that are currently overlooked. To do this, it is not necessary to find all possible presence of circularity in the city.

6.3.1 The representativeness

Only one interviewee was representing each level of the MLP as well as only one interviewee representing each redevelopment. It is possible that more interviews would have resulted in a better or different understanding of the levels and the redevelopments. However, the interviewees were knowledgeable enough to answer the questions asked and are considered experts in the topic they were asked about. Furthermore, document analyse was conducted to back up their perception of the level or redevelopment. Therefore, the interviews are considered sufficient representation of the levels and the projects.

6.3.2 Gathering information

All interviews were conducted online due to the COVID-19 pandemic, which caused some technical issues. The interviews were often disturbed by distractions that happened due to the comfort of home-office (e.g. dogs barking, construction noises, and so forth.) and small connection errors. However, these disruptions were not significant enough to lose the topic of discussion. On the other hand, the construction noises did cause some (10 min of audio) data loss in the interview with Sebastien P. Bouchara.

To make sure that the data collected is reliable, the interviews were recorded and transcribed. This way, the researcher did not rely on her memory and ensured that the data is not altered.

All interviewees, along with the researcher, use English as a second language as the interviewees are Danish, but the researcher does not speak Danish. This caused some difficulties in the process of transcription, but all significant Danish words (e.g. street names and names) were found. It also might have caused a minor language-barrier in the form of expression, but all answers which were a bit more difficult to understand were asked back in a follow-up question confirmed or corrected by the interviewees.

The interviewees did not have the same understanding of the circular city concept as the research did, which could have altered some of their answers. However, the questions were tried to be formulated around aspects of circularity and not necessarily about the circular city concept itself. Also, sustainability was sometimes used in the replacement of circularity as it has a universal understanding. This way, the interviewees shared all information around sustainability, and the researcher could filter the information and only analyse what is relevant to circularity and the investigation in general.

The interviewees were asked whether it is okay if the interviews are recorded, the information provided is public and if the report can mention them by their name. They all agreed. The information shared has no harm to the interviewees. The interviews are, therefore considered ethically correct.

In terms of document analyse, most of the documents relevant and essential for the research are in Danish. To overcome this barrier, google translate and pdf translator was used. This might have caused some minor miss translations, but the programs used for translation are reliable, and only that information was used, which made sense in the big picture.

Overall, the methods of interviews and document analyse complemented each other well thought the research. Generally, the strategy was to do document analyse before and after each interview to prepare questions that can be the most useful and to do further research on the information learned in the interview. Furthermore, the knowledge gathered in the interviews also affected the questions of the later interviews, which improved the quality of data collection. Finally, the interview guidelines were shared with the interviewees beforehand allowing them to prepare but were used with the flexibility to allow questions and discussion about relevant topics which the researcher did not think about beforehand. This also improved the quality of data collection.

6.3.3 Reliability and validity of the project

The research relies heavily on the theoretical frame and background research done in the literature review (Chapter 2). The literature review and thereby, the theoretical framework is considered valid and reliable as it uses literature produced by recognised and reliable researchers and are published by recognised and reliable publishers.

There were five interviews conducted with experts. The interviews conducted are valid and reliable because of their expertise in their field and the level or redevelopment their interview represents. To reduce possible misunderstandings or discomfort, it would have been preferred to conduct them in person, but, it is expected that the general outcome would have been the same.

The document analysis is also considered valid and reliable as the documents used are all produced by citizens of Aalborg and experts in the field they cover. The Municipality made the local plans and the planning documents used along with the information accessed on their webpage.

Critical realism says it is possible to distinguish between high and low credibility (Næss, 2015). This being considered with the fact that all data collected is from a reliable source (experts),

the results of the research are perceived as reliable and valid. If investigated another time, the relevance of the methods and the way the interviewees were chosen would not have changed; however, more interviews could have provided more information.

6.4 Further research possibilities

The findings of this research can inspire many new researchers to produce further knowledge though further examinations. One direction further research could take is focusing on what actions are taken in Aalborg so far and investigate how redevelopments could have more of these efforts present in them. The work of Aalborg Municipality was generally found quite successful; therefore, another way the research could carry on is by looking into how the Municipality's strategy could be generalised and used in other cities.

Further research could also focus on the main obstacles found in the transition. Asking how Aalborg could include adapting actions? Which are the old infrastructures that hold back the city from circularity? Which are the most necessary infrastructures for the circular economies? Answering these questions could lead to findings that help the city to overcome its physical restrictions and implement flexibility.

It can be expected that the circular transition and the achievement of a circular city status have many side effects, some of which are negative. Therefore, another direction that further research can take is the investigation of these side effects and the possible way to reduce the undesired ones or solve the new issues with a circular mindset.

Finally, a very important discussion is the one currently happening around growth. This topic still needs wide-scale research on the theoretical level. The first step in transitioning to a healthy relationship with growth is finding out what is a healthy relationship. Investigating if there is a scenario where growth is not needed? Or if growth is needed then what is the right form? Should there be a limit to growth? Can socio-economic structures thrive without being dependant on growth? Once this topic is figured out, investigation on how the new vision could be implemented into the current systems and what needs to be changed is the next step, because the answers will most probably require a fundamental change in the current way of doing things.

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