MASTERS THESIS

The Nexus between Circular Economy and Climate Change Mitigation Policies in Small and Medium-sized Dutch Cities

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PREFACE

The decision to research on circular economy, a fast-growing topic yet still uncertain in many aspects, was mainly driven by a spark of instant yet deep curiosity. With the evident challenges and dangers of our current linear economic system, the inculcation of the term circular economy in the academia and business world is extremely promising and without doubt, it is expected to dominate global discussions in the next decades. In this timely manner, cities have often been a point of personal discovery and departure in the understanding and putting into perspective several topics in the environment domain as waste and energy management. This comes from the point of witnessing how (dis) organized systems and structures can influence the ability of cities to fully tap their potential and resources. Amid my amusement of functional and effective systems within the context of urban development (cities) in the Netherlands, is my growing knowledge and interests on climate change discussions and its intensity particularly after the adoption of the global Paris climate agreement during the Conference of the Parties (COP) 21 in 2015. For this reason, I opted to take the chance of not only putting into perspective the concept of circular economy by understanding how small and medium-sized cities in the Netherlands are dealing with the transition, but also, to understand this transition in relation to the ongoing discussions and implementation of initiatives related to climate change mitigation.

Fascinated and in oblivion of what would lie ahead, I am in utmost gratitude to my supervisor Dr. Laura Franco-Garcia for her unwavering support in bringing focus and clarity to my many ideas. I am eternally grateful for the numerous Skype Calls, emails and light discussions full of energy and motivation when I needed it the most. In like manner, I would like to sincerely appreciate my second supervisor Dr. Gul Ozerol for always asking the right questions that triggered my thought process and together with Dr. Franco, for constantly giving sharp feedback on my document.

I extend similar hearty gratitude to the 11 interviewees who dedicated their limited time amid the vacation hastes and without whom, I would not have explored the research to this extent. The informants are namely Prof. Jacqueline Cramer-University of Utrecht, Ms. Nadine Galle-Metabolic, Ms. Joke Dufourmount-Circle Economy, Mrs. Bekkers Milene-Municipality of Venlo, Mr. Martin Hulsebosch-Municipality of Dordrecht, Mr. Erwin Lindeijer-Municipality of Almere, Mr. Paul Kok- Municipality of Zwolle, Mr. Maurits Korse- Municipality of Haarlemermmeer and Mr. Jan Harko Post-City of The Hague. In addition, I would like to thank two other informants who chose to remain anonymous from the University of Groningen and City of Turin and will be referred to as interviewee 1 and 2 respectively in this research. I continue to thank EUROCITIES network for accepting my request to attend their conference on energy transition in cities in Antwerp which helped widen my understanding of policy and lobbying within the EU context on the important issues faced by its cities.

To everybody else that I may have forgotten to mention, including my family members whom I would not go into much details, in the interest of time, I thank you all very much. Lastly, I thank God for the continued strength and health that I sincerely do not take for granted.

I hope this research gives a further understanding of the circular economy concept in the context of small and medium-sized cities. I also hope that the reader finds it interesting to go further into researching other areas identified particularly on the nexus between climate change mitigation and circular economy, as I believe it is a discussion going to define many decisions of the future.

With that being said, I hope you enjoy reading the findings of this research.

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ABSTRACT

In the wake of resource depletion, inefficient resource use and prediction of worse climate change impacts, cities present a viable platform to adopt local solutions for global challenges. The climate change policy challenge for cities presents a two-way struggle due to its inseparable nature in achieving climate change protection and development simultaneously. The indicated issues have been the core focus among researchers and policy makers in large and mega-cities. However, similar attention has not been paid to small and medium-sized cities which are still in the verge of growing with a great potential of developing in a resilient manner.

The introduction and development of circular economy concepts in cities such as recycling/reusing waste, closing the material cycle and use of renewable technologies and processes often align with climate change mitigation goals. Albeit this, there is minimal evidence of the application of circularity practices and strategies in climate change mitigation policies in the context of urban development in small and medium-sized cities. This could be attributed to the experimental nature of adopting circular economy concepts in addition to its inadequate placement within the borders of urban sustainability, in comparison to the dominating business-focused narrative.

The main question that this research addresses is **'***What are the crucial success factors for circular small and medium-sized Dutch cities in relation to climate change mitigation strategies?*

For this reason, the research in hand identifies the potential areas for linkage of circular economy and climate change mitigation policies by identifying how five selected medium-sized cities namely: Almere, Dordrecht, Haarlemermmeer, Venlo and Zwolle are approaching circular economy. The population size in the selected cities range in between 100,200 inhabitants in Venlo and 196,932 inhabitants in Almere. The case cities are a representative of five of the twelve Provinces in the Netherlands namely; Flevoland, South Holland, North Holland, Limburg and Overijssel. In terms of the unique combination and composition of the cities; Almere is the newest city in the Netherlands while Dordrecht is the oldest city in the Holland area; Haarlemmermeer hosts Schiphol Airport, the main international airport in the Netherlands; Venlo was dubbed the 'greenest city in Europe' in 2003 and in 2012, they hosted the World's largest Horticultural exhibition, Floriade, of which Almere will host (Floriade) in 2022. Comparatively, two large cities Turin in Italy and The Hague in the Netherlands were analyzed as control cases to explain some findings that suggest the "*size of the city*" as the factor for disparities and/or similarities among cities.

Primary and secondary data sources were utilized through document review and a series of interviews with key informants including Prof. Jacqueline Cramer -former Minister of Housing, Spatial Planning and the Environment- policy advisors from the municipalities, small & medium-sized enterprises and knowledge institutes' representatives. The data gathered was analyzed qualitatively by using content analysis techniques.

The main findings of the research identified four *conditions (or success factors) that enable* the transition of cities towards circular practices, here the most prominent in the list: (1) use of innovative non-financial instruments as sustainability tenders and circular procurement to stir creative competition; (2) encourage flexibility at all levels, as there is still an aspect of 'trial and error' in the transition to a circular city; (3) facilitate cross-sector and cross-value chain

collaborations schemes through smart coalitions, innovation contents , etcetera; (4) foster trust as it is central to the transition process whereby a great deal is given and taken.
In all the cases, the role of municipalities in orchestrating the process and stimulating change is prevalent. A '*one story'* narrative emerges on the nexus between circular economy and climate change mitigation policies for cities. The narrative is that a true functioning circular economy, initiated through the previous mentioned conditions, is part of the climate change endeavor. However small and medium-sized cities, in comparison to larger cities, are at a disadvantage in facilitating the nexus of mitigating climate change and adopting circular economy in regards to inadequate human capacity, limited access to resources and out-of-date infrastructure. Projecting into the future, the research found the following *areas to present high potential for the nexus*: (i) building and construction sector; (ii) the use of bio-based alternatives; (iii) mobility; (iv) nature based solutions and (v) people's mindsets. This presents an opportunity for SMCs to share limited resources towards mitigating climate change and the transition to a circular city.
By and large, the transition to circular cities is a gradual iterative process. The concept of circular economy is gaining ground from other concepts, such as cradle to cradle that cities have been working on, as seen in the case of Venlo. With climate change being a global issue, experimenting locally with concepts such as circular economy, present what can be perceived as a lifetime opportunity to effect feasible systemic changes that will accelerate the process. Although this may be true, the transition to circular cities is to a large extent determined by the willingness of actors to voluntarily take action, as legislations are yet to change and be stringent and defined as those related to climate change mitigation. This is explained further in the research as part of the conditions or success factors for cities in the transition process and could be put into consideration by similar cities in the Netherlands working towards the transition to circular cities.
The structure of this report is as follows. Chapter 1 introduces the research by giving an overview of current state of cities globally, and narrows down to Europe and the Netherlands. It further describes the challenges faced by The Netherlands being a highly urbanized country, and problems related to climate change and the possible solutions presented through circular economy. The section ends by defining the research objective and research questions. Chapter 2 discusses the findings based on literature study from other researchers on related issues. The main concepts and theories associated to circular economy and climate change mitigation strategies in relation to cities are discussed with examples of Chinese cities. These cities are selected as examples for purposes of lesson drawing being that China is leading in adopting circular economy and was the first country to enact a Circular Economy Promotion Law in 2009. Thereupon, an analytical framework is developed to identify specific issues related to the transition to circular cities and reducing CO_2 emissions in cities, as part of climate change mitigation. The literature review provided basis for formulating interview questions that were applied to gather empirical knowledge and either confirm or argue with related literature findings. The research methodology is presented in Chapter 3 where the linkage between the two concepts is elaborated in a conceptual model that informs the research framework. Chapter 4 presents the research findings based on interviews conducted with 11 key informants and Chapter 5 links the literature findings (Chapter 2) and interview findings (Chapter 4) towards answering the research sub-questions. Chapter 6 concludes with recommendations, a reflection of the research methodology and the identified gap for future research.

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CHAPTER 1: INTRODUCTION

1.1 Background

In 2016, an estimated 54.5% of the world's population lived in urban settlements and by 2030, urban areas are projected to host 60% of the global population (United Nations, Department of Economic and Social Affairs, Population Division, 2016). Most compelling evidence shows that cities account for two thirds of the world's overall energy consumption which is equivalent to 70% of the global greenhouse gas emissions (World Bank, 2014), albeit occupying only 2% of the world's land surface (UNEP, *n.d*). At this point in time, cities are responsible for 50% of the waste produced globally and consumes 75% of natural resources (UN Habitat, 2016). Under those circumstances, the UN Habitat report on State of Cities discussed on the evolution of cities as centers of prosperity. It continued by stating, on a positive note, that cities in the 21st Century are places where people want to gather with the desire of finding a better future and '*realize aspirations and dreams, fulfill needs and turn ideas into realities'* (UN Habitat, 2013).

With attention to Europe, not only does the future of the region lie in its cities but also its effective global competition and democratic legitimacy, is dependent on the performance of its cities and metropolitan areas (EUROCITIES, 2016). More than 87% of the population in EU countries live in urban areas in 850 large cities, 8414 small and medium-sized cities and more than 69,000 in very small towns (EPSON, 2013). This indicates that almost half of the urban population lives in large cities, accounting to 46% while 24% in small and medium-sized towns and 19% in very small towns (EPSON, 2013). This goes to show that urban areas in Europe are highly exposed to social, environmental and economic crisis, if actions are not taken.

Ellen MacArthur Foundation, five years ago, brought together several complementary school of thoughts in describing the concept of circular economy[1], giving it wider exposure and appeal. The concept was however mentioned more than 20 years already by some scholars as illustrated in table 1. The circular economy framework aims to generate practical and feasible solutions to many of the current challenges experienced globally. Prendevillea,et al (2017) stresses on the importance of circular economy at the city-level by stating two main reasons. For one thing, technical and biological nutrients become aggregated within cities' boundaries and can be found in quantities worth harnessing through urban mining[2]. Secondly, the close geographic proximity of stakeholders within cities is effective in enabling collaborations to close resource loops and minimize waste.

[1] Circular economy is a "continuous positive development cycle that preserves and enhances natural capital, optimizes resource yields, and minimizes system risks by managing finite stocks and renewable flows" (Ellen MacArthur Foundation, 2016).

[2] Urban mining- the systematic reuse of anthropogenic materials from urban areas (Brunner, 2011).

Table 1: Gradual development of the circular economy concept (Adopted from Prendevillea,et al.,2017)

No	Year and author	Concept
1	(Simmonds p.366, 1862)	Identified the lack of systems to capture the wealth in waste generated from waste materials as food by-products in large towns and cities.
2	(Boulding, 1966)	Discussed the physical limitation of the planets natural resources.
3	(Stahel and Reday, 1976)	Envisioned an economy of loops based on labour.
4	(Frosch and Gallopoulos, 1989)	Described the concept of industrial ecology as a transformation of the linear economic system to an integrated industrial system.
5	(Benyu, 1997)	Explained the biomimicry concept of mitigating natural systems for environmental benevolence.
6	(Braungart and McDonough, 2009)	Developed the cradle-to-cradle concept (as opposed to cradle-to-grave) which promotes the separation of biological from technical materials to recover, reuse or repurpose them.
7	(Pauli, 2010)	Discussed the Blue Economy concept which proposes a systems of multiple cash flows (waste equals value) as opposed to a depletive 'linear' view of value creation.

Amidst this, proof beyond reasonable doubt shows that climate change[3] is one of the defining challenges of the future of cities. From emission reductions to the capacity and potential to adapt to changing situations, the extent and impact of climate change phenomena depends on decisions made in cities today. That is to say, cities create innovative spaces to respond to climate change from production and management of greenhouse gas emissions to the implementation of international agreements and policies (Bulkeley & Betsil,2003). Under those circumstances, circular economy initiatives provide innovative opportunities for the many challenges cities are facing as climate change (Circle Economy, 2016). In a research conducted by Circle Economy and Ecofys (2016) the findings indicated that circular economy can greatly accelerate the attainment of the historic Paris Agreement[4] goals. This argument is analyzed and discussed in detail later in the report.

This research explores the link between the two integral concepts in the transition of small and medium-sized cities to circular cities[5]. The scope is limited to how circular economy initiatives in cities interact/moderate with climate change mitigation strategies. The research foremost

[3] Climate change refers to "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods" (UNFCCC, 2011)

[4] Paris Agreement is an agreement within the UNFCCC that aims to strengthen the global response to the threat of climate change by keeping global temperature rise well below 2 degrees Celsius above pre-industrial levels and pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius (UNFCCC, 2014)

[5] A circular city is where linear processes from material extraction to waste is (partly) replaced by circular processes and connections made between flows. These flows create the city's metabolism that allows the city and economy to function (Agenda Stad, n.d)

identifies how the selected case cities are adopting and implementing circular economy and goes further to assess if and how the initiatives are directly or indirectly linked to reducing CO2 emissions in cities, and if the actions are intentional or non-intentional.
The selected case small and medium-sized Dutch cities are Almere, Dordrecht, Haarlememmeer, Venlo and Zwolle.

1.2 Problem Statement

The Netherlands is a highly-urbanized country with about three quarters of its population living and working in urban areas. The share of the population (over 500,000 people) that live in metropolitan areas is on the contrary, relatively small compared to those living in small and medium-sized towns (Netherlands Environmental Assesment Agency, 2016). This has been attributed to the polycentric urban structure of the Netherlands where most urban regions are made up of multiple urban cores with relatively short distances from each other, for instance the Randstad region which primarily consists of four of the largest Dutch cities Amsterdam, Rotterdam, The Hague and Utrecht. For this reason, the Netherlands is considered one of the most urbanized countries in Europe with more than three quarters of its population living in urban areas (Netherlands Environmental Assesment Agency, 2016). The high population density and concentration of human activity in Dutch cities has advantages and its fair share of disadvantages in terms of air pollution, waste management and competition between different types of developments. Whilst globally, the climate change policy challenge for cities seemingly presents a two-way struggle in its inseparable perusal of achieving climate change protection and development simultaneously. The indicated issues have been the core focus among researchers and policy makers in large and mega-cities. However, similar attention has not been paid to small and medium-sized cities which are still in the verge of growing and with this lies the potential for its growth and development to be more resilient. The introduction and development of circularity concepts in cities such as designing out waste and closing the material cycle reduces inefficient resource use and can go hand in hand (fit in) climate change mitigation goals. Globally, climate change mitigation goals focuses on reducing greenhouse gas emissions to 40-70% below 2010 levels by 2050 and near zero or negative by 2100 to hold the rise in global average temperature to below 2℃ (OECD, 2015). Under those circumstances, circular economy goes a notch higher in its efforts to retain value of resources and ensuring resources are retained in the system for as long and continuous time. However, there is minimal application of circular economy practices and strategies in climate change mitigation policies in the context of urban development in small and medium-sized cities. As a result, the research in hand analyses the two concepts to identify potential areas of nexus by first identifying how selected cities are approaching the transition to a circular economy, then after, the research prompts the connection with climate change mitigation strategies for cities.

1.3 Research Objective

The objective of this research is to contribute to the understanding of the success factors for circular Small and Medium-sized Cities (SMCs) in relation to climate change mitigation strategies for cities.

1.4 Research Questions

The accompanying main research question is:

What are the crucial success factors for circular small and medium-sized Dutch cites in relation to climate change mitigation strategies?

To aid in answering the main research question, below are the sub-questions:

i) How can cities retain value and make more efficient use of their existing resources?

ii) What are the (existing and potential) relationships and collaborative activities among different actors in circular SMCs?

iii) What is the interrelationship between circular economy and climate change mitigation strategies in cities?

CHAPTER 2: LITERATURE REVIEW

This chapter introduces theories and models on various concepts related to the research topic and objective. Section 2.1- discusses on size of the cities in relation to addressing societal issues, with a focus on small and medium-sized cities and its growth factors. Section 2.2-first introduces circular economy and discusses a step-by-step approach in implementing circularity concepts and goes further to discuss the circularity ladder. Section 2.3- discusses on the implementation of circular economy in Chinese cities. Section 2.4 assesses the link between cities and climate change and Section 2.5 describes the transition from a linear to circular city metabolism and the characteristics of a circular city.

2.1 Small and Medium-sized Cities (SMCs)

Globalization has triggered economic and technological changes and it is against the background of combining competitiveness and sustainable urban development in cities that the growing challenge prevails. Small and medium-sized cities often appear to be less equipped in terms of critical mass, resources and organizing capacity (Giffinger, Fertner, Kramar, & Meijers, 2007). Further studies as of Siegel and Waxman (2001) found six challenges experienced by small cities in the US: a) out-of-date infrastructure, (b) dependence on traditional industry, (c) obsolete human capital base, (d) declining regional competitiveness, (e) weakened civic infrastructure and capacity, and (f) limited access to resources. The indicated challenges are adopted in designing the interview questions, and their analysis helped inform the discussion in Chapter 5. Counterargument research indicates with increasing evidence that size alone is not sufficient explanation of a cities' competitive position and function in the real world. There are smaller cities endowed with specific specialized functions that would normally be only found in larger cities (Capello & Camagni, 2000). Moreover, the challenges faced by small and medium-sized cities can be met more precisely with better knowledge and positioning of the cities.

2.1.1 Growth factors in SMCs-*What and how next?*

Small and medium-sized cities have specific potentials to compete with larger cities. Erickcek & McKinney (2006) identified that the larger the city size is, the more other agglomeration disadvantages as traffic congestion, high property prices, social segreration, crime and environmental pollution increase. This shows that SMCs present a manageable and controllable opportunity. Additionally, Hildreth (2007) found that SMCs can play multiple roles unlike large cities. For example, SMCs do not offer urbanization economies[6] instead they offer more localized economies within the industries they specialize, developing in more diverse sectoral composition. Public policies have the potential to increase the economic viability of smaller metropolitan areas and cities (Erickcek & McKinney, 2006). 'Policy transfer' and 'lesson-drawing' refers to the adoption of urban development strategies and experiences by learning trials, errors and efficiency of policy strategies already in operation (Giffinger, Fertner, Kramar, & Meijers, 2007). At the same time, Dolowitz and Marsh (2000) mention that it is imperative to pay keen attention on some factors that may impede the transfer of experiences. These are: *uninformed transfer*-where the borrowing city could risk and have insufficient information about policies/institutional structures in the lending city. *Incomplete transfer*- where the crucial elements of policies, strategies or

[6] Urbanization economies refers to the economic advantages from larger market size, labor markets and knowledge exchange across the whole urban area (Hildreth, 2007)

institutional structures, which assured success in the lending city were not transferred and *inappropriate transfer*- where insufficient attention is paid to economic, social, political and ideological differences in the lending and borrowing city.

2.2 Circular Economy

The work of Murray et al. (2015) found that there is not yet a definition of circular economy that is commonly accepted but rather a consent on the fact that circular economy focuses on "closed" flow of materials and the use of raw materials and energy through multiple phases. Ellen MacArthur Foundation (2016) and the World Economic Forum (2014) described circular economy as an industrial system that is restorative and regenerative by design. It replaces the end-of-life concept with restoration, shift towards use of renewable energy; eliminates use of toxic chemicals that impair reuse and return to the biosphere and aims for the elimination of waste through the superior design of materials and all kinds of resources, products, systems and business models. Further, Murray et.al (2015) found that circular economy has both a linguistic and descriptive meaning. Linguistically, it is an antonym of a linear economy which is defined as converting natural resources into waste through production and consumption. The production of waste leads to the deterioration of the environment by removing natural capital and reducing the value of natural capital caused by pollution. On the other hand, the descriptive meaning of circular economy relates to the concept of the cycle where the two cycles of importance are: (i) the biological and; (ii) technical. According to Ellen MacArthur Foundation (2012) as identified by Cramer (2014) in the biological cycle, biomass returns into the biosphere after product use directly or in a cascade of consecutive use. While in the technical cycle inorganic products and materials as metals and plastics are encouraged to stay in closed loops to ensure circular use of non-renewable resources and prevent pollution.

2.2.1 Implementing circularity concepts

According to Yuan et al. (2006) there are three levels where circularity concepts can be applied, these are micro, meso and macro levels. The micro (individual) refers to companies and how their environmental performance is measured; the meso level refers to an eco-industrial network developed where different production systems and environmental protection benefit and the macro level is where eco-provinces, eco-municipalities and eco-cities are developed. This research contributes to the macro level of the circular economy by reviewing existing (and potential for) circularity practices in Dutch SMCs in relation to climate change mitigation strategies related to reducing emissions in cities.

Correspondingly, Eijk (2015) found that initiatives on circular economy are more appealing if initiated by local government than the national level. He presented a practical approach to implement circularity which are more parallel than step-by-step. These steps are elaborated below:

Action 1: Understand circular necessity

This recommends the true and deep understanding of the necessity for circular economy and why current models cannot be sustained and the fundamental changes needed to abandon the linear economy. Also, important, is to comprehend the opportunities a circular approach will deliver.

Action 2: Lead by example

Circularity concepts are explicitly explained by action as transforming own processes and using governmental procurement power to stimulate suppliers. This can be through adjusting

regulations to take a circular path and this gives strong signals that the government is keen about transformation.

Action 3: Map circular economy principles to local context

Circular economy principles should be contextualized locally. This is through defining which sectors and policy areas are most affected as waste, resources and the materials susceptible to price and supply fluctuation or overpopulation in urban areas. Based on these, 'hotspots' can be identified and worked upon.

Action 4: Create a comprehensive vision or strategy

Even though not all implications and changes may be clear at this stage, the study recommends to foremost design a long-term vision on circularity by developing a clear roadmap for the next couple of years.

Action 5: Engage stakeholders: Start the dialogue

To facilitate the transition, it is highly advised to engage all stakeholders and get them involved at an early stage to bring ideas and solutions from the bottom-top. Stakeholders' should be able to provide input for the overall vision, strategy and policy instruments hence create involvement, buy-in and produce most promising solutions.

Action 6: Choose instruments and start initiatives

Identification of hotspots and stakeholder engagement are a gateway to choosing the most effective policy instrument. Governments have multiple instruments at their disposal as laws and regulations, fiscal measures and grants to promote circularity aspects.

Action 7: Monitor, adjust and scale

Transition is a process; hence progress should be measured, roadmap adjusted and successful initiatives be implemented on large scale.

The research assessed the steps taken by cities in adopting circularity concepts in relation to this step-by-step approach by Erijk (2015).

2.2.2 Circularity ladder

In 1979, the Dutch parliament accepted the motion of Ad Lansink on waste management policies in the Netherlands. This provided for a hierarchy in the waste management approach otherwise known as the 'ladder of Lansink'. The waste management approach emphasized that priority should be given to prevention and limiting waste generation, then reuse and recycling then incineration and finally disposal of waste in landfills. The question of whether the waste hierarchy laid the first slabs of the long road to circular economy remains.

This research picks up from the waste hierarchy to the circular ladder which refers to the economic activities with an increasing degree of circularity (Eijk, 2015). As shown in figure 1, these activities are Prevent, Reuse, Recycle and Dispose. Prevention presents the highest degree of circularity and recycling the lowest, while disposal is avoided. In the middle, each stage represents circular activities as maintenance, repair, refurbishment and cascading biomass. On the right are six circular business models (or strategies) as Circular Design and Products-a-Service that can set the circular activities in motion.

From the six-circular business models it can be noted that all business models impact different activities, but some impact a wider range of different activities than others. For example, circular design impacts all aspects, whereas a sharing platform does not directly lead to refurbishment or recycling (Eijk, 2015). On the other hand, some business models can achieve higher degrees of circularity than others for example using biomass or recycles as input materials only has a direct

impact on recycling-although they have an indirect impact on prevention of using virgin material as well. All these is elaborated in figure 1.

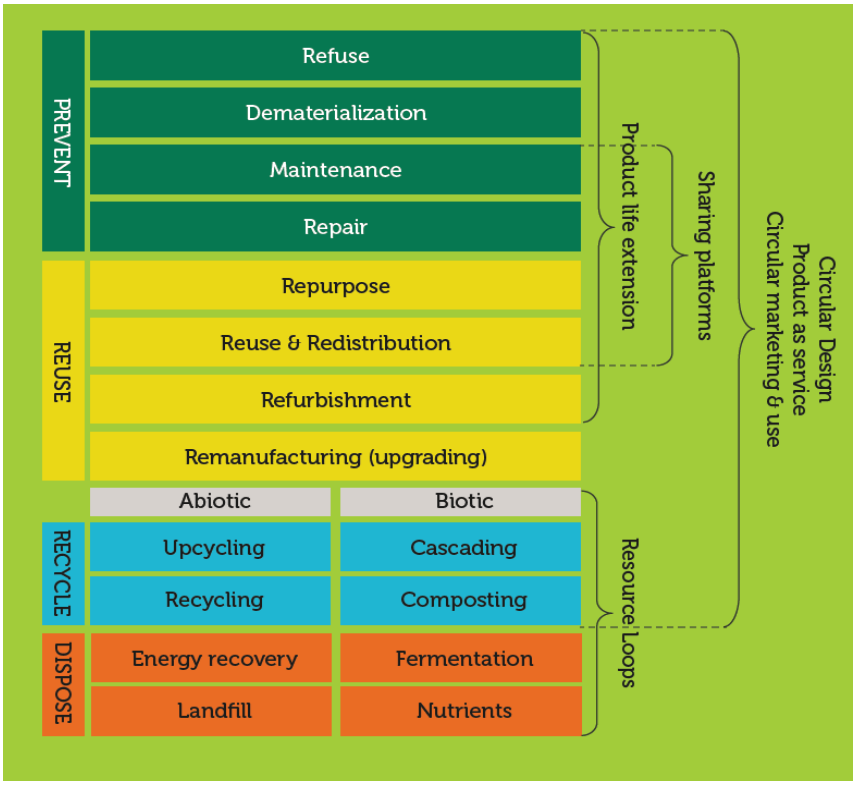


Figure 1: Circularity ladder (Eijk, 2015)

The circular ladder forms part of the analytical framework for the research as it was used to assess how cities are retaining their resource value towards addressing the first research question.

2.3 Cities and Circular Economy

In the city or regional level, pollution prevention becomes more paramount in the perusal of the social, economic and environment development, characterized by material and energy circulation (Zhijun & Nailing 2007). According to Zhijun & Nailing (2007), there are four systems that categorize circular-economy in cities and provinces. Those are: **i*)the industrial; ii)the infrastructure; iii)the cultural setting,* and; *iv)social consumption*** . The infrastructure system serves as the basis of the rest, while the industrial system affects social consumption and in turn social consumption affects the human habitation environment (Zhijun & Nailing 2007). It is this set of four systems together that consitutes the larger complex circular systems in cities. With this in mind, the development of small and medium-sized resource-based cities is facing an important strategic turning point. Qiping (2011) claim that circular economy development model is the only (prime) way for their transformations. The example below shows how circular economy concepts are being taken into consideration in China which is selected in view of its leading capacity in adopting circular economy and being the first country to enact a Circular Economy Promotion Law in 2009.

2.3.1 Lessons from Circular Economy Implementation in Chinese cities

In China, the interest and promotion of circular economy has moved from theory to practice. The country's national leadership discovered the dangers of exhaustive and excessive utilization of natural resources in the traditional linear manner which proceeds through to creating waste. This move intends to help China leapfrog into a more sustainable economic structure (Zhu and Qiu, 2008). In 2008, China proclaimed circular economy its central goal and officially enacted the Circular Economy Promotion Law in January 2009 (Su, Heshmati, Geng, & Yu, 2013). This gave China the status of the world's first national law to adopt a different economy model from the conventional linear economy (Mathews & Tan, 2011). The Ministry of Environmental Protection (MEP) and National Development and Reform Commission (NDRC) spearheads the implementation of circular economy in China through legislative, political, technical and financial measures (Su, Heshmati, Geng, & Yu, 2013 & UNEP, 2006). City and municipality level is one of the approaches to implement circular economy in China. Mathews & Tan (2011) found that the focus on the city/municipal level for circular economy is on recycling and the interconnected processes promoted through economic and administrative incentives. Su, Heshmati, Geng, & Yu (2013) conducted an in-depth analysis of a comprehensive study by Geng et al (2009b) on Dalian city. The city conducted a pilot project from 2006 to 2010 with an aspiration of being a leading environmental friendly city. To reach this, Dalian city had an objective that by 2010 it will: i) further improve land, water and energy use efficiently and remove all bottlenecks that restrict the city's sustainable development and; ii) improve the levels of reuse, recycling and recovery for solid wastes and wastewater and in turn significantly reduce disposal amounts (Dalian Municipality, 2007). In 2007, the city resolved in shutting down high energy intensive small scale industries and encouraged advanced technology and equipment for large manufacturers, regulating the structure of industries by attracting services with low energy intensity (Dalian Municipality, 2007). This resulted in increased energy efficiency between 21% and 27% with respect to GDP and industrial added value. Regarding efficient water use, Dalian city adopted both supply and demand-driven approaches for water management (Geng et al, 2009). Some of these initiatives included finding new water sources, minimizing water loss and encouraging water saving behavior among residents through price incentives and quota management. The collaborations between government, enterprises and citizens effectively led to a rise in efficient water use by a 52% reduction of water consumption per produced industrial value and 67% reduction of water consumption per capita (Su, Heshmati, Geng, & Yu, 2013). In regards to waste management, Dalian aimed at reducing the quantity of waste disposed and safe disposal/reclamation of waste in industrial and residential sources (Geng et al, 2009). The city encouraged enterprises to pursue ISO 14001 certification and embed the 3R principles within their production procedures. Additionally, the municipality established a waste reporting system to trace and track all waste flows (Su, Heshmati, Geng, & Yu, 2013). Further, a demonstration project was carried out in selected communities to aid in improving the recycling rate of waste in residential areas. These efforts led to a 17% decrease of municipal waste generation per capita, another 17%-20% increased waste water and solid waste treatments (Su, Heshmati, Geng, & Yu, 2013). Additionally, the increase in waste reclamation indicates reduced consumption of virgin material and waste disposal. The work of Su, Heshmati, Geng, & Yu (2013) concluded that the implementation of circular economy policies in Dalian was effectively as a result of collaborative

efforts from key stakeholders as government, enterprises and citizens. This greatly helped the city accomplish its goals of resource use efficiency and waste management.

Another pilot city project on the implementation of circular economy was in Guyang city in the southwest part of China. In 2002, a mayor-led approach was adopted in the Guyang to explore circular economy options. A road map was developed with specific goals for six sectors; coal-based industry, phosphorus-based industry, aluminum industry, herbal medicine, tourism and organic agriculture (UNEP, 2006). The major lesson learnt is that a shift in government policy and economic system was required to adequately implement this plan for Guyang city. A final example is that of Zibo, a resource-based which is facing a bottleneck of its economic growth that is driven by high input, high energy consumption and high pollution (Qiping, 2011). In response to this, Zibo city designed action plans and countermeasures to advance its transition to a more circular city. The circular economy action plan of Zibo City focused on three main aspects: ***(i) Transformation from resource-based pattern to ecological-agriculture pattern:*** this entailed the reasonable use of ecological resources to produce animal, husbandry and fishery products while maintaining the ecological balance. Ecological agriculture promotes the circular economy of Zibo City as it is key to the foundation of its economy. ***(ii) The implementation of clean production and building of eco-industrial parks:*** The practice of circular economy in industries is oriented on clean production by promoting circular utilization of material and energy with companies in Zibo. This encourages the development of eco-industrial parks to transform the petrifaction, porcelain, mechanic, electron, construction and textile and silk industries (Qiping, 2011). This forms mutualism of ecological networks, closed circuit in logistics, utmost utilization of matter and energy and an eco-production chain in the economic development of Zibo. ***(iii) Promoting the development of circular society:*** This refers to the circular utilization of matter and energy in the production and consumption processes. Large circulation is said to contain two interactive sides: the macro policy guide of the government and the micro living behavior of the social public (Qiping, 2011). Linking to the four systems introduced earlier through the work of Zhijun & Nailing (2007), it can be said that Zibo city is incorporating all the systems in its plan to shift to circularity.

For the most part, the political will in China is evidently visible and strong in supporting both financial and social investments to enable the big steps taken by the cities. It is also clear that the different initiatives included other stakeholders as citizens to effect behavior change as seen in the water management practices. What has been fundamental for cities is the shift of government policy and economic systems to incorporate the transition and boost China to currently being one of the leading country's leading in adopting circular economy.

2.4 Cities and Climate Change

Climate change is the "*most visible environmental symptom of human actions and is beginning to define the true cost of linear growth*" (Circle Economy and Ecofys, 2016). To achieve the global climate mitigation policy of limiting global warming to no more than 2 degrees Celsius, cities have a crucial role to play. The work of Bulkeley & Betsil (2003) recognize that climate change is profoundly a local issue and cities are central to the politics of climate change. According to Climate Service Center and KfW Development Bank (2015), cities consume up to 80% of total energy production and account for 71% to 76% of global CO_2 emissions. Cities are long known as important economic hubs and for this reason, their demand for resources is equally high.

With the close interconnection between urbanization and climate change, possible and evident mitigation options are inclined towards low-energy, low-carbon or climate-neutral cities. In line with this, Bulkeley & Betsil (2003) studied several literature and found four reasons why cities are a significant arena to address climate change and the influence local governments have in achieving national and international targets on emission reduction. Foremost, and as previously mentioned, the energy consumption and waste production in cities is high and local authorities can play a substantial role with their influence in energy and supply management, transport supply and demand, waste management, land-use planning and so forth. The second reason is the long-term engagement of local authorities with sustainable development issues in an attempt to translate global rhetoric to local practice in ways that impact mitigation of climate change. Thirdly, local authorities possess great potential to facilitate ongoing actions and efforts on climate change mitigation by lobbying national governments and developing small-scale projects to demonstrate costs and benefits of controlling green house gas emissions. Lastly, the study by Bulkeley & Betsil (2003) denotes that local authorities have considerable experience in addressing environmental impacts in the fields of energy management, transport and planning through innovative measures and strategies. In like manner, OECD (2014) found that local action takes place in the context of broader national frameworks which can either empower or slow down city-level actions. Consequently, national and regional policies and incentives are required to trickle down to city-levels to effect meaningful change.

The linkage and role that circular economy can play in the interaction with climate change mitigation strategies in small and medium-sized cities is explained in the following section.

2.4.1 The Climate Change mitigation policy and Circular Economy nexus in SMCs

Climate change poses daunting consequences to human health, livelihoods and assets and risks for the future generations. According to UNEP, the climate change policy packages proposed at the historic Paris Agreement in 2015 can only deliver up to half of the emission reduction needed. The goal of the Agreement is to reduce the earth's average temperature to no more than 1.5C meaning global emissions must be cut by 26 billion tons annually by 2030 (Circle Economy and Ecofys, 2016). Implementing circular economy can help to reduce the remaining emissions by half according to Circle Economy and Ecofys (2016). To support, this Murray, Skene, & Haynes (2015) suggest that circular economy is the most recent attempt to conceptualize the sustainable integration of economic activity and environmental wellbeing. The study found that in the wake of resource depletion, inefficient resource use and predicitions of worse climate change impacts for many people, innovative sustainable business models as of circular economy is viable in regard to ways of life, manufacturing and consumption.

The report by Circle Economy and Ecofys (2016) state that focus on climate change and emission reduction needs to shift from renewables and efficiency improvements to *retaining value and making more efficient use of existing resources* by returning them into a continuous and long lasting system, as per circular economy. Further, a circular economy features low consumption of energy, low emission of pollutants and high efficiency according to UNEP (2006) and these are critical areas for climate change mitigation strategies. The research assess the possibilities and practicability of this nexus for small and medium-sized circular cities and dicusses the same in Chapter 5.

Below are the top five ways in which circular economy can assist fight climate change which can be applied at the city level (Circle Economy and Ecofys 2016):

i) *Do more with less*- Approximately 60 billion tonnes (equivalent of 22 kgs per person per day) of raw materials are extracted from the earth annually. Half of these materials are fuels burnt for food and a significant portion of the other half is used to build homes, offices and roads while the remainder is used for a variety of products. Yet of all these, only 7% is reused. Circular economy principles promote the reusing of materials through repair, refurbishment and upgrading.

ii) *Substitute carbon-intensive materials*- This means shifting focus from typical climate change policies of reducing emission per product/service to promoting safe alternatives.

iii) *Create a domino effect*- 55% to 65% of greenhouse gas emissions are related to extraction, transport and procession of raw materials in developed countries. Increasing circularity means reducing the dependence on raw materials conversely reducing the amount of energy needed to extract, transport and process these materials.

iv) *Efficient use of resources and energy*- Improved efficiency is linked with reduced costs and counterarguments show it also increases demand. Studies on energy efficiency show that only 5% to 30% of efficiency gains are lost through greater use. This rebound effect could be similar for resource efficiency.

v) *Disrupt the digital stage*- Circular economy business models are slowly disrupting the traditional ones. Physical services are quickly being replaced by online equivalents. Access to a product/service is quickly promoted and adopted compared to ownership. This enables resource optimization and maximization of value.

In relation to cities, these five ways elaborated above can be applied by different actors from local government to business and academia.

2.5 Linear to Circular City Metabolism

Kennedy, Cuddihy, & Engel-Yan (2008) defined urban metabolism as the sum of the technical and socioeconomic processes that occur in cities, resulting in growth, production of energy, and elimination of waste. A city's material flow lays the basis of analyzing the efficiency of resource management systems in a city. Zaman & Lehmann (2013) indicate that the concept of zero waste directs linear city metabolism to a circular city metabolism. In the linear metabolism, materials, energy and water are consumed as inputs and afterwards they produce solid waste, wastewater and emissions to the atmosphere. A zero waste city on the other hand is closely linked to the circularity ladder concepts discussed earlier. The material flow in a zero waste city is circular meaning the same materials are used repeatedly until its optimum level of consumption. No materials are wasted or underused in circular cities, instead, they are reused, repaired, sold or redistributed within the system (Zaman & Lehmann, 2013). In the case that reuse or repair is not possible as materials are recycled or recovered from waste stream and used as inputs, subsequently reducing extraction of natural resources as shown in figure 2.

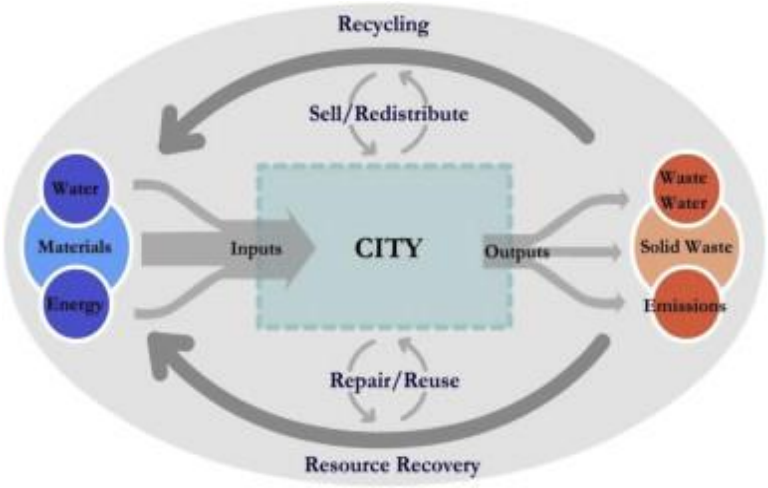


Figure 2: Symbolic flow of a circular city (Zaman & Lehmann, 2013).

The symbolic flow of a circular city gives an indication that a city's performance is well reflected by its waste management systems. The study however avoids using waste management approach for Dutch circular cities as the area has been exhaustively researched.

2.5.1 Characteristics of a Circular City

Circularity presents cities an opportunity to be resilient and independent, besides being sustainable. It enables the achievement of sustainable urban development through interactions between the design of the economy, socio-cultural lifestyles and the evolution of the natural environment (Agenda Stad, n.d). According to Agenda Stad (n.d), below are the main characteristics of circular cities:

Independent- Cities are better able to adapt and absorb with increase in its knowledge and skills. Various flows in the city are recognized and used as valuable raw materials for a sustainable economy. Hence, the insights in these flows makes it possible to create new local connections that lead to systems with less residual materials, pollution and dependence on geo-political relationships.

Resilient- Autonomy and independence in circular cities makes it more resilient and better able to cope with shocks. This is because it is possible to design smaller, local systems or circuits that are more flexible with a specific local focus on city or urban regions. Moreover, the ability of circular cities to produce and reuse makes it stronger and less vulnerable than the consuming dependent cities. Its regenerative ability similarly increases with the insight in and availability of flows and information.

Rich- The approach of a circular city is of broader value hence wider access to new sources and capital. The intrinsic value of flows in the city are better utilized and by-products of one process serves as raw material for other processes. Circular cities make clever use of space and competences in the city in addition to recycling materials and raw materials. Connections that create more value as health, happiness, responsibility and autonomy are given more attention in the development or circular cities.

Energetic- Circular cities present an opportunity for citizens and businesses to be creative and innovative. Urban parties and authorities are receptive, new connections are realized between

society, government, institutions and businesses. This creates an engine of innovation making cities more vibrant and energetic.

2.6 Elements of the Analytical Framework

From the theories and models presented here above, the research applies the theories related to step-by-step approach of implementing circularity, the three circularity ladder concepts of waste hierarchy, circular activities and circular business models as well as climate change mitigation policies/goals in cities as the independent variables. While the dependent variable is circular small and medium sized cities which are independent, resilient, energetic and rich. This is elaborated in figure 3 below.

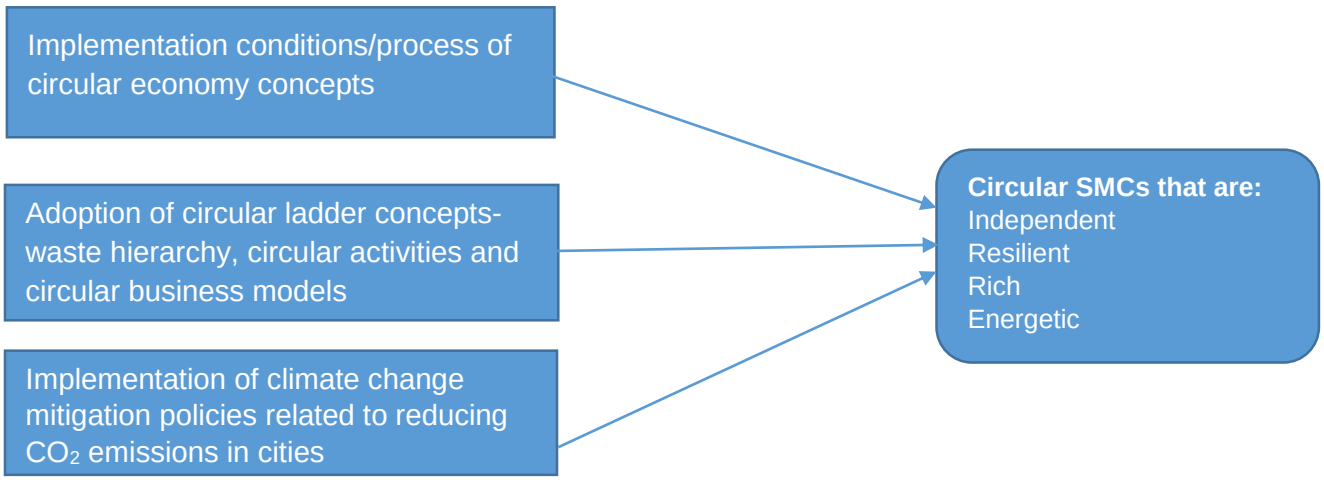


Figure 3: Elements of the analytical framework for assessing SMCs transition to circular cities

CHAPTER 3: RESEARCH DESIGN

In this chapter, the methodology used for selecting, collecting and analyzing data is presented. The chapter starts with the description of the research framework, research questions and definition of concepts. Then after, the methods used in collecting and analyzing data is elaborated. The nature of this research is qualitative, meaning all research questions are addressed in a qualitative manner. The analytical framework for assessing the success factors for circular Dutch SMCs in relation to climate change mitigation policies is based on secondary data sources. Primary data is drawn from empirical knowledge and experience of individuals working in municipalities, businesses and academia on the transition to circular cities.

3.1 Research Framework

Vershuren and Doorewaard (2010) define a "research framework" as the schematic presentation of the research objective. It includes a seven-step-by-step activity to achieve the research objective as shown below:

Step 1: Characterizing the objective of the research project

The objective of this research is to contribute to existing literature by making an analysis on the success factors for circular Small and Medium-sized Dutch Cities in relation to climate change mitigation strategies for cities.

Step 2: Determining the research object

Research object refers to the phenomenon under study (Vershuren and Doorewaard, 2010). In this research, circular Small and Medium-sized Dutch cities serve as the research object. Circular SMCs is defined by the research as cities that are adopting circular economy principles and practices to boost the city's metabolism.

Step 3: Establishing the nature of research perspective

Verhuren and Doorewaard (2010) define the research perspective as the 'spotlight' or 'lenses' that can be used to study the research object closely. This research observes circular SMCs in the perspective of the circular ladder concepts on waste hierarchy, circular activities and circular business models in relation to climate change mitigation goals on reducing CO_2 emissions in cities. To give recommendation, the study used in-depth interviews and content analysis to identify and assess different perspectives of the interrelation between circular economy practices and climate change mitigation goals for example in regards to economic instruments, municipality's capacity amongst others. This research is henceforth inclined towards an exploratory form of research.

Step 4: Determining the sources of the research perspective

The research used scientific literature to develop a conceptual model. The right-hand column of figure 4 shows the theoretical frameworks studied for the research. Whereas the left-hand column are the key concepts that are used to specify the research object.

Key concepts	Theories and documentation
Material flow	Circular ladder
Size of the city	Characteristics of a circular city
Collaborations	Circular economy and climate change mitigation strategies for cities
CO2 emissions	Implementing circularity concepts

Figure 4: Sources of the research perspective

Step 5: Making a schematic presentation of the research framework

The schematic presentation of the research objective is presented in the two figures below. Figure 5 elaborates the conceptual model or assessment criteria of the research. This is based on the circularity ladder concepts, climate change mitigation goals for cities and characteristics of circular cities.

The interpretation of figure 6 is that climate change mitigation policies in cities influence the transition to circular cities which are independent, rich, energetic and resilient. However, circular ladder concepts interacts/moderates with the relationship between climate change mitigation policies and circular cities. Therefore, the model shows that circularity ladder concepts affects the abilities of cities to meet their climate change mitigation goals. The research intends to answer the question of the relationship between the climate change mitigation goals for cities and circular cities by unravelling further the core concepts into dimensions/parts as shown below.

During the research, specific elements related to the core concepts as policies, finance instruments, priority sectors and stakeholders' engagements and their relationships were analyzed based on the research objective, interest and capacity of the researcher and research timeframe.

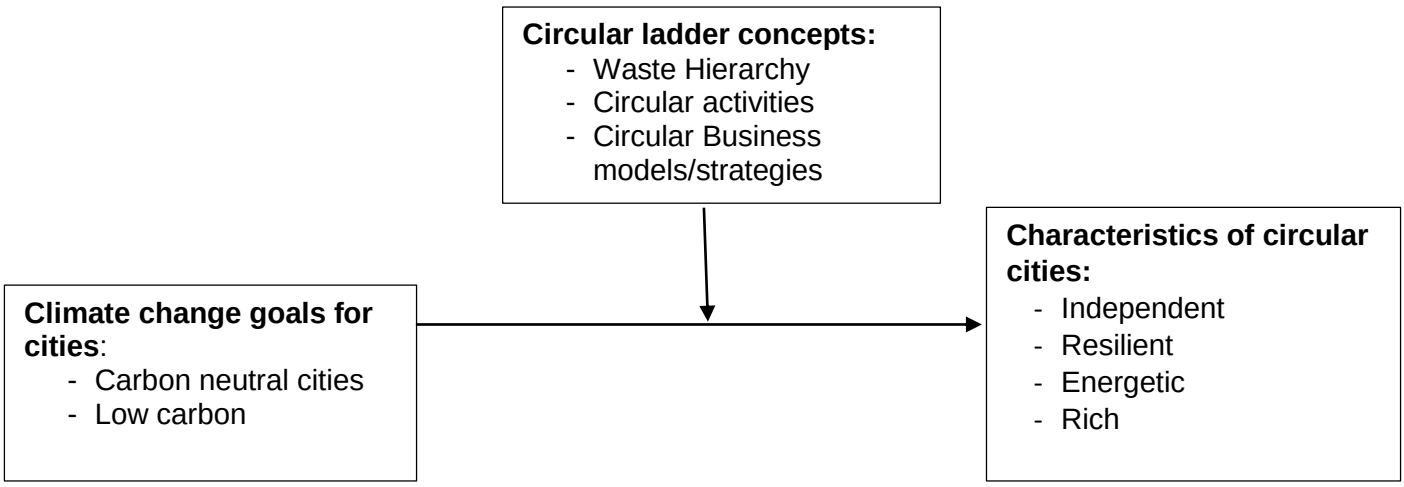


Figure 5: Interrelation Conceptual Model

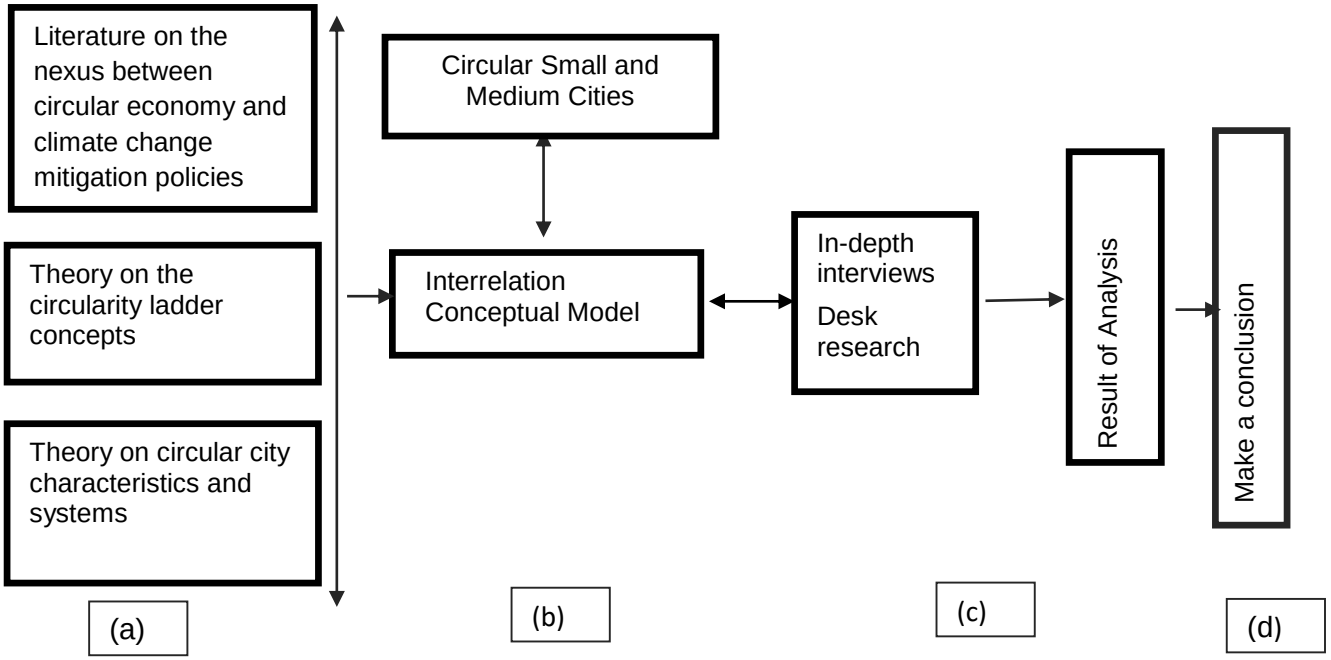


Figure 6: Research Framework

Step 6: Formulating the research framework in the form of arguments which are elaborated

(a) This section refers to the sources from which the research perspectives are developed, based on consultation with relevant scientific literature in terms of the nexus between climate change mitigation strategies and circular economy practices in cities. This leads to the development of the conceptual model.
(b) In this section, the research perspective (lenses) is applied on the research object. It shows how circular SMCs are analyzed as per the conceptual model through interviews and desk research.
(c) The results of the analysis are then confronted as indicated providing as a basis for recommendation.
(d) Under those circumstances, the research makes a conclusion regarding the nexus between climate change mitigation strategies and circular economy practices in SMCs.

Step 7: Checking whether the model requires any change
There is no indication that any change is required at this point of the research design.

3.2 Research Questions

The main question that this research intends to answer is *what are the crucial success factors for circular small and medium-sized Dutch cites in relation to climate change mitigation strategies?* To aid in answering this question, below are the related sub-questions:

- How can cities retain value and make more efficient use of their existing resources?

- What are the (existing and potential) relationships and collaborative activities among different actors in circular SMCs?
- What is the interrelationship between circular economy and climate change mitigation strategies in cities?

3.3 Defining Concepts

Circular SMCs- refers to the SMCs that are adopting circular economy principles and practices to boost the city's metabolism in the Netherlands.

Bio-based products- are those which are wholly or partially derived from materials of biological origin, excluding materials embedded in geological formations and/or fossilized (European Commission, 2017).

Collaborative platforms- refers to the potential and existing collaborative schemes in the transition process.

Elements in the transition process- refers to the activities organized within cities in transition that could be considered as the baseline of the transition process.

Innovative instruments- refers to the experimental nature of certain instruments, which may not be necessarily new, but is viewed as innovative in the context of the transition's trial and error nature

Nature-based solutions- are solutions that are inspired and supported by nature. They are cost-effective, and simultaneously provide environmental, social and economic benefits that help build resilience. Such solutions are expected to bring more diverse, nature and natural features and processes into cities, landscapes, and seascapes through locally adapted, resource-efficient and systemic interventions (European Commission, 2017).

Peoples' mindsets- Mindsets contain both intellectual and emotional elements that affects people's perceptions, interpretations and actions. They guide how we feel and think, and are formed by a combination of organizing models, beliefs, values, preferences and attitudes (Conner Partners, 2011). Based on this definition the ability to change peoples' mindset to for example purchase circular products or engage in circular economy initiatives in their neighborhoods is fundamental in the transition

3.4 Research Strategy

The research uses the grounded theory approach also known as the theory-oriented research. In this approach, similarities and differences which underlie the research object are identified (Vershuren and Doorewaard, 2010).

In that case, the research compares various practices in circular SMCs and climate change mitigation goals with each other, within the theoretical premises identified earlier and in relation to interviews conducted with the representatives from case cities, to identify similarities and differences.

3.4.1 Research Unit

The unit of this research are the circular small and medium-sized Dutch cities, namely Almere, Dordrecht, Haarlemmermeer, Venlo and Zwolle, whereas the circular ladder concepts in relation to climate change mitigation goals for cities are used as the observation units.

3.4.2 Selection of Cases

Prior to the selection of circular SMCs to analyze for the study, internet-search based research was conducted. Thereafter, a criterion was applied to select the case SMCs in the Netherlands and to narrow down the number of those most relevant for this research. The table 2 below summarizes the criteria for case selection.

Table 2: Criteria applied for selecting case cities

Criteria	**Determined by**
Have a population of between 50,000 to 250,000 inhabitants	EU definition of a small and medium-sized city
Signed Circular City Deal	The ambition of the Deal to move all participating cities towards circularity by 2050
Adopted identifiable steps towards the transition to a circular city	Project websites, repeated mention of initiatives in these cities in various documents and recommendation by experts
Availability/ability to cooperate	Ability to identify relevant stakeholders knowledgeable about circular economy initiatives in the city within the time available

The selected cities are part of the eight cities that recently signed the City Deal: Circular City-a pillar of the Dutch Government's programme on transitioning to a circular economy. Four cities from the eight were excluded as they did not meet the main criteria of a small and medium-sized city based on the population. From the remaining four cities that met the size definition of a SMC, random sampling was applied to identify the cities with relevant primary and secondary information available during the research period. Four case cities were eventually selected and the fifth city-Zwolle, was a result of snow-balling effect through referral from the Project Leader Circular Economy in Overijssel in Oost NL. The selected case cities are listed in table 3 in addition to their location within the Netherlands and the population size as of 2015.

Table 3: Selected case cities and population size

City	**Population Size**	**Province**
Almere	196,932	Flevoland
Dordrecht	118, 899	South Holland
Haarlemmermeer	144, 152	North Holland
Venlo	100, 200	Limburg
Zwolle	123, 861	Overijssel

In terms of the unique combination and compositions of the cities; Almere is the newest city in the Netherlands while Dordrecht is the oldest city in the Holland area; Haarlemmermeer hosts Schiphol Airport, the main international airport in the Netherlands; Venlo was dubbed the 'greenest city in Europe' in 2003 and in 2012, they hosted the World's largest Horticultural exhibition, Floriade whereas in Almere will host Floriade 2022.

Comparatively, two large cities Turin in Italy (899,455 inhabitants) and The Hague (514,861 inhabitants) in the Netherlands were analyzed as control cases to explain some findings that suggest the "*size of the city*" as the factor for disparities and/or similarities among cities. The intention of the comparative analysis is to identify the possibilities of creating conditions for lesson-drawing from large cities as a pro-active measure that may result to voluntary policy transfer in SMCs. The selection of Turin in Italy which is also a front runner in championing the transition to a circular economy was to identify the experiences of other cities outside the Netherlands for a broader analysis. The research also intended to identify the experiences in Copenhagen and reached out to the contact but adequate response was limited by time.

3.4.3 Research Boundary

Research boundary determines the limitation and consistency of the study to achieve the research's goal within the specific time. The following boundary is used in this research:

- The circular SMC's practices are limited to specific activities already being adopted and implemented in cities as per the circularity ladder.
- The research focuses on climate change mitigation strategies/policies aimed at reducing emissions in cities meaning climate change adaptation strategies are not analyzed.

3.5 Research Material and Accessing Method

Verschuren and Doorewaard (2010) define research material as the means of defining and operationalizing the key concept of the research objective and the set of research questions. The data and information used to address each research question was collected via:

- *Document review*- documents related to the transition to circular economy in the case cities, such as manifestos, consultancy reports by companies such as Metabolic and Circle Economy that advise cities in transition, and academic reports by renowned researchers and experts.
- *In-depth interviews*- a total 11 interviews were conducted comprising of at least one actor from the five Municipalities that provided insight on how the city is approaching circular economy activities as well as climate change mitigation strategies. The actors interviewed are central to the main activities and initiatives by cities in the transition to circular cities hence, they are representative of entirety of the processes. Identically, the interviewee from Dordrecht clearly explained the inability to find more information than the discussed during the interview. Besides this, two actors from the large cities Turin and the Hague were interviewed, two actors from small and medium-enterprises consulting on the transition to circular cities and two academia representatives.
- *Attending conferences/workshops*- the researcher attended one conference in Antwerp organized by EUROCITIES[7] on energy transition in cities as well as a webinar organized by World Bank Group on sustainable cities.

[7] EUROCITIES-a network of major European cities with members comprising of elected local and municipal governments with the objective of reinforcing the important role that local government should in a multilevel government structure.

Data collected using the above-mentioned methods was analyzed through content analysis. This is an approach used to analyze verbal and written qualitative data (Elo & Kyngäs, 2007). Content analysis was applied to analyze literature on circular economy practices and the possibilities of its contribution to meeting climate change mitigation goals for cities. Similarly, content analysis was applied to analyze the in-depth interviews held with experts and promoters of circular economy practices, municipality and academia representatives. The interviews were recorded upon consent of the interviewees and transcribing was done through word-by-word equivalent procedures immediately after the interview and sent to the informants to validate the accuracy of the information.

To guide the interview preparation, the table 4 below informed the type of data and information required and method of accessing this information.

Table 4: Data and information required for the research accessing method

Research Question	**Data/Information Required to Answer the Question**	**Sources of Data**	**Accessing Data**
How can SMCs retain value and make more efficient use of existing resources?	-The types and approach to circular ladder activities implemented by SMCs - Which circular economy practices help cities retain the value of their existing resources for resource efficiency purposes	Primary Data: Representatives from the municipalities, businesses and experts Secondary Data: Documents Literature	Questioning: Interviews Content analysis and search method Conferences/workshops
What are the (existing and potential) interconnected relationships and collaborative activities among different actors in the circular SMCs?	-Actors and stakeholders practicing circularity in SMCs -Actor's willingness to collaborate in circular activities for SMCs -Coordination of these activities	Primary Data: Representatives from the municipalities, businesses and experts Secondary Data: Document analysis	Questioning: Interviews Content analysis
What is the interrelationship between circular economy and climate change mitigation strategies in cities?	-Circular economy activities that contribute to reducing emissions in cities (directly or indirectly) -How is the implementation of related activities are organized	Primary Data: Municipality representatives, experts and academia representations Secondary data: Documents Literature	Questioning: Interviews Content analysis

In choosing the key informants, the research applied convenience sampling which involved choosing the informants willing to take part in the research within the time available for example Nadine Galle from Metabolic, Joke Dufourmount from Circle Economy, interviewees 1 and 2 and Jan Harko Post from The Hague; theoretical sampling was applied in selecting Prof. Cramer to provide insights on previous research, likewise the informants from Almere, Dordrecht, Haarlemmermeer and Venlo who are part of the City Deal for Circular Economy in the Netherlands. Snowball sampling techniques was applied to identify and interview Mr. Paul Kok from the Municipality of Zwolle. The intention of this research was to interview professionals working on policy areas of climate change and sustainability issues with a focus on the transition to circular cities. To a large extent, this was achieved and table 5 below is a brief professional description of the interviewees, their affiliations and roles, and type of interview conducted.

Table 5: Professional description of the interviewees and their affiliations

Expert	**Affiliation**	**Title and role**	**Type of interview**
Prof. Jacqueline Cramer	University of Utrecht	Prof. Cramer is a ***Professor in Sustainable Innovation*** at Utrecht University and member of the Amsterdam Economic Board in charge of circular economy. She is also former Minister of Housing, Spatial Planning and the Environment.	15 minutes' phone interview
Ms. Nadine Galle	Metabolic	Mrs. Galle is a ***Sustainability Consultant and Education Lead*** who works on among other roles, applied sustainability and circular development at De Ceuvel and was engaged in the Amsterdam Buiksloterham[8] project which currently serves as one of the global examples of circular development	One hour phone interview
Ms. Joke Dufourmount	Circle Economy	Mrs. Dufourmount is a ***Project Manager of Cities Program*** working on assessing opportunities for circularity in cities, knowledge development and quantifying circular economy efforts.	One hour Skype interview
Interviewee 1	University of Groningen	Prefers to remain anonymous	One hour Skype interview
Mrs. Bekker Milene	Municipality of Venlo	Mrs. Bekkers is a ***Senior Policy Advisor on Sustainability and***	One hour, face-to-face interview

[8] Buiksloterham- a former industrial area in Amsterdam North currently being redeveloped into a working/housing area with a wide array of stakeholders from creatives, architects, designers, entrepreneurs and currently serving as a global example of circular urban development.

		Circular Economy and has been working in this area for more than 15 years now. She was initially actively involved with environment issues and currently she is working mostly on cradle to cradle and circular economy issues.	
Mr. Martin Hulsebosch	Municipality of Dordrecht	Mr. Hulsebosch is a ***Senior Policy Advisor Economic affairs*** and previously worked as a Policy Advisor for about eight years from other roles.	30 minutes' phone interview
Mr. Erwin Lindeijer	Municipality of Almere	Mr. Lindejier is an ***Energy planner and Environmental Specialist*** focusing on energy transition related issues and has been in this role for about 15 years.	40 minutes' phone interview
Mr. Paul Kok	Municipality of Zwolle	Mr. Kok is an ***Economic Advisor*** in charge of the transition of Zwolle to circular economy and has been engaged in other roles at the Municipality for about 14 years.	One hour phone interview
Mr. Maurits Korse	Municipality of Haarlemermmeer	Mr. Korse is a ***Sustainability and Circularity Advisor*** within the sustainability programme of the Municipality.	Answered directly on interview sheet
Mr. Jan Harko Post	City of The Hague	Mr. Harko Post is a ***Policy Advisor*** at the Department for City Management in The Hague and is specialized in environmental issues, waste management and European affairs. He has been involved in this role for about 25 years.	Answered directly on interview sheet
Interviewee 2	City of Turin	Prefers to remain anonymous	40 minute Skype interview

Conducting the interviews had several goals such as being able to understand from a practical point of view, how municipalities are coping with the transition to circular cities. The discussions revolved around the implementation of ongoing circular activities with existing climate change mitigation policies and goals, with the intention of finding the possibilities of a nexus. The basic outline of the interview questions can be found in appendix A.

Operationalizing the analytical framework entailed the development of a questionnaire as the research instrument to analyze the described theories. Some of the questions linked to the analytical framework and applied in this research include:

1. How the municipality adopting circularity concepts and what is the priority areas?
2. How is the municipality considering infrastructural changes to mitigate the impacts of climate change?
3. How can cities measure the progress and the socio-economic and environmental benefits of a circular economy?
4. Has there been a need for shift in government policy and economic systems to enable the implementation of circular economy and existing climate change mitigation goals for cities?
5. What is the future of the nexus between circular economy and climate change mitigation at a policy level for cities?
6. Who are the most important stakeholders in the nexus?
7. How do the enablers come together and find a mutual understanding of a transition context, and agree over the best course of action?
8. Does the municipality offer any incentives to stakeholders implementing circularity concepts or initiatives linked to reducing CO2 emissions for example through lower prices for permits?
9. What are some of the circularity activities implemented by the municipality that are aligned (directly or indirectly) towards emission reduction and retaining resource value for cities?
10. What is the role of technology (engineers) in all the related aspects to be facilitated to move infrastructure towards circular practices?

Important to note is that the questions slightly varied for cities and other informants outside cities. For instance, due to time availability Prof. Cramer only had 15 minutes while in cases as Zwolle, the interviewee preferred an open discussion on their approach in adopting circular economy.

3.6 Data Analysis

Data analysis refers to the process of evaluating data using analytical and logical framework/reason. This is further explained below:

3.6.1. Method of Data Analysis

The research used qualitative methods to analyze data. Three complimentary techniques and procedures were adopted to aid in the controllability of data collected qualitatively. As discussed by Verschuren and Doorewaard (2010) they are ***i) sensitizing concepts and open coding-*** where all sources are made available while the intriguing/inspiring concepts become gradually precise. Actual research activities included taking notes during interviews and formulating concepts that could interpret the identified phenomena hence 'open coding'. This took place in the desk research and empirical data collection phases. During this process, data was compared, labelled and classified. ***ii) Axial coding***- based on the desk research, the concepts and insights were improved with a new and more specific meaning after the empirical phase. The various concepts (codes, labels) were correlated within a cause-and-effect diagram in form of a matrix with activities that set the transition process into motion. The conditions and context associated with circular activities and their role in reducing carbon emissions in cities were indicated and crucial success factors identified. ***iii) Selective coding***- the phenomena was described, concepts formulated and key words reduced to a concise description. Key concepts were determined based on their relations in a specific line of argumentation which in this case is the transition process and the ability of circularity concepts to reduce greenhouse emissions for cities. Specific words, phrases and sentences that were emphasized or repeated by interviewees or deemed important or emergent by the researcher were identified, analyzed and coded in different colors. Table 6 summarizes the type of data required and method of analysis.

Table 6: Data and method of analysis

Data/Information Required to Answer the Question	Method of Analysis
How cities are adopting circular economy concepts and implementing climate change mitigation strategies	Qualitative: analyzing the approach of SMCs in adopting circular economy concepts and the link to reducing carbon emissions through coding[9]
Interconnected relationships and collaborations of actors • Actor's circular approach • Actor's ability to carry out their activities • Collective bargaining	Qualitative: analyzing the roles and relationships between actors in promoting circular economy concepts and the schemes in bringing actors together through coding
Climate change mitigation goals for cities • The link between climate change mitigation goals and circular economy initiatives	Qualitative: analyzing the (future) impacts of circular economy initiatives in helping cities meet their climate change mitigation goals related to emission reduction through coding

[9] The role of coding is to 'fracture' the data and rearrange it into categories to facilitate analysis. It is developed through deductive categories (derived from existing literature), inductive categories (generated through research), and drawn from categories used by subjects (emic categories)

3.6.2. Validation of Data Analysis

Qualitative phase

To avoid research bias or reactivity, the validation of data was done through respondent validation and quasi-statistics methods. Respondent validation involved soliciting feedback on the data gathered from the interviews and drawing conclusions from the key informants. This helped to rule out possible misinterpretations of events and meaning. Secondly, quasi-statistics was used to determine frequencies and variables statistically to be able to assess the amount of evidence in the data and support a conclusion.

3.6.3 Analytical Framework

The schematic presentation of the analytical framework is as shown below in figure 6 and as derived from figure 3. The framework is presented in orange boxes overlying the elements of the analytical framework as the specific aspects the research intends to identify. The research used the analytical framework in part ***a)*** to find out the practical steps applied by cities in implementing circularity activities, the stakeholders involved in the process as well as the policy and economic instruments applied; in part ***b)*** the research looked at the types of circular initiatives adopted in cities, the enablers of these activities and the linkages with reducing emissions in cities; part ***c)*** assessed the infrastructural changes implemented in cities that aim at reducing carbon emissions and part ***d)*** looks at how circular cities can quantify and measure their progress in the transition process to be independent, resilient, rich and energetic.

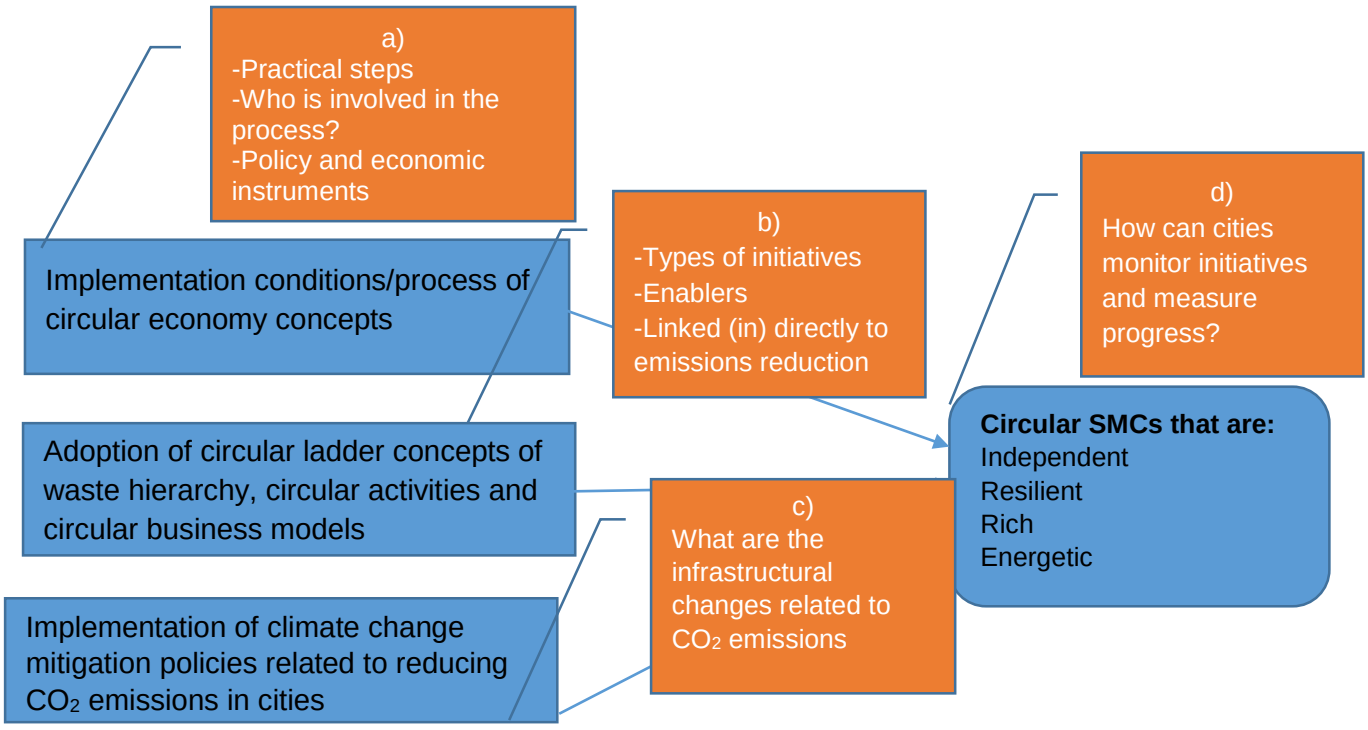


Figure 6: Analytical framework

CHAPTER 4: RESULTS AND FINDINGS

This chapter presents the research findings based on data collected through content analysis of documentation and semi-structured interviews with key informants from municipalities, small and medium-sized enterprises, policy experts and academia. Additionally, representatives from large cities as Turin and The Hague were interviewed to assess the activities in these cities as control group, as they are neither small nor medium-sized cities. The findings from the interviews and content analysis of documents and reports are presented below in three parts. 4.1 discusses on the crucial success factors for cities in the transition process, 4.2 gives an overview of the similarities and differences for the case cities in transition and in relation to the control group and 4.3 discussed the nexus between circular economy and climate change mitigation goals/policies in cities. Quotes are used in some cases to present examples or illustrations and support specific arguments.

4.1 Crucial success factors for cities in transition

Most interviewees mentioned (in) directly the experimental nature of the transition process to circular cities. Since the concept is relatively only about five years old, many cities are still trying to understand how to adopt it or identify already existing circular activities and classify them accordingly. Thereupon, it is important to identify what are enablers of the transition process and how they can be identified and accelerated, in addition to changing the approach where necessary.

The coding processes led to five main categories which informed the subsequent sections: 4.1.1 identifies important elements in the transition process; 4.1.2 discusses the identified innovative instruments in the transition that are not financially related; 4.1.3 looks at the different types of collaboration schemes and; 4.1.4 combines the issue of leadership and trust.

4.1.1 Elements in the transition process

This refers to the activities organized within cities in transition that could be considered as the baseline of the transition process. Figure 7 summarizes the indicated elements in sub-categories further derived from the coding phrases. The seven sub-categories on the left are illustrated by the image on the right as a representation of the number of times mentioned by the interviewees.

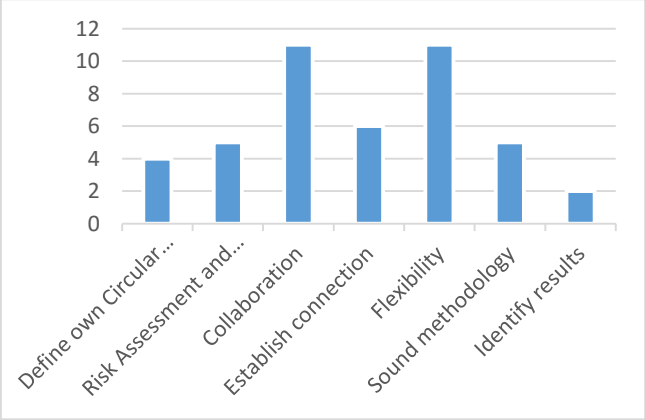
Sub-Category	Representation
• Define own circular economy • Conduct risk assessment and Current State Analysis • Collaborate • Establish connections • Be flexible in system changes and gradual shifts • Develop a sound methodology • Identify intermediate results i.e. grown enthusiasm, more collaboration	

Figure 7: Important elements in the transition process and the representation

Most of the interviewees emphasized that cities need to define what circular economy means in their specific context. As it was elaborated by the interviewee from Haarlemmermeer, cities

should ask the right questions for instance if a circular economy considers materials, energy, water or social aspects or if it is about using recycled materials or solely about the future recycling possibilities. Furthermore, what is the role of the environment/nature in relation to a circular economy. These are some of the questions that provoke cities to understand what a circular economy could mean in their local context. In addition, the interviewee from Venlo mentioned that cities should focus on making it right from the start and not less bad by opting for an easy way out. She further explained that in Venlo for instance, the approach considered in adopting circular economy activities is in designing healthy products without toxic materials to maintain the quality and value of resources' as per the principles of cradle to cradle.

Secondly, most interviewees stressed on the importance of conducting risk assessments to identify priority or problematic risk areas within the city that are prone to for example flooding, heat stress etcetera, as one of the initial steps in the transition. This is evident in all cities which, in one way or another, have identified priority areas in their approach to circular economy. Likewise, what strongly emerged, and important to note for cities in transition, is the potential of circularity that lies in areas of new development within cities. Prof. Cramer reiterated this by mentioning that small and medium-sized cities could apply new techniques to build new houses on energy neutral standards which is relatively easier to implement compared to cities as Amsterdam and Utrecht who face the limitation of what can be executed in historic areas. In another instance, Almere's new District shut down its gas pipes more than 5 years ago and currently citizens in this area, albeit the population being low, are organizing everything on their own from roads, sewage to heating systems and the municipality only provides electricity. In Zwolle, the municipality allowed access to an area for people to implement circular economy activities. In this specific case, the municipality found out that some cases which had mentioned rules as a hindrance in taking initiatives eventually did not implement any activity without the rules, while the ones who successfully implemented activities had other different reasons than the rules. The mentioned examples shows the emergent potential evident in areas of new development in cities.

Adjacent to this and equally important is that cities should analyze their current material flow systems to understand what is happening within their boundaries and how the systems are functioning. However, a point often overlooked according to the interviewee from Metabolic, is the importance of conducting current state analysis (CSA) in cities and within sectors to generate a portfolio of different systems. This was also reiterated by the interviewee from Circle Economy.

The importance of collaboration was emphasized by all interviewees. The transition is as much a systematic transition as it is an economic one, henceforth, collaborating with stakeholders is indisputable as seen in its prominence in figure 7. Different types and levels of collaborations are existing and even further, are relevant and possible and in the transition process. Prof. Cramer emphasized that stakeholders need to transcend their own goals and identify what can be achieved together by constantly sharing experiences. Example of collaboration efforts include innovation contents organized by the Municipality of Almere which has seen *coalition building* between companies that would otherwise not have met and worked together, others include the voluntary agreements in Venlo, smart coalitions in Zwolle and circular business club in Dordrecht.

Developing sound and flexible methodologies is important in the process. This could be through an integral approach to developments and projects through policy instruments. For example, Venlo is in the process of developing new policies that integrate circular economy and cradle to cradle. Venlo is also encouraging education institutes to integrate cradle to cradle and circular economy concepts into their school curriculum. Such local practical efforts

and solutions are important to inform policy formulation as policies are sometimes counterproductive to innovation since they are not up to date with development, according to the interviewee from Venlo. The interviewee from Metabolic stressed further on this point by mentioning that cities should shift from the old and typical master plan system to flexible zoning plans as in the Buiksloterham project in Amsterdam. Correspondingly, what is currently witnessed in cities is the use of green public procurement and sustainability tenders to stir creative and sustainable competition as will be further discussed in the section 4.1.2.
Other examples of sound methodologies include the development of guide book with indicators which Metabolic is designing for cities to use in tendering process to give circularity scores, while Circle Economy is working on among other projects, the evaluation and quantifying of circularity efforts to better inform cities. The research also found that constant sharing of experiences is an iterative process. More than half of the respondents mentioned the importance of combining top-bottom and bottom-up initiatives. This process helps demonstrate positive and financially attractive business cases. Another important reason of constantly sharing information is for 'front runner' or 'pioneers' to attract the middle group and slow adopters using innovative tools and methodologies. This is already evident in cities as Almere who are working with energy ambassadors, a group of enthusiastic citizens on energy issues to attract other people to participate in the process.
Lastly, the aspect of flexibility was repeatedly mentioned by the interviewees as the way of boosting creativity. In an example, the interviewee from Metabolic suggested that standards and ambitions should be given but people should be given room to experiment. This latter is further elaborated in the upcoming section.

4.1.2 Innovative instruments

By innovative instruments, the research refers to the experimental nature of certain instruments, which may not be necessarily new, but is viewed as innovative in the context of the transition's trial and error nature. Figure 8 presents some of the instruments in sub-categories and on the right in relation to the frequency mentions.

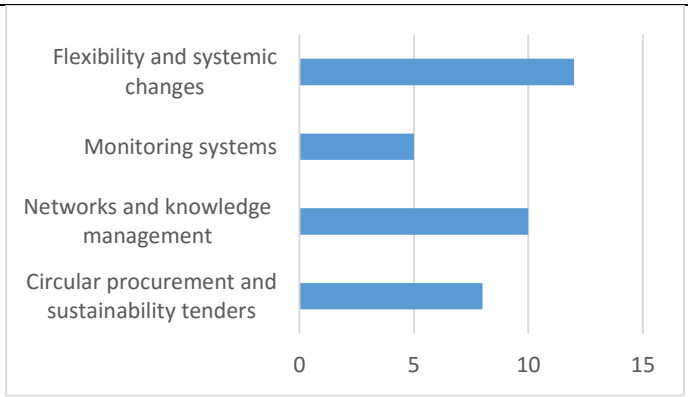
Sub-Category	Representation
• Flexibility and systemic changes • Monitoring and measurement systems • Networks and knowledge management • Circular procurement and sustainability tenders	

Figure 8: Innovative instruments adopted in the transition and its representation

The use of circular procurement and sustainability tenders as a procurement policy to monitor the recycling possibilities and material flows is evident in some case cities as Haarlemmermeer. To effect the circular procurement policy, the interviewee from Metabolic gave an example of mandating contractors to give an assembly and disassembly plan together with a materials passport to show the kind of material going to a building/city and how it can be re-used or recycled at the end of the life cycle. The adoption of circular procurement was evident in only one case city, Haarlemmermeer. As will be discussed in Chapter 5, this could

be attributed to the lack of sufficient knowledge on what types of materials are used in different sectors and how they are flowing within the boundaries of the city up to its end of life, in addition to available alternatives. To understand such flows, the use of networks is one way of helping to not only share experiences and find out what is functioning or not, but also to enable cross sector and cross-value chain collaborations as given by the respondent from Circle Economy . These types of networks are seen locally through both digital and offline platforms which can help achieve circular waste streams in neighborhoods and districts. Such networks can in a great deal help boost local economies. For instance, Almere is encouraging its local entrepreneurs to produce and sell locally in addition to establishing an Upcycle platform where people bring their old stuff which are further demolished or taken apart and resold in whole or in parts.

At the same time, Venlo recognizes the importance of knowledge management systems in the transition process. The city is deriving innovative ways of retaining new knowledge within the city especially from young skilled people who often leave to bigger cities and seek better opportunities. Venlo is creating innovative projects through cradle to cradle concepts together with the young talents in education institutes in collaboration with companies who sometimes absorb the students upon completing school. The role of knowledge institutions was reiterated by Interviewee 1 who emphasized that education institutions will play a crucial role in the transition through applied science which will greatly help accelerate the process. Likewise, the informant from Zwolle felt that education and science comes in handy in the transition to help customize innovation to fit the process and not necessarily come up with new innovation.

As mentioned in the previous section, the transition requires flexibility to give room for experimentation, innovation and creativity. Monitoring and measurement systems are central here as cities should be able to identify the impacts of their actions, both positive and negative. However, there is no specific measurement system/method predominantly mentioned and cities as Dordrecht discussed their lacking in this area. Some examples of monitoring and measurement systems mentioned by interviewees include guide book with indicators for scoring tenders, circular scores for tenders, city/urban dashboards-giving real time data of what is happening in the city, energy score cards, energy nexus, hard data measurements of water, energy etcetera and qualitative measurements. For instance, Venlo is assessing the impact of cradle to cradle in improving the health conditions of its employees and the ripple effect in saving financial costs of the municipality. Whilst Zwolle is applying principles of Lansink ladder to monitor yearly progress in regards to waste management and Haarlemmermeer has in its circular procurement key performance indicators (KPIs) that focusses on circular concepts. With this in mind, another perspective brought about by the interviewee from Venlo is that cities should be careful to measure the right things. To further elaborate, the municipality of Venlo used rain water for toilets which could not earn the municipality BREEAM certification points as it did not meet the then ambitions of the certification.

In the light of this, Venlo find that it is imperative for the transition promoter to know what to measure in order to use the adequate indicators.

4.1.3 Collaborative platforms

This refers to the potential and existing collaborative schemes in the transition process. The technical capacities of stakeholders can be tapped through different forms of consortiums which defines roles of each stakeholder. The consortiums help to capitalize on the stakeholders' strength and get things off the ground. Examples include smart coalitions in Zwolle and Circular Companies' Cooperation being developed in Almere. Another example is

the innovation contest organized by the municipality of Almere where companies collaborate on projects together and the best ideas are supported (including financially) by the municipality. According to the interviewee from Almere, the scheme helped bring together companies that would otherwise not have met nor worked together. Whilst in Dordrecht, the municipality entered a corporation with a Business Club from the region that organizes meetings with circular business cases. This year, the Business club has hosted four sessions on circular economy focusing on the re-use of electronics used within businesses and the use of waste products from coffee roasting to improve soil for agriculture etcetera.
In addition, cities as Almere invited external experts as Gunter Pauli the inventor of the Blue Economy concept, to help come up with new business opportunities for the city. By the same token, the Ministry of Infrastructure and Environment in collaboration with other consultancies helped Dordrecht identify the challenge posed by the chemical sectors' waste stream and the large potential for circular economy in its recovery and re-manufacturing sectors. Whilst, TNO investigated the economic impact of Haarlemmermeer's sustainability policy and one of the results indicated an increase in the amount of 'circular jobs' in the municipality, at 9%.
What is central in the described partnerships and schemes is to not only, find actors who can orchestrate or steer the process and bring people together but also to identify the different stakeholders' level of influence in the society. For example, the interviewee from Haarlemmermeer mentioned that in their analysis, circular economy has a big impact in the building and construction of public spaces (roads, public parks, schools, and etcetera) and housing. However, the municipality's level of influence on housing is smaller compared to that of public spaces which they can influence using tenders/procurement policy. To reiterate this, the interviewee from Venlo said '…*when we have a bigger span of control we can decide what we want to do in these buildings, but when there is a private party who wants to build something, we have less possibilities, we try to persuade and inspire them but we cannot force them to do it'*.

4.1.4 Leadership and Trust

All the interviewees outside the municipalities, in one way or another, characterized the municipality's ***leadership*** as being "*active, present and visible*" in the transition process. Expressively, the City Hall of Venlo Municipality is a vivid example with its monumental building built on the principles of cradle to cradle, this building also uniquely serves as a communication tool for the public.
Trust is equally an important issue and this was frequently mentioned by the interviewees. The transition involves giving and taking sufficient trust from different stakeholders that foster the process to move faster with evident success. The interviewee from Metabolic mentioned that Municipalities could set the rules and not necessarily the outcome expectations. This is already evident in areas as Zwolle where the municipality designated an area for citizens to experiment with circular economy activities and in the new District in Almere where citizens are organizing everything themselves.
The informant from emphasized that by all means, for circularity to be embedded in people's lives, a sense of ownership of the transition process is required; in this case openness, keeping of promises, perseverance, courage, shift from blame culture and co-creation amongst others were pointed out.

4.1.5 Highlights of this section

As mentioned in the beginning of this section, identifying crucial success factors of the initiatives happening in the city not only gives evidence on the feasibility of the process but is central to encourage even bigger steps moving forward for cities in transition amid other goals

as climate change mitigation. The table 7 gives a summary of the activities in the transition processes in three sections, goals defined, steps undertaken and the expected outcomes. The activities indicated in this table are a detailed and dissected analysis of the four success factors previously discussed and as derived from the interviews.

Table 7: Goals, steps and expected outcomes in the transition to circular economy

Goal	**Steps**	**Expected Outcomes**
Define own circular economy	-Ask the right questions -Make it right from the start -Do it right than less bad	True functioning circular economy
Materials knowledge	-Identify the types of materials and their use in different sectors -Identify material flows and feedback systems -Identify alternatives	-Current State Analysis of material use and flow -Materials passport -Material assembly and disassembly plan -Resources map
Risk management	-Assess problematic areas -Prioritize these areas -Focus on areas of new developments	 -Resources map -Flexible zoning plans
Develop sound methodology	-Have an integral approach to developments and projects -Establish a connection using circular business models -Combine bottom-up and top-down initiatives -Use data to continuously innovate	-Best practice -Guide book with indicators
Collaborate	-Transcend individual goals -Define roles based on influence -Constantly share experiences -Innovation contents -Host inspirational workshops	-Positive citizen and business attitude -Smart Coalitions -Voluntary agreements -Circular companies' cooperation
Keep citizens engaged	-Integrate citizens in sustainability vision -Demonstrate initiatives as use of CAR glasses -Identify enthusiastic people to create awareness	-Open innovation platforms -Local sharing platforms -Networking platforms
Change in current economic systems	-Explore opportunities to keep money locally -Demonstrate financially attractive business cases -Price externalities -Change tax systems -Energy funds to support citizens' initiatives	-Decoupled economic growth and local CO2 emissions -Local finance systems -Increased circular jobs

Shift in policy and regulations	-Connect new legislation with up to date practical solutions -Adopt more flexible zoning plans -Stir creative and sustainable competition through green public procurement policies and procedures	-Circular economy becomes norm than exception -Shift in political priority and landscape
Adopt non-financial instruments	-Develop circularity score for tenders -Use procurement policies to monitor recycling material flows	-Circular procurement -Sustainability tenders
Develop monitoring and measurement instruments	-Know what to measure and the indicators to use -Identify challenges in the process -Ensure transparency in operations/systems	-City/urban dashboard -Lansink ladder -Energy score cards -Circularity score for tenders
Information sharing and knowledge management	-City to city learning -Retain new knowledge within city through creative concepts as cradle to cradle	-People are challenged positively -Tap young talents
Active and present leadership	-Orchestrate the process -High ambition level -Create a connection	-Visibility -Energy -Money
Enhance trust	-Give and take trust -Create a sense of ownership -Keep promises -Give legitimacy and room for experimentation -Set out the rules of the game and not outcome -Open feedback	-Goes faster with success -Successful business models -Flexible competition policy -Shift from blame culture

4.2 Cross-case analysis

This section gives a brief analysis of the case cities experience and the lessons drawn from each case. Experiences from other cities as Turin and The Hague whose population size does not fall in the scope of small or medium-sized cities are discussed to identify if the size of the city matters in the transition. Section 4.2.1 discusses the role of municipalities in the transition process based on the case studies and 4.2.2 discusses on the size of the cities explaining the relative similarities and differences for the case cities in relation to Turin and The Hague.

4.2.1 Role of municipalities

The interviewee from Zwolle stressed the fact that whether municipalities engage or not, cities are in transition based on the current global economy.

In all cases, an evident pattern emerges showing that the municipalities have delineated priority areas/sectors in the transition process, engaging with a diverse group of stakeholders. Regardless, there are some visible similarities and differences on the roles played by each city as well as the adaptive capacity in terms of resource available and ability to coordinate responses. For example, cities as Almere, Dordrecht and Haarlemmermeer seem to be more engaged in orchestrating the process while Zwolle plays a much little role compared to these cities as they instead give room for businesses to explore. Almere seems to more be salient in financial investments of circular economy initiatives, to point out, it is investing approximately 2 million euros on building a heating system to dry wet biomass and make paper in addition to organizing and financing innovation contests and so forth. While Zwolle and Venlo are more inclined towards people oriented investments compared to financial ones. The interviewee from Venlo expressed the worry in using financial tools because when it stops to exist, there are possibilities that some people retract from engaging yet financial tools should not be a precondition to act or not.

When it comes to the shift in policy instruments and/or systems to factor the transition simultaneously with climate change mitigation strategies, there is some slight variation. In Dordrecht for example, circular economy is presenting a larger political bargain, to put it differently, political parties with the intention of stimulating the economy are more attracted circular economy compared to sustainability; Haarlemmermeer is identifying the different roles within the municipality to create an integral approach; Venlo is developing new policies to integrate circular economy and cradle to cradle; Almere's Energy policy is emerging stronger on sustainable energy as the city wants to be energy neutral by 2022 and Zwolle is more careful with the shift and tries to ensure they do not put in too much money and energy but instead the Municipality tries to be more creative in the process.

Identical to this, is the issue of incentives offered by the municipality for the transition process. Majority of the cities do not have incentives to support circular economy activities but are offering other forms of support, instead. For example, Venlo hosts and organizes meetings and inspirational workshops with stakeholders, Haarlemmermeer is supporting projects in schools and sports club to help reduce the use of energy, Almere is creating a cooperation for circular companies in addition to supporting a group of horticulture businesses, as one of the founding fathers, to be 100% sustainable. Besides this, they (Almere) also give discounts to permits worth over 1 million euros for renewable energy.

All things being considered, to this extent, all the cities and other professionals outside the city have learnt some lessons on the transition process. Some of the lessons are here enlisted in relation to the success factor/conditions in the transition process as shown in Table 8:

Table 8: Lessons learnt by stakeholders in the transition process

Success factors/conditions	**Lesson Learnt**
1. Use innovative non-financial instruments such as sustainability tenders and circular procurement to stir creative competition	Combine both small and big steps for example policy as well as engaging with citizens at the local level and get them to help raise awareness and involve communities to participate (E. Lindjier, personal communication, July 11, 2017). Policies or regulations do not always hold back most innovations as many people suggest, what is required instead is to approach issues differently than we currently do (M. Korse, written communication, July 13, 2017)
2. Encourage flexibility at all levels, as there is still an aspect of trial and error in the transition to a circular city	High standards and ambitions should be used to guide people but not define the end results. Instead people should be given a chance to use their full creativity. In the end, a true circular city is one that is embedded in the local context and in people's lives through systems and structures (N. Galle, personal communication, June 26, 2017). Energy and good political will from all levels (local, national to EU) are mandatory to scale up bottom-up initiatives and take them steps further (J. Dufourmount, personal communication, July 18, 2017).
3. Facilitate cross-sector and cross-value chains collaborations schemes through smart coalitions, innovation contests, etc.	The transition cannot be made possible if actors act alone, it is a system change and this requires new financial and organization management to land it operationally (J. Cramer, personal communication, July 3, 2017). A multi-disciplinary expertise is required from knowledge institutions through teaching, learning and putting things into practice to help fasten the transition process. Companies in transition should take advantage of research institutes to fill research gaps through applied sciences (Interviewee 1, personal communication, July 4, 2017).
4. Give and take a great deal of trust in the transition process	Be close to people and make them recognize the real meaning and value of the transition by translating the communicated messages and intentions (P. Kok, personal communication, July 17, 2017). The traditional sustainability thinking pointed out so much on the negative side, people should however, be challenged more positively. For instance, people should be encouraged to consume products designed in such a way that it can be reused in the production process other than being victimized for consumption. In addition, cradle to cradle proves to be a positive innovation story that focuses on doing things right from the start (B. Milene, personal communication, July 10, 2017).

4.2.3 Size of the city in relation to the transition process

As mentioned above, the researcher gathered experiences from the city of Turin and The Hague based on the same questions asked for the case study cities, with the intention of analyzing if there are any differences or similarities in the transition process depending on the size of the city. During the interviews with the SMCs, the question on the disadvantages SMCs have over bigger cities was asked and the following were some of the selected aspects from the list provided by the research*; obsolete human capital base and limited access to resources* were mentioned twice while *out-of-date infrastructure, dependence on traditional industries, declining regional competitiveness and competition between growing industries* were also identified.

In Venlo for instance, the interviewee mentioned that quality is leaving the region in reference to young people with knowledge and fresh talent moving to bigger cities leaving a fast-growing aging population which presents a challenge for the city. In Almere, the issue of reduced number of Full Time Employees (FTE) to about two or three is limiting the municipality from achieving its full potential towards achieving their energy neutral goal by 2022. Haarlemmermeer is facing the challenge of increased competition with growing industries for instance noise pollution from Schiphol airport together with developing residential areas.

Interviewee 1 from the University of Groningen further reiterated the challenges faced by SMCs in regards to the investments needed to pursue expected changes and benefits in the long term. Prof. Cramer from University of Utrecht, in retrospect, felt that small cities in some cases move faster due to their limited bureaucracies compared to bigger cities. She identified human resource as the main advantage bigger cities could have over smaller cities, as bigger cities have the capacity to mobilize their human resources to focus on circular economy. This disadvantage is evident in the case of Almere explained here above.

The informant from Zwolle felt no big difference between SMCs and larger cities as the people and problems are the same. Though what may be the difference is the issue of space to enable circular economy activities. The interviewee further mentioned major issues to be considered by all cities irrespective of the size include: i) return logistics- is a major issue in the transition as space to some extent is required to facilitate circular activities; ii) finance-different structures are needed to finance circular economy and; iii) rules and regulations-this may hinder certain activities for instance the extents of recycling. For that reason, the interviewee felt smaller cities have a bigger potential to deal with the mentioned issues as volumes are smaller, land complicated issues are controllable and it is easier to mobilize people compared to bigger cities.

Based on the experiences from Turin and The Hague, some similarities and differences in implementing circular economy activities, in comparison to SMCs were identified as shown in table 9.

Table 9 : The list below shows some of the similarities and differences in relation to size of the city

Similarities	**Differences**
Circular procurement is one of the three priority areas for The Hague in adopting circular economy issues just as other SMCs are practicing.	In as much as Turin perceives their transition process to be slower as it is yet to develop its circular economy strategy, the city is visibly active globally, for example, the Deputy Mayor of the city attended and signed the Servile Declaration on circular economy in addition to

	participating in a global hackathon. To this extent of the research, the case cities do not have such international experiences and exposures.
The Hague municipality, just as in the case of Zwolle, prefers 'facilitating circularity concepts' type of initiatives than financial related as cheaper permits. The municipality is keen on resource management as opposed to waste management and they are experimenting with the concept of ***resource broker***. In this concept, businesses are helped to understand the value of their waste streams as resources for other businesses and they are linked to help extract maximum value from these waste streams as resources	What is also happening differently in case of Turin, is that the city is incentivizing companies to calculate their CO_2 emissions during construction projects and to compensate through forest related activities. This is also included in the public bidding process. In addition, the city is currently developing municipal regulations to give more incentives (including financial) to events organized sustainably.
In Turin, there has been a shift in the Energy Policy to promote district heating and switch to the use of natural gas. What is striking however, is in the food recovery and food waste sector, which is one of their priority areas for circular economy, national government legislations were changed to support the local initiatives. Previously the national legislations hindered the implementation of local initiatives due to the strict government regulations on food. This is an evident example of local practical solutions informing national regulations since passing of the law, more actors are seen to be working on reducing food wastes in Turin.	The status of The Hague being a center of government gives them an upper hand in implementing activities as improved energy efficiency in government offices. The city is connecting as many government office buildings as possible to facilitate heating and cooling and this processes helps to minimize energy loss.
From Turin's experience, one of the lessons learnt, which is like other cases, is that the transition should focus on making it right from the start than less bad. An example given by the interviewee is that in the energy transition most people often opt initiatives that produce best results with the least investment and this eventually becomes rapidly expensive to intervene in the system bringing challenges in the future. This corresponds with the approach taken by Venlo in designing products without toxic materials to maintain the quality and resource value	Another evident difference as identified by the researcher is the visibility of bigger cities in international networks and events. For example, the researcher met the informant from The Hague in an event organized by EUROCITIES.

Generally speaking, and a point often overlooked, the terms 'pace setter' city or 'leading cities' are often used to describe cities that are forefront in the transition process, and often assumed to refer to bigger cities. However, this is not necessarily true, as despite the challenges faced in SMCs, there are evident similarities in the steps undertaken in the transition and impacts so far. This goes to show the potential of SMCs to make even bigger strides in the transition to a circular city. Irrespective of the size of the city, the transition process will require tailor-making of own activities and development of certain specific expertise to enable the process.

4.3 Circular Economy and Climate Change mitigation nexus in cities

The research inquired from the key interviewees if there are possibilities of a nexus between circular economy and climate change mitigation goals at this point in time or in the future. The questions asked were, *what is the future of the nexus between climate change mitigation and circular economy in cities? Who are the most important stakeholders in the nexus? What kind of research is required to inform and motivate cities to better understand the potential and possibilities of the nexus?*

Majority of the interviewees found an 'indirect' link while others had not 'thought about it'.

What evidently came up is the fact that the topic of climate change has been for a long time a key topic for cities and there is an evident shift to discussing circular economy as a one-sized approach to sustainability. Circular economy is expected to accelerate over the next decades to be mainstream in the society. In the following section, there is an analysis of data that informed the researcher on the possibilities and practicability of the nexus.

4.3.1 It is 'one story'

Majority of the interviewees find the issue of circular economy and climate change to be 'one story' as illustrated in Box 1. The interviewees from the municipalities were mainly policy makers working in areas as circular economy, sustainability, cradle to cradle and economic affairs. Most of them mentioned the gradual shift of their work from sustainability thinking to circular economy. For instance, in Venlo the interviewee mentioned 'a*t first I was working more on the environment and now you see more shift to circular economy and cradle to cradle'*. This shows the interrelated roles that city official's play and the indirect link of circular economy and other initiatives

Box 1 Extracts from the interviews which reiterate the interlinkage between circular economy and climate change

- *'….it is one story because of climate change and resource scarcity, not only are there changes in the physical environment but also in the economy…'*
- *'…. any transition to a true functioning circular economy is inherently going to help mitigate climate change.'*
- *'...the link between circular economy and climate change is becoming more and more apparent'*
- *'…there is the trickle down all along the value chain when changing the use of natural resources…'*
- *'…circular economy will stimulate a lot in terms of climate change…'*
- *'…there is a big future, circular economy will lead to reduction of resources and save costs, so it is not only about climate change mitigation….'*

- *'…circular economy, it is coming out pretty fast perhaps as a different point of departure with CO_2 reduction, energy transitions, etcetera…'*
- '….*in mitigating and adapting climate change, most of time when you close loops in terms of energy, raw materials, water, etcetera, you also include how to make cities resilient, adaptive in terms of climate adaptation'*.
- *'…circular economy is part of the climate change endeavor'*

In the meantime, when it comes to the coordination or handling of both issues in the municipalities, in some cases the interviewees mentioned the lack of adequate time to consult with colleagues working on climate change mitigation issues who are spread between water and energy fields. While in Haarlemmermeer the interviewee mentioned that despite the indirect effect of emission reduction through material resources, which is their focus on circularity, *'it is hard to be an active actor and monitor in this (emission reduction)'* and in Almere case, it was clear that the '*fact is you have to do both but that is also a conflict on the resources available (the money available to do things)'.*

4.3.2 Potential area of nexus in programs/initiatives/sectors

The question on the future of the nexus leads to a mention of some specific sectors, areas or initiatives to which circular economy can in a great extent influence the potential of cities to reduce their CO_2 emissions. Majority of the interviewees found an evident nexus in the areas **of *i) building and construction of public spaces*** for example roads and houses. In this sector, the interviewee from Haarlemmermeer discussed the high potential of CO_2 emission reduction evident in avoiding materials as concrete and the use of fossil fuel based materials as tarmac through innovative circular economy practices. The respondent from Zwolle likewise mentioned that the shift in this sector is big and '… *people will no longer invest in building or construction not based on the principles of circular economy. The defunct volumes will in turn help reduce CO_2 emissions at a great deal'.*

Secondly, the use of **ii) *bio-based alternatives*** where for instance, Haarlemmermeer is already supporting such initiatives while Almere is adopting the use of (renewable) wood for fuel. However, in Almere the debate constantly emerges on the negative impacts of using wood from forests and the impacts on climate change, despite their resolve to use some types of wood which are too small and cannot be used as wood material.

Also, frequently mentioned is the topic of **iii) *mobility***, which is one of the infrastructural changes adopted by the municipalities to reduce CO_2 emissions. This was identified as an area of potential nexus especially with the issue of logistics related to mobility being very much present in cities. Some examples mentioned include the principles of *sharing economy* observed in Uber as well as the transition form good to services as in Phillips. ***Iv) nature-based solutions*** present an opportunity of overlap of both issues and can be investigated further in future. Lastly, the subject of ***v) people's changing mindset*** whereby, compared to the past, there is growing knowledge and awareness on alternative consumption options than the current sophisticated products. As identified, there are high possibilities, and already existing examples of people creating small interconnected economies in industrial and residential areas through circular innovations, digital and local platforms and so forth reducing human impacts on the physical environment.

From the larger cities, Turin and The Hague, the point of nexus was identified in urban metabolism and climate planning. This refers to the analyzing of flows of goods, materials, resources and energy within the city and identifying areas of making improvements in these metabolisms by using the principles of circular economy. For illustration purpose, Turin is part of a European project called *Urban Wins* where they are mapping and discussing urban metabolisms to develop a strategic plan on managing the waste cycle. In this process, an area of potential nexus is evident in that the urban metabolism part will help reduce CO_2 emissions and the waste cycle is inclined towards circular economy. Likewise, the interviewee from The Hague found the transition from waste management to resource management in both municipalities and businesses to present a potential for future nexus, as the benefits of resource efficiency will translate into energy efficiency contributing to climate change mitigation.

4.3.3 Relevant stakeholders in the nexus

As in most societal issues, stakeholders are important. For the nexus between circular economy and climate change mitigation issues, the research inquired from the interviewees on the most important stakeholders that would help realize the nexus. The interviewees identified public authorities, residents, research institutes, SMEs and data providers.

Public authorities are from a vast variety of societal and economic roles ranging from local government, municipal owned privatized services as waste management, water and energy distribution, among others. The role of the national government was explicitly mentioned as important to create an emphasis on the connection (nexus); however, they are lacking in streamlining activities within their ministries and this could be a problem for deploying the nexus. Further, as mentioned by the respondent from Venlo, local governments are usually more experienced and innovative than national governments thus, national governments should use existing practical solutions to legally arrange how things should work in the nexus.

Residents of the city, also referred as citizens, are important as they are closest to their neighbors and can promote a '*movement for transition'*. Citizens are essential in the nexus as they are the ones to adopt the circularity activities and as suggested, more investment should *de facto* be made to people and ensure the necessary information on the transition to circular economy amid mitigating climate change, is meaningful and of value. The use of demonstrations can help make information meaningful and of value to citizens. Almere for instance is using CAR 3D glasses to vividly show the initiatives planned as windmill installations near residential areas and citizens are welcomed to view enabling a better understanding of the co-existence. Another example is the use of urban dash boards with real time data on resource flows within the city which is open to the public to view flows of materials as water within the city. The initial step is to gather enthusiastic people/citizens such as the energy ambassadors in Almere who raise awareness and involve more people to participate. The most compelling evidence of what a small group of enthusiastic people can do is in the case of Venlo municipality where it took less than ten people to convince the government to shift to the new city hall building constructed on the principles of cradle to cradle principles, see figure 9.

Figure 9: Venlo new City Hall built with cradle to cradle principles (Source: Researcher)

Research institutes or knowledge generating organizations were also identified as important in not only the continuous generation of knowledge but also to customize innovation as it may not be necessary to come up with new innovations now, rather to be more creative with what already exists.

In the same fashion, the role of ***data providers***, who can be government, private sector, research institutes, among others, is prominent. They play an important role in informing the process, showing the metabolism of the city and motivating 'follower cities'. This was specifically mentioned by the respondent from Circle Economy, who said that the general lack of data to back up circularity efforts impeded the quantification of benefits, and disadvantages of a circular economy. Such data can help decide on what is working and what is not. Currently the Organization is working on assessing the development of circular jobs in the Netherlands. The role of technology came out clear in the context of providing and spreading data. For instance, the informant from Metabolic discussed on the urban/city dashboard which is an almost real-time data showing different resource flows in an urban center showing how materials/resources are re-used and cascaded into the system. This is already evident in some cities and the public is open to check and see for instance where water is coming from and how it is used. Another key point in relation to data, is measuring the right things. For example, Venlo's new city hall building ambitions did not meet BREEAM's certification criteria of saving water as they could have earned points by saving drinking water but instead the building used rain water to flash toilets. BREEAM certification conditions has changed since. However, this is to show the importance of knowing what kind of data is available, for what purpose it can be used and how people can translate such as financial benefits, health benefits and so forth.

Small and Medium-sized Enterprises (SMEs) and local entrepreneurs can play different roles in the nexus. For example, the respondent from Metabolic mentioned on the existing gap between residents and researchers, with attention to being a key player of the Buiksloterham project in Amsterdam, and the needful role of SMEs to play a liaison role. By the same token, SMEs can connect 'leading cities' with 'follower cities' as already their work traverses those cities. Other roles of SMEs are to develop circular solutions for everyday problems and in the light of local solutions for global problems. Almere emphasizes on SMEs making products from local resources asking local entrepreneurs to keep and sell locally. Whilst in Zwolle upon realizing the role of SMEs in its economy, they are keen on ensuring do not continue with business as usual in the company's product chain to secure raw materials.

Lastly, ***fundamentalistic people,*** those who profoundly believe in either circular economy principles or climate change mitigation were identified as important since these two concepts are crucial for cities.

In as much as the list may not be an exhaustive representation of the necessary stakeholders as some interviewees either begun by saying '*basically everyone',* or *'may be hard to say right now',* or that it will vary depending on what stakeholders' in the region are busy with, as well as, the focus of the region/city, it can be said that this gives a general overview of the nexus.

The next chapter presents the discussion of this research findings and give answers to the research sub-questions by linking the analytical frameworks and interview findings. This will help contextualize the results of the interviews with other findings of this research.

CHAPTER 5: DISCUSSION

This chapter discusses the main findings of the research based on secondary data from existing literature together with empirical data from the interviews conducted. The crosslinks between the applied analytical framework findings in Chapter 2 and interviews findings in Chapter 4 provides answers to the research sub-questions. The structure of this Chapter is in line with the research sub-questions as presented in Chapter 1. The first research question is answered in section 5.1 discussing how cities can retain their resource value and make efficient use of existing resources, section 5.2 illustrates the existing and potential collaboration frameworks among actors and stakeholders in the transition process, and section 5.3 discusses the nexus between climate change mitigation goals for cities and the transition to a circular economy.

Small text boxes are used in the beginning to provide direct answers to the research sub-questions which are further discussed hereafter.

5.1 Resource inefficiency and retaining existing resources value in cities

This section argues the various ways cities can retain the value of their existing resources. This is an aspect core of circular economy based on its definition by Ellen MacArthur Foundation (2016) and the World Economic Forum (2014) that circular economy is an industrial system that is restorative and regenerative by design. Box 2 provides initial direct answers to the first research question.

How can cities retain their value and make more efficient use of their existing resources?

-Through conducting material flow analysis and current state analysis to understand what is happening within the boundaries of the city to better inform the diagnosis process.
-Through activities such as Total Cost Ownership/Life Cycle Costing thinking as well as using bio-based materials and reusing/refurbishing.
-Adopt concepts as resource broker to shift from waste management to resource management thinking by linking businesses together.
-Create local digital and offline sharing platforms to connect citizens and achieve circular waste streams.
-Develop and maintain fresh knowledge and talent in the city through creative projects.
-Adopt green public procurement policies as circular procurements and sustainability tenders to stir creative competition and ensure resources are used to their optimum.
-Requesting material passports as well as assembly and (dis) assembly plans from contractors to gain materials knowledge and understand what can be re-used at the end of life cycle.
-By using networks to effect cross-sector and cross value chain collaborations.
-By encouraging local entrepreneurs to produce and sell locally.
-By taking advantage of technological developments.

5.1.1 Size of cities in relation to retaining resource value

One of the interviewees rightfully mentioned that cities are *large enough to make a difference but small enough to make it happen*. This means that cities present the right scale to experiment and identify what works to create a ripple effect for initiatives to spin off. In connection to size of the

city, Siegel and Waxman (2001) identified six challenges faced by small cities. The findings of the empirical research found that of the six, issues related to obsolete human capital base and limited access to resources were repeatedly mentioned by interviewees from the case cities. In some cases as Almere, the interviewee projects a challenge for the city to meet its energy neutral goal by 2022 with the reduced number of full time equivalent employees, unless the national government intervenes and increases their budget allocation on energy related issues. Prof. Cramer agrees to this as she mentioned that bigger cities have more capacity to mobilize their staff to focus on circular economy issues on top of other issues cities are already tackling. The ability of big cities to be part of international networks as EUROCITIES and being present in the global scene means increased knowledge and access to information on what is happening and to some extent this provides them additional advantages as access to finance or other resources related frameworks.

Comparatively, the issue of human capital base is also experienced in smaller cities whereby young and fresh talent migrates to bigger cities in search of better opportunities leaving a much older population. This is a big challenge considering circular economy initiatives require creativity, innovation and experimentation which is commonly characterized by younger generations. In addition to the issue of human resources, other issues as out-of-date infrastructure, dependence on traditional industries, declining regional competitiveness and competition with growing industries arose. Cities as Haarlemmermeer are experiencing competition between growing industries as airports amid the development of residential areas facing noise pollution issues.

Despite the challenges, the potential of small and medium-sized cities is still relatively high in the transition process, as to this extent the large cities investigated have not made comparatively large steps. As Capello and Camagni (2010) mentioned, with better knowledge and position of small and medium-sized cities, the challenges faced can be met more precisely. For instance, organizing local sharing platforms as in the case of Almere's Upcycle platform where people bring their old stuff which is further demolished or taken apart and resold in whole parts. This is more feasible and practical in smaller cities compared to larger cities for instance Amsterdam which face social segregation and crime issues according to Erickcek & McKinney (2006) that can greatly impede such initatives. This means that front runner SMCs can take such advantages and capitalize on the strengths of their decision making systems and spare for infrastructure development as houses and roads, to develop in a circular manner. This is evident in the cases in China where cities and municipalities are using economic and administrative incentives to create interconnected processes in their recycling systems (Matthews and Tan, 2011).

5.1.2 Shift from waste management to resource management

Granted that population continues to increase, the issue of resource scarcity in the current global economic system persists and business as usual is no longer be tolerable. China took a significant step in 2008 by proclaiming circular economy as its central goal and enacted the Circular Economy Promotion Law to help the country leapfrog into a more sustainable economic structure (Zhu and Qiu, 2008).

For cities, this means that knowledge of their material flows and current state analysis of the sectors that drive their economy is crucial, the same goes for the product value chain in businesses operating within the city. Organizations as Metabolic are helping cities identify intervention points by conducting material flow analysis to understand the current state of neighborhoods and advice on what alternative materials can be used and the kind of emissions

that can be reduced in addition to the biodiversity impacts of the alternative materials. This sort of guidance helps cities draw valuable materials from their waste streams towards being a zero-waste city. Zaman and Lehmann (2013) describe a zero-waste city as where same materials are repeatedly used until its optimum level of consumption. In a similar fashion, The Hague is experimenting with the resource brokers' concept which helps businesses understand the value of their waste stream as a resource for other business and connects.

To retain the knowledge of value of existing resources, it is imperative to foremost shift thinking from waste management to resource management. Waste streams serve as the ideal starting point for cities to value its resources in specific sectors. With success in retrieving resources from these waste streams, more people and sectors will come on board and it is creating such local economies and local impacts that triggers global change and impacts.

5.1.3 Decision-making hierarchy

Since the adoption of Ad Lansink motion in 1979, there has been an incremental use of the waste management hierarchy which prioritizes prevention of waste then reusing, recycling the final option is to incinerate and dispose wastes in landfill. Cities as Zwolle are adopting the principles of Lansink ladder to assess their current situation in regard to waste disposal and the amount of raw materials saved through recycling. This kind of decision-making hierarchy deems promising for cities to know how to retain value of their resources. Correspondingly, companies as Metabolic are helping cities with the decision-making hierarchy by identifying ways of reducing material use, creating local synergies to cascade resources throughout the system and monitoring and management of information feedback loops to ensure for example use energy is sustainable supplied. Another example is the tapping of heat from industrial areas as energy for district heating and cooling.

Similar efforts are seen in Dalian City in China where the city increased waste reclamation by encouraging enterprises to pursue ISO 14001 certification and embed the 3R principles with production procedures (Geng et al.). In addition, the municipality established and demonstrated a waste reporting system to trace and track waste flows and these efforts led to a 17% decrease of municipal waste generation per capita, 17-20% increased waste water and solid waste treatments (Su, Heshmati, Geng & Yu, 2013). The city recorded that consequently these initiatives led to reduced consumption of virgin material and waste disposal.

Ordinarily, waste management practices are already evident in most cities for a long time and looking ahead in retaining resource value; educational, technological and social advancements will help improve these activities in the auspices of the decision-making hierarchy. For instance consumption behaviors and decisions could be guided by Total Cost Ownership (TCO) which helps buyers determine the direct and indirect costs of a product or a system. By the same token, Life Cycle Costing (LCC) could help to determine the most cost-effective option among different alternatives in relation to purchasing, owning, operating, maintain and finally disposing. The indicated efforts will drive consumers' consumption choice which in turn will influence resource and value retention in cities.

5.2 Collaboration Schemes in Cities

The transition to circular cities just as tackling climate change related issues is to a large extent dependent on collaborative efforts. The nature of problems faced by cities and their solutions is deep rooted to societal concerns as mind-sets and the interconnectedness of actors working on

similar issues. What differs in most cases include problems related to capacity based on the experience of different actors in handling these concerns and in the event of that, the importance of collaborations is apparent. In this section, the important stakeholder collaborations in working towards emission reduction and helping cities retain their resource value are explained. Box 3 provides initial direct answers to the second research question.

What are the (existing and potential) relationships and collaborative activities among different actors in circular SMCs?

Diverse stakeholders are engaged in circular activities in SMCs. The collaborations are mostly based on roles and capacities of actors, and the level of influence in the society. What matters in all the collaborations is the need of a stimulator or someone to orchestrate the process. Moreover, collaborations are enhanced through agreements and voluntary manifestos which bind actors to planned actions.
At this point in time however, it is fair to say businesses and consumers are the most important stakeholders in the transition to circular SMCs. This is because businesses are coming up with new products, services and business models on the circular economy principles that requires consumers' purchasing power and willingness to adopt.

As with most societal issues, collaboration is core in the transition process. Most of the efforts however start small as apparent throughout history. In the transition to circular cities, the current efforts is enabled by small groups of people coming together as pace setters in different capacities and sectors. In the local community level, we find initiatives organized as in Almere's new District with a relatively small population planning all their systems and infrastructure independently in a circular manner. The municipality of Almere is also using small groups as energy ambassadors to create awareness to other members of the community on energy issues; while Venlo is hosting inspiration workshops for the community to engage in progressive activities in the city; and Turin is working with local food vendors towards reducing food waste and enabling food recovery as one of their circular city ambitions. The common nature of these activities at the local level is starting with the low hanging fruits to trigger the bigger actions. Small initiatives help in changing peoples' mindsets as it is at this level that transformations start particularly with concepts as circular economy which need to be translated in a meaningful and valuable way for people.
Another level of collaboration is on the business level. In this time and era, making business sense of societal change is imperative. Businesses need to understand the impact of their current decisions in the future and initiatives as Smart Coalitions in Zwolle and Circular Business Cooperation are enabling this. At the same time, businesses are helping municipalities understand what is happening within the boundaries of their cities through consultancy projects and technologies, facilitating processes and bringing different types of actors together, generating data, providing products and services to residents of the cities to name a few. Similarly, cross-sector and cross value chain collaborations are important in tapping value of circular waste streams. This means that in the transition, businesses play diverse roles and they can be said to be at the core of the process.
Government and other public authorities are on the positive side viewed as enablers or stimulators of the process and on the negative side they are perceived as a hindrance. There is a thin line in governments' engagements in the transition process. Nonetheless, governments are responsible

for its citizens and therefore their engagement may not always be the most favored but fundamental. With understanding the trial and error nature of the transition process, governments should give more room and flexibility for the process, while playing an oversight role to ensure in any case there is no detrimental effects in the society. This is explained by one of the interviewees in that as much as sharing platforms as Uber and Air BnB are great examples of a transition from products to services, one of the circular business models. They, on the other hand, may have negative impacts on the social fabric in some parts of the city. That being said, governments should be close to citizens and businesses to foster trust and collaborations towards meeting similar goals. The most crucial role that governments can play include formulating policies, laws and giving tax incentives to initiatives that help cities reduce their emissions and reduce the over-reliance on natural resource and instead take advantage of their resource values.

Knowledge and education institutes are important actors for development of up to date information in the transition process. Knowledge institutions help make sense of the process by identifying and filling knowledge gaps. Most of the innovations in the transition process is effected through applied research and this can be built with young and fresh talents in knowledge institutions supporting the 'creative disruption' nature of the transition.

To give a structure to such collaborations, cities are working through schemes as smart coalitions, circular business cooperation, and open innovation platforms and in some cases voluntary agreements are signed to keep the actors committed to the process.

Important to mention however, as mentioned by the interviewee from The Hague, citizens and business can be fairly said to be the most important stakeholders in the transition process as they are the 'engine' of a city in terms of production and consumption, This confirms UNEP (2013) statistics that the global economic production is concentrated in cities where 80% of global GDP is produced.

To conclude, collaboration comes with trust, information sharing, leadership and willingness of actors to recognize mutual gains and realize problems to be solved. Actors need to know their level of influence and complement efforts where possible. To reiterate, Prendevillea et al (2017) argued that the geographic proximity of stakeholders aid in collaboration to close resource loops and this is effective in cities.

5.3 Circular Economy and Climate Change Mitigation Policies in Cities

Cities are in transition, which means there is a shift from the traditional linear economy to a more circular economy and this is apparent in various sectors in the city. One of the important components of the transition process is in energy transition which is also core of climate change mitigation goals for cities in relation to reducing CO_2 emissions. This means that the transition to a circular economy is central for cities aiming to reduce CO_2 emissions as part of their climate change mitigation goals. Important to note however, is the practicability for small and medium-sized which are faced with among other challenges, limited access to resources and comparatively lower human resource capacity. The question is whether to combine these two core concepts and aim for an integral approach or let the indirect link prevail?

This section debates the point of nexus between the two concepts in terms of specific activities mentioned by the interviewees that can help propagate the process of cities meeting climate change mitigation goals. Box 4 provides initial direct answers to the third research question

What is the interrelationship between circular economy and climate change mitigation strategies?

Though not directly, circular economy concept in one way or another is expected to help cities reduce their greenhouse gas emissions. The coordination process is still vague in terms of allocating human and financial resources given that most circular economy initiatives are still in the trial and error phase while for a very long time in cities have been working towards climate change mitigation (and adaptation). With the current shift in political priorities to circular economy, cities need to identify ways in which the two concepts can effectively be correlated. Currently, a potential nexus is identified in areas as building and construction of public spaces, use of bio based alternatives, mobility, nature based solutions and change in people's mindsets. This presents an opportunity for cities to communicate the same message with the limited resources.

The study of Bulkeley and Betsil (2003) found reasons why cities are significant areas to address climate change and influence local governments to reduce emissions. In the light of this, circular economy initatives have proven to in a great extent influence waste production in cities as previously discussed through initatives as the decision-making hierachy and tapping of resources from wastes. Likewise, municipalities are currently working on translating and communicating circular economy issues to its stakeholders as a way of involving people in the transition process as previously described. For exanple is the Municipality of Venlo's new city hall building constructed on circular economy principles is cucrrently serving as a communicaition tool to citizens. As discussed in Chapter 4 on the experiences gathered from the case cities, there are many incentives and financial support offered by the municipalities to support circular economy initatives. Nonetheless, there are several financially attrative business models being implemented by actors and with this, cities can demonstrate the possibilities of circular economy initatives to reduce GHG emissions in the endevour of lobbying and garnaring support from national governments. Lastly, with the transition, there is evidently going to be a need for government policy and economic instruments to shift. Even further this is already happening in some cities as Venlo where the city is planning to combine circular economy and cradle to cradle into one strategy.

Besides this, there are already evident potential conflicts/challenges in the nexus as in the case of Almere where the use of biomass for fuel is on one hand seen as a circularity practice while on the other hand a trigger of climate change. Similar conflicts are noticed in land use for producing organic material (agricultural purposes) or circular or energy transitions for example building or for solar panel etc. Another key challenge as mentioned by the informant from Haarlemmermeer is the lack of direct influence by most players to actively push for the nexus based on technological developments, culture developments and autonomous developments.

All in all, the benefits of the two integral issues are critical for cities to complement in each other and better integration is impetus to gain mutual benefits in terms of people, planet and profit.

5.3 Summary of the Chapter and Emergent features

At this point in time, it can be said that there are three groups of people in the transition process to circular economy as shown in figure 7, consisting of the *front runners*, also known as pioneers, the *middle group* and *slow adopters*. The most important group of people who will accelerate the transition process is the **middle group**. The middle group can be categorized as the people who are interested to adopt circular economy initiatives in their neighborhoods, productive sectors, among others, but are not fully incorporated in the discussions and processes. Focus and attention should shift to this group in cities. The slow adopters on the other hand, require more time and resources to convince others on the necessity of the transition and shift in current methods of utilizing resources, materials, products, services and so forth. Whilst for the front runners, there is need of additional support to accelerate and scale up the ongoing initiatives to demonstrate the feasibility of the transition, and provide blue print for the middle group to evaluate what could (not) work.

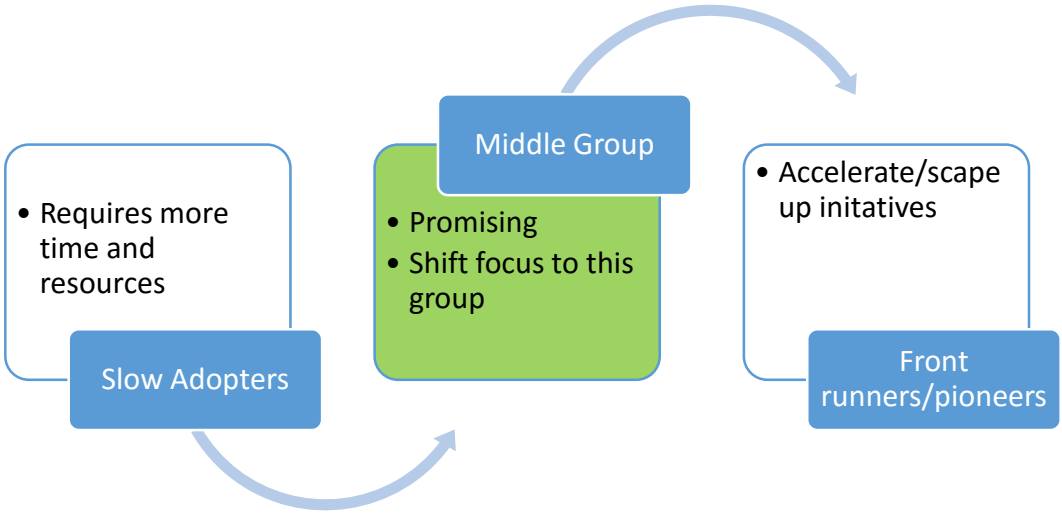


Figure 7: Categories of actors in the transition process

This section discusses four categories and conditions of success identified through empirical data. The experimental nature of circular economy concepts requires the use of data and performance indicators to constantly monitor and measure progress in addition to innovate. The kind of information and knowledge derived from this process will help better inform policy processes and economic systems of possible shifts. In this instance, policy makers at the national level need to monitor local activities and work closely with local governments to identify practical solutions that will ensure policy and legislations are not counterproductive to initiatives and innovations on circular economy.

By all means, the findings of the research reiterated on the importance of stakeholders in the transition process. Collaboration schemes can be formed at all levels and with all kind of stakeholders, by bringing together the most enthusiastic people and identifying the level of influence of this group in the society. This collaboration is bound together using voluntary agreements and manifestos which states the commitment and role of each stakeholder in process. Voluntary agreements are ideal to help show the level of interest and commitment in the transition process. They also help actors identify as part of a systems change and belonging to

such groups gives the stakeholders mileage in areas as increased sales, exposure by invitation to forums and in other cases access to funding. The aspect of leadership is important in orchestrating and stimulating the transition process. This stimulating role can help bring closer the middle group, define ambitions, foster collaborations and experience sharing and in the end, give room for experimentation of initiatives.

In the final analysis, a true functioning circular economy will help cities meet their climate mitigation goals and strategies. The point of nexus identified for the two concepts lie in the areas of: (i) mobility, (ii) building and construction of public spaces, (iii) use of bio-based alternatives, (iv) nature based solutions and (v) change in peoples mindsets as shown in figure 8. In that case, the relevant results altogether lead to addressing the main research question, *what are the crucial success factors for circular SMCs in relation to climate change mitigation strategies?* In addressing this question, the research provides knowledge to the research gap on the minimal incorporation of circular economy concepts in climate change mitigation strategies. Henceforth, this research concludes by stating that the crucial success factors for circular SMCs in relation to climate change mitigation strategies is to factor in the four conditions by innovatively linking the five potential areas of nexus. The experiences learnt in the process will give SMCs basis in developing integral policies incorporating the two concepts that will undoubtedly define the future of cities.

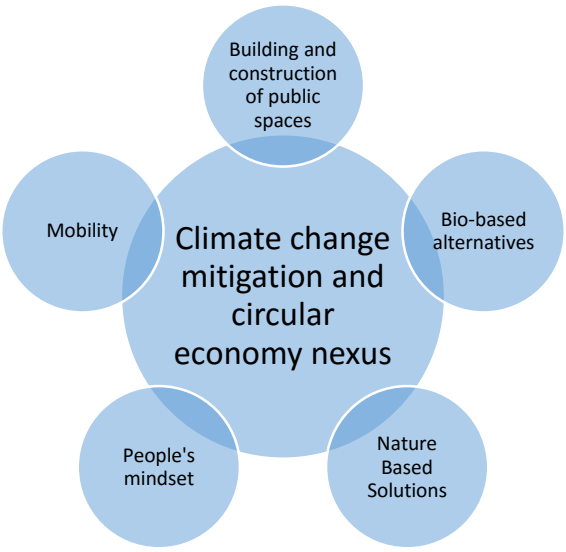


Figure 8: Areas of nexus between circular economy and climate change mitigation strategies in cities

CHAPTER 6. CONCLUSIONS AND RECOMMENDATIONS

The purpose of this research was to identify the possibilities of a nexus for circular cities in transition in relation to climate change mitigation strategies. The immediate aim was to understand how cities are adopting circular economy concepts in the transition process, and to link this process to meeting climate change mitigation strategies. This chapter brings the most important results of the research together. The concluding remarks are presented in section 6.1 which addresses and integrates the research questions to the previous sections. This leads to section 6.2 presenting recommendations for the future of the transition of small and medium-sized cities to circular cities in relation to climate change mitigation strategies. Section 6.3 critically reflects on the research methods applied and discusses the gaps identified for future research.

6.1 Conclusions

To aid in addressing the main research question on the success factors for circular small and medium-sized cities in relation to climate change mitigation, three sub-questions were addressed. In the first sub-question, the research sought to identify how cities can retain their resource values and make existing use of their existing resources. This is an aspect core of circular economy in in its restorative and regenerative nature to ensure that the values of resources are not only used to their optimum level but also retained within the system for as long as possible. Evidently, the knowledge of materials and resources within the boundaries of the city is a fundamental step in understanding what and how to retain resource value. In that case, the research found that cities should conduct material flow analysis and create a portfolio indicating the current state analysis of materials and resources in neighborhoods, productive sectors etcetera. This will help to better inform the diagnosis and decision-making processes on retaining value of existing resources and this aspect was not evident in the case cities, to this extent of the research. Some of the activities identified in this process include conducting Total Cost Ownership/Life Cycle Costing thinking, using local digital and offline sharing platforms to reuse/refurbish materials and achieve circular waste streams. Similarly, the adoption of green public procurement procedures such as circular procurement and sustainability tenders deems promising to help cities retain the value of their resources. Examples of identified activities in this process include developing material passports and material (dis) assembly plan in the construction sector to help cities understand what types of resources are used until the end of its life cycle. Another point that came up is the need for shift in thinking from waste management to resource management and capitalizing on networks to enable cross-sector and cross-value chain collaborations. This process will help cities realize the wealth of resources that lie as waste and in turn retain their value. The resource broker concept, which helps to identify the value of waste resources for other entities, is being experimented at a low scale in The Hague. This represents an evident pattern of circular economy initiatives which at the moment are mainly in an experimental and trial and error phase. However, with evident success, the transition process will scale up and move faster.

The second sub-question aimed at assessing how actors are coming together, or could come together, and create interconnected relationships and collaborative activities in circular SMCs. Incontestably, the transition process requires diverse stakeholders to come together with the hope that their actions triggers systems change. There are numerous actors active with circular economy activities in cities ranging from SMEs, education institutes, citizens and the local government. At this instant, collaboration schemes are based on the roles and capacities of actors

in addition to their level of influence in the society. Important to note, the pre-condition of enhancing collaborations and bringing people together is the availability of a stimulator or someone to orchestrate the process, and altogether, to formulate voluntary agreements and manifestos to foster actions.

The third sub-question aimed at assessing the interrelationship between circular economy initiatives and climate change mitigation strategies in SMCs. It came out clear in the research that, albeit indirectly, a true functioning circular economy will in a great deal help cities reduce their emissions. Although this may be true, the fact remains that small and medium-sized cities, in comparison with larger cities, are at a disadvantage in regards to inadequate human capacity, limited access to resources and out-of-date infrastructure. Projecting into the future, the research found the following *areas to present high potential for the nexus*: (i) building and construction sector; (ii) the use of bio-based alternatives; (iii) mobility; (iv) nature based solutions and (v) people's mind-sets.

Lastly, the main question this research aimed to address is the success factors for circular cities in relation to climate change mitigation strategies. In the final analysis the research found the most prominent conditions for this success to be: (a) use of innovative non-financial instruments as sustainability tenders and circular procurement to stir creative competition; (b) encourage flexibility at all levels as there is still an aspect of trial and error in the transition to a circular city; (c) facilitation of cross-sector and cross-value chains collaborations schemes through smart coalitions, innovation contents , etcetera; (d) give and take a great deal of trust in the transition process.

6.2 Recommendations

Cities play a crucial role in reducing global emissions of carbon dioxide. Circular economy initiatives are eminently proving promising to accelerate this process, and cities are undeniably already in transition. What is important for cities to note in this process, is how to create interlinkages with climate change mitigation goals and strategies. The five potential *interlinkages* areas identified by this research are mobility, building and construction of public spaces, use of bio-based alternatives, nature-based solutions and change of people's mindset. SMCs can bring together actors in these areas and share resources and knowledge to develop circular initiatives, activities or business models that aid in reducing carbon emissions. By identifying this intervention points, SMCs acquire competitive advantages in the near future with regards to access to resources and meeting global targets.

The table 10 below presents the proposed recommendations for circular SMCs in relation to climate change mitigation strategies in the short-, medium- and long-term. In this case, short-term can be defined as the time scale between now and 6 months, while medium-term is between 2 and 5 years and long-term to be 5 years and beyond.

Table 10: Summary of the recommendation, time-scale and indicators based on the success factors/conditions in the transition process

Time scale / **Success factors/conditions**	**Short-term**		**Medium-term**		**Long-term**	
	Recommendation	**Indicator**	**Recommendation**	**Indicator**	**Recommendation**	**Indicator**
1. Use innovative non-financial instruments such as sustainability tenders and circular procurement to stir creative competition	Invite stakeholders and review current City tendering procedures and policies	Identify and incorporate Key Performance Indicators on circular economy to include in public tenders	Adopt circular procurement and sustainable tendering process to trigger innovation	Competitive and creative bidding process for public tenders and increased awareness	Enactment of new procurement policies and laws incorporating circular economy	Shift in procurement systems and policies
2. Encourage flexibility at all levels, as there is still an aspect of trial and error in the transition to a circular city	Invite enthusiastic individuals and external experts with technical know-how to give guidance on the transition process	Innovative and up-to date solutions proposed	Establish collaboration schemes to bring together the front runners and the middle groups	Defined, reliable and functional collaboration systems and schemes	Build new infrastructure and design new systems based on lessons learnt	Exemplary best practices on feasible business models
3. Facilitate cross-sector and cross-value chains collaborations schemes through smart coalitions, innovation contests, etc.	Identify local environmental pollution problems and the required knowledge, information and infrastructure to tackle with circular economy concepts	Analysis of problematic areas as sources of waste stream and their potential resourcefulness	Conduct material flow analysis and current state analysis of the crucial sectors	Resource flow map and portfolio of current state analysis	Create platforms to connect local businesses and enterprises to foster local economy	Local orientation of resources and selling of locally produced and manufactured goods

4. Give and take a great deal of trust in the transition process	Allow circular economy practices to come from grassroots knowledge	Developed interest and technical capacities at local levels	Develop positive synergy with the government	Effect policy shifts and economic systems based on local practical solutions	Develop new policies and legislations based on local practical solutions	New integrated policies and legislations

Local governments in SMCs should take advantage of their strategic positioning close to citizens and their potential to drive change at this level to reduce the high energy consumption and waste production in cities. Local governments need to demonstrate financially attractive business models implemented by actors at the local level to lobby and garner more support from the national government. Being that local authorities are considerably more experienced in addressing environmental impacts, this provides a great opportunity to work closely with national governments and assess possibilities of accelerating circular economy initatives to address the challenges faced as climate change.

With all being said, cities should take speedy actions and reduce CO_2 emissions from their industries, infrastructure, waste streams and so forth. Circular economy is present, and the vast opportunities that come with it should not be left to chance by cities in this time and age. This research in that case, hopes to have sufficiently informed relevant actors on the low hanging fruits and areas of potential nexus to invest the relevant available resources for SMCs.

6.3 Reflection on methodology for further research

This section reflects on research methods applied all through the research and the extent to which the findings might have been influenced by the chosen methods, the possible shortcomings and special circumstances.

The circular ladder, which served as one of the elements of the analytical framework applied by the research introduced three components: *circular activities, circular business models and the waste hierachy*. The three formed the basis of assessing the adopted circularity concepts. Of all the aspects per component, the research was able to identify the adoption of reycling, repair, remanufacturing, reuse and redistribution, refurbishment, remanufacturing, upcyling activites that form part of the waste-hierachy. Sharing platforms, recource loops, products-a-service and circular design business models were also identified. This forms part of the circular ladder but to the extent of this research, other activities and business models were not sufficiently covered. This could be attributed to lack of information from respondents in the business sector (companies) who are developing, designing and implementing the related activites and business models. In the event of this, there are high possibilities that other activities in the circular ladder could aid in reducing emissions in cities as part of climate change mitigation strategies.

On the other hand, due to the broad and global nature of climate change, the research approach focused on the transition to circular cities as the entry point to assessing climate change mitigation strategies. As a result, the research is inclined more towards the implementation process/conditions of circular economy concepts in cities' element of the analytical framework. This method means there could be some issues related to climate change mitigation strategies for cities that might have been overlooked. Similar concerns were addressed by one interviewee who mentioned that to efficiently address some of the questions, he needed to consult with colleagues working on climate change mitigation issues, who were busy clearing work load in preparation for holidays. However, the research was determined to understand the nexus and make meaningful conclusions and recommendations. In that case, during the interview process the researcher was intentional to constantly bring up the linkage of circular economy practices with climate change mitigation, to not only understand the implementation of related issues but also to give a broad understanding during the interviews. Another observation, is the stressed attention to climate change adaptation issues in the Netherlands due to the challenges (and

opportunities) of the country being under sea level. This means that for most cities such as Dordrecht, more attention is on climate change adaptation compared to mitigation. In any case, circular economy is rightfully described by Murray et al., (2015) as the most recent attempt to conceptualize sustainable intergration of economic activity and environmental wellbeing. This means that both climate change mitigation and adaptation strategies can be addressed through circular economy.

Consequently, the methodology reflection process helped identify opportunities and possible revelant areas of further research in cities. For instance, further research could assess the nexus of circular economy and climate change adaptation policies/strategies. Furthermore, to encourage the shift and adoption of circular economy practices, cities need to assess the impacts of their activities so far. This is an area also identified through the interviews as lacking and presents an opportunity for future reseach, to assess the benefits of circular economy in a particular context, backed with sufficient data.

Lastly, and importantly, further research can assess in detail the impacts of the five areas identified for potential nexus of climate change mitigation and circular economy to inform future policy formulation processes.

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APPENDIXES

Appendix A-Interview outline and the questions and answers

RESEARCH SURVEY TEXT

June 2017

Dear Sir/Madam,

I am a **student at the University of Twente** (UT) pursuing Masters of Environment and Energy Management. I am conducting a research as part of my thesis which aims to assess 'The nexus between Circular Economy and Climate Change Mitigation Policies for Small and Medium-sized Dutch Cities'. This research is supervised by Dr. Laura Franco-García from CSTM Department at UT.

The transition to Circular Cities and its interaction with existing climate change mitigation policies/strategies for cities presents an opportunity to accelerate this process. However, understanding the practicability and implementation process is particularly important to identify the crucial success factors for circular Small and Medium-sized Cities (SMCs).

It is for this reason that I would like to discuss and share your thoughts based on your knowledge and experience on related issues. I will highly appreciate your inputs in answering the following questions which can also be discussed via phone or Skype (my contacts are as below). If preferred, your participation can be anonymous. Your opinion will be analysed statistically and used only for purposes of this research.

Thank you in advance for your willingness to contribute to this research.

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A.1 PROF. JACQUILINE CRAMER

What are the opportunities for lesson-drawing and policy transfer for small and medium-sized cities from large and mega-cities already adopting circularity activities as Utrecht?

Well, in my experience sometimes, smaller cities can move ahead in some respect faster because their bureaucracies are less complex so it is not always that the big cities are the front runners, they just have more money and expertise and are able to mobilize their staff to focus on circular economy compared to smaller cities. But the decision making is sometimes easier, not always, it depends on the composition of the city council.

How can cities measure progress and capture the socio-economic and environmental benefits of circular economy in reducing CO2 emissions?

Depending on the level of policy formulation, it could be national or local government. What governments presently are starting to do, which they did not do before is they are formulating policies in terms of not only being energy neutral by 2030 but also outing these goals into strategies as it is easy to formulate these beautiful ambitions but if do not have a strategy you will not make it. For example, in the Netherlands some cities are already busy with the energy score cards or energy nexus where they assess what they want to achieve and put the ambitious goals they need to have in place for example renewable energy systems as using the heat emitted from industrial sites and the possibilities of energy saving.
Hence, cities need to have an idea of what they can reach with what kind of goals and then see how they can connect for instance parts of the city to heat storage systems while in another region for instance new housing can be built on energy neutral standards through the newest techniques which are not easy in to implement at the centre of cities as Amsterdam and Utrecht because of the limitation of what you can do in historical areas.

What are some of the important short-term and long-term instruments required by cities in transition to a circular city simultaneously with meeting climate change mitigation goals?
Depends on the definition of a circular economy, most cities define circular economy regarding closing the loop of products and materials, ensuring the storage capacity of natural systems including the transition towards renewable energy systems. In many cases energy is part of the circular economy. In terms of mitigating and adapting climate change, most of time when you close loops in terms of energy, raw materials, water etc you also include how to make cities resilient, adaptive in terms of climate adaptation. In principle, depending on the definition, ***climate change is part of the circular economy endeavour*****.**

Will there be a need for shift in government policy and economic systems to support and enable the implementation of circular economy and existing climate change mitigation goals for cities?
The first thing is of course the pricing of the externalities as the problems we cause are not prized, for example pollution is not prized. If you put all the external costs of pollutions into the creator of the product, you can make resources and fossil fuels more expensive, then transition can be much faster.
Changing the tax system is the most important change you can make but it is the hardest change in many cases that should be done at the EU level and you get a lot of quarrels because 1/3 do not want hence the reason the effective measure is not in place.

What are the forward looking (practical) steps for cities in transition to circular cities and who are the enablers for such transitions?
So, you need to find out which kind of (resources) renewables can be used in which part of the cities and in the neighbourhoods and set up bottom-up approach and involve the citizens and make sure they are part of the transition towards sustainable housing for example. Also include all the industries and put the ambitions in terms of strategies for companies especially SMEs because you can easily do that at a local level compared to bigger companies which are regulated via provinces in the Netherlands or the national government. Also for the traffic and transportation you need clear strategies and you need to work with stakeholders to set-up concrete action plans for the short-term and long-term and make sure you stick to these plans. Of course, you should

make sure you connect with the national governments to make sure that some of the things are changed at national level as some of the changes you cannot make at local levels.

Who should take the lead role in effecting citizens engagement in the transition process?
The best thing is for local citizens to pick the lead in the neighbourhoods as they are the closest to their neighbours to get a movement for transition. When a local government tries to be in the lead, chances are the citizens think the government is organizing everything but it is not possible without the support of citizens who should change their behaviour and the same goes for retail companies if they are not feeling responsible for climate change themselves and wait for government to act there are a lot measures that are not taken as they should take them themselves. It is a plus (plus), everybody must take their responsibility and play a role.

What are some of the key lessons learnt from your experience in promoting and accelerating for circular economy in cities from an academic perspective?
Most of the transition towards the circular economy cannot be made if actors act alone, you must work together, it is a system change meaning you must have people that orchestrate or steer the process, the ones that try to mobilize all the people, there needs to be consortia of local government and companies that really make this change, and new financial and organizational management to get things off the ground. It is really a system change.

A.2 NADINE GALLE- METABOLIC

What is your position at Metabolic and for how long have you been involved in this role?
Nadine Galle is a Sustainability Consultant at Metabolic and worked in this role for 1 year. Earlier, she worked on the De Ceuvel project to advance Metabolic Lab's work on applied sustainability and master classes and workshops on related issues for about 6 months.

What are some of the circularity activities that are aligned (directly or indirectly) towards emission reduction and retaining resource value for cities?
Metabolic work is central on material flow analysis and additionally on intervention points. We conduct material flow analysis to see how the current state of a neighbourhood, city or region looks like, thereafter we identify the intervention points as what other materials could be used and further analyse of what kind of emissions can be reduced and the biodiversity impacts if alternative materials are selected.
We work in a decision-making hierarchy in retaining resource value that is we first look at how to reduce material use, then how to find local synergies to cascade certain resources throughout the system to retain their value. Afterwards we see how we can manage to get information feedback loops to continue monitoring the systems and check the supply of the energy within the systems to ensure it is supplied in the most renewable ways possible.

How can cities delineate the priority areas in implementing circularity activities simultaneously with climate change mitigation policies?
Foremost is through conducting a risk analysis to find out which areas of the cities are at most at risk to climate change for example lower levels as coastal areas that are susceptible to flooding, frequent storms etc. From the risk analysis, one could pick priority areas. Generally, areas close to water are likely to be a problematic area.

While in implementing circular activities, it is important to focus on areas that are about to undergo new development compared to areas with numerous national monuments. An example is the Buiksloterham, a former industrial area in Amsterdam North currently being redeveloped into a working/housing area. After the companies left, the area was attracting lots of criminal activities as few people lived there. Hence the area become an interesting case study especially since the city of Amsterdam was becoming congested. The municipality wanted to develop the areas through the typical standard master plan way but after the financial crisis most of the projects did not go through. Instead, a wide array of stakeholders from creatives, architects, designers, entrepreneurs were invited through a Sustainability tender open for people to temporarily use the piece of land for about 10 years in a creative and sustainable way. The De Ceuvel project helped to do the material flow analysis for the circularity potential in the area and they identified potential to experiment with new materials. The outcome of the project was a 10 year of circular development manifesto which was voluntary signed by 25 parties comprised of diverse range of people who would not sit on the same side of the table usually for example energy, suppliers, big housing corporations, creatives, architechts, small design studios, local water authority boards and city of Amsterdam. Numerous projects are slowly coming up now attracting city delegation from all over the world to learn on the Buiksloterham as a global example of circular urban development. The nature of the project is very organic and bottom-up which makes it unique and could be a key success factor.

Who are the most important stakeholders in enabling circularity in cities?

The city government- the more the municipal and local government are involved the better. The Federal Government helps to put circular economy into the agenda so it trickles down to the municipality who play the main role in local development.

Second is the energy and water suppliers. Third is the water companies in general as circular urban development projects are still experimental with how to deal with sanitation, waste water treatment for drinking water and with that water authorities are important to ensure that the water is safe for the citizens. Fourth is the original residents of the area. These stakeholders are not necessarily listed in the order of importance.

How could cities measure progress and capture the socio-economic and environmental benefits of circular economy?

There are two main ways.

First is by setting up urban/city dashboard which is already happening in some cities. Hereby there is almost real-time data from different resource flows in an urban centre showing how materials/resources are re-used and cascaded into the system. It is open to the public for anyone interested to see where their water is coming from and how it is used.

Second, the use of Sustainability tenders to kick-start new urban developments. Metabolic came up with indicators to determine which tenders are the most circular. We created a guide book for civil servants working in the government to use it and compare tenders, give a circularity score and pick the most circular tenders based on a sound methodology. (check the published report on Amsterdam).

How can you characterize the state of municipality leadership in the transition to circular cities in The Netherlands?

In the case of the Buiksloterham project Amsterdam's municipality leadership is quite high and they work closely with other Departments to include circularity in all the new developments working in the city, which is quite positive. Amsterdam municipality play's a visible role, you see them in many events and, they organize events for younger people, facilitate meet-up events for local residents, creatives and entrepreneurs at the Buiksloterham project. Everything can be faster but in general they are very active. Amsterdam is playing a leading role, and Rotterdam too is implementing various circularity initiatives.

What are some of the short-term and long-term instruments to support the transition to a circular city simultaneously with meeting climate change mitigation goals for cities?

Long-term: To set-up flexible zoning plans for different areas compared to the typical master plan for 20-30 years that are more rigid. A zoning plan is more flexible for experimentation.

Short-term: Planning instruments as the Sustainability tenders which enables more land use and land leasing through use of tenders as it draws the most creative and best ideas as people are put in competition with each other.

Also, the municipality should seek from new developments both an assembly and disassembly plan for different building plans as well as a material passport so that contractors know what is going into a building and what comes out of it to know what can be re-used at the end of life cycle and if not possible to re-use, how can it be recycled.

Which approach is most effective, top-bottom or bottom-top in implementing circularity activities simultaneously with climate change mitigation goals for cities and why?

Both. Bottom-top: is important to give people the idea they are included and it is their city while the top-bottom helps to ensure it is done in a safe and responsible way. Government should retain an oversight roles and give lenience and flexibility to the bottom-top people executing on the ground.

Will there been a need for shift in government policy and economic systems to enable the implementation of circular economy and existing climate change mitigation goals for cities?

The whole circularity approach is a new way of doing things for example the flexible zoning plans and tendering process are new and will require certain systems change for it to become a norm and not a one-off system change. It however goes quickly once people realize it is a success and they feel positive about it.

In the wider EU context, the Horizon 2020 is sponsoring interesting projects which look at the synergies between European cities as it makes more sense to close the loop (logistic and finance wise) in a wider scale within Europe. Nonetheless, in transitioning to a circular city, you should make sure at what level it makes sense to close the resource gaps.

What is the future of the nexus between circular economy and climate change mitigation goals for cities at a policy level?

Any transition to a true functioning circular economy is inherently going to help mitigate climate change. For example, the use of Nature Based Solutions is more of an overlap with circular economy. Climate Change mitigation is more on a global scale but locally we should look more critically how clean the city is on a local scale. Hence, in the future, I would want to see how we

take the global ideas of climate change mitigation and circular economy and focusing on more local environmental pollution solutions to get there.

What kind of research is required to inform and motivate cities to better understand the potential and possibilities of the nexus?
Foremost, which is too little now, is to look at the Current State Analysis of different countries, cities, sectors to get a portfolio of different CSA of different systems. However, we need to know the current flow analysis of different resources and different systems.

Who are the most important stakeholders in the nexus?
Residents of the risk areas of the cities, researchers from Universities and Small and Medium-sized Enterprises.
More partnership is required between the residents and researchers which is an existing gap that SMEs as Metabolic can play a liaison role as they have more ties with the city inhabitants. Also, the link between 'leading cities' and 'follower cities' which are typically smaller and can learn from the leading cities.

What are the forward looking practical steps for cities in the transition to circular cities and who are the enablers for such transitions?
Conducting a material flow analysis to know/understand the current state and pick the priority areas.

How do the enablers come together and find a mutual understanding of a transition context, and agree over the best course of action?
The idea of a Manifesto from the Buiksloterham was interesting and few cities have gone that route. It is scary for cities as it involves giving and taking a lot trust. However, it works well in the end as people feel a big sense of ownership. People who sign the manifesto are more determined to keep their promises. The more the Municipality is in control the less the residents take control. The municipality should recognize such projects and give them the legitimacy to move forward through awards, room for experimentation, leniency on permits etc.

What is the role of technology (engineers) in all the related aspects to be facilitated to move infrastructure towards circular practices?
They play a large role for the new infrastructure that is required for a truly circular city as local nutrient recovery, alternative sanitation/waste water treatment rain water filtration areas etc which will require them to implement them properly.
However, they will play less of a role in the facilitating of getting them and more of a role in the execution. But it is smart to have them on board as early as possible to say what is possible.

What are some of the key lessons learnt your experience in promoting sustainability and circular urban development?
It is important to set the rules of the game but not the outcome. For example, in the Amsterdam Buiksloterham project is open to build and design whatever and however but needs to meet a high sustainability standard/ambitions (filter own water, reuse own water etc), but only the rule of the game not the end result. Giving people guidance but also giving them a chance to use full creativity- (bottom-up and top-down approaches meet in the middle). You give me a little bit of freedom I give you a little bit of freedom.

In true circular city, people would not talk about circular city. It should be embedded in people's lives, it should be system and infrastructure that is incorporated into the local context and in people's lives.

A.3 JOKE DUFOURMOUNT-CIRCLE ECONOMY

What is your position at Circle Economy and for how long have you been involved in this role?

Joke Dufourmount-Project Manager of Cities Program at Circle Economy since January 2017.
My job mainly consists of two parts: Circle City Scan on assessing opportunities for circularity in different cities. This entails mapping material flow, assessing policy opportunities, potential breeding grounds for circular innovation among others. The second part is about knowledge development and quantifying the circular economy as there is a general lack of data to back up circularity efforts. We try find how can we do impact evaluation and analysis of our efforts within the circular economy using different tools, indicators, identifying what types of data do we need and what types of data is available etc

How can cities delineate the priority areas in implementing circularity activities simultaneously with climate change mitigation policies?

The link between circular economy and climate change is very much about GHG emissions related to resource extraction. So, the resources used between circular economy and climate change is a bit of an in-between.
However, we need an urban policy making or urban level impact, irrespective of the impact being much larger beyond the borders of the urban territories. What we see is that circular economy is also complex and involves areas as logistics and mobility which are very much present in the city. Therefore, cities can look at the circular economy principles that are directly related to greenhouse gas emissions within the territory of the city for example in mobility.

Who are the most important stakeholders in enabling circularity in cities?

Local enterprises are essential in the cities transitions. However, their efforts are best fostered by a player who could be an authority, an innovation board, chamber of commerce, public entity board etc. The government should facilitate and enable businesses and engage citizens as we see a lot of bottom-up initiatives, which need the support to scale up.

How could cities measure progress and capture the socio-economic and environmental benefits of circular economy?

The circular economy might be a relatively new name for another concept, so you find there are a lot of measuring instruments and indicators out there that partly covers circularity efforts for instance value recovery, air quality, etc.
However, what is limited is to capture circularity in a holistic way, that is the challenge for the future especially when it comes to socio-economic impacts as the actual employment effects. In our ongoing projects, we have for example developed a methodology to assess the circular labour market to identify how many people are employed in this area. We also map resource flows through cities and identified that cities do not know what resources flow within their city and this is essential information when it comes to circularity.

How can you characterize the state of municipality leadership in the transition to a circular city in The Netherlands?
I am quite impressed with Dutch cities, municipalities and local governments. There are a lot of efforts, energy and money going into the circular economy. I am not sure how much of the consequence is thanks to the influence of the local government, but I would define the leadership as being present, ambitious and emerging more tangibly. The attention that is being paid for circular procurement for example is quite impressive, it is not every city/municipality but what we see is that there is a lot happening for example in initiatives as the City Deals.

What are some of the short-term and long-term instruments to support the transition to a circular city simultaneously with meeting climate change mitigation goals for cities?
Local governments have quite a few instruments available to them, and different from those at national government.
We see local governments are quite strong at for example connecting and making networks, and essential for circular economy is cross-sector and cross-value chain collaboration. What local governments have high potential in doing is connecting the right stakeholders on the ground. What they have less power over is for example financial or regulatory instruments, they have little say in taxation, quality standards whereas these have proven to stimulate the circular economy.
So generally what cities are stronger in are networking, circular procurement and awareness raising.

What are some of the circularity activities that are aligned (directly or indirectly) towards emission reduction and retaining resource value for cities?
Reducing emissions: mobility and all initiatives related to that.
While in terms of retaining value, we see a lot of initiatives on **organic residual streams;** which is about the entire value chain as urban farming, urban food systems, urban food production, value recovery, organic waste management, and what kind of energy can be captured from the organic waste. Also on **construction sector** which is more towards urban mining and how we can design buildings for the future, for disassembly with an eye on the future to be able to recover value form different elements and urban mining where we can keep old construction and building materials to be used for other constructions.

Which approach is most effective, top-bottom or bottom-top in implementing circularity activities simultaneously with climate change mitigation goals for cities and why?
Bottom up is very important in terms of the players you need to engage that is citizens and businesses. They are essential for the energy, ideas and innovations that is necessary. And the top down approach, the interventions of the governments in local, regional and national levels are important to scale up bottom-up initiatives.

Will there been a need for shift in government policy and economic systems to enable the implementation of circular economy and existing climate change mitigation goals for cities?
Absolutely. Our current policy and regulation system is organized within the linear economic system and weather incrementally or revolutionary it is going to have to adopt to a more sustainable economy. In the Netherlands, we are not there yet, but we are on the right track.

What is the future of the nexus between circular economy and climate change mitigation goals for cities at a policy level?
The link between circular economy and climate change is becoming more and more apparent. The circular economy is really about a local action and creating a global impact which is in the reduction of greenhouse gas emissions. There is the trickledown effect all along the value chain when you are changing your way of using natural resources.
What kind of research is required to inform and motivate cities to better understand the potential and possibilities of the nexus?
I am absolutely convinced that we need more proof that a circular economy is successful in tackling both environmental, socio-economic challenges. We need proof that this system can drive an actual inclusive society, create jobs, actual urban disparity and so forth. We need to be able to quantify the different positive and negative impacts of a circular economy.

Who are the most important stakeholders in the nexus?
Public authorities, research institutes or knowledge generating organizations in combination with data providers from different sources as private companies.

How do the enablers come together and find a mutual understanding of a transition context, and agree over the best course of action?
I think organizations as public authorities or companies as Circle Economy can bring the right stakeholders together in a more personal or peer-to-peer level. Parallel to that, there are a lot of new platform ideas emerging as open source platforms with the advancement of the digital technologies.

What is the role of technology (engineers) in all the related aspects to be facilitated to move infrastructure towards circular practices?
Connecting stakeholders, spreading knowledge and providing data. There is also the material science and product engineering level which is advancing greatly with different applications or types of products that are more sustainable or circular.

What are some of the key lessons learnt your experience in promoting and accelerating practical implementation of circular economy?
You need the energy and political will to scale up the bottom-up initiatives which are already receiving a lot of attention from the citizens, but there needs to be a political effort to support these efforts and take them a step further. These political will transcends at all level from local, national to EU level, depending on the different roles at the different levels of governance.

A.4 INTERVIEWEE 1

Which of the following aspects closely describes the challenges experienced by small and medium-sized cities in relation to large and mega-sized cities adopting circularity concepts? (kindly prioritize next to the selected challenges)

- Out-of-date infrastructure ☐
- Dependence on traditional industry2 ☒
- Obsolete human capital base ☐
- Declining regional competitiveness ☐
- Weakened civic infrastructure and capacity ☐

- Limited access to resources**-1** ☒
- Other
- In general, resources to pursue certain changes even if it benefits in the long term, the people/sectors necessary to propagate this change is about investments, which limits people due to access of resources
- Also, dependence on traditional industry is important because transition from linear to circular will have implications on certain industries looking at if they will stay in business or not, when you look at reuse, recycle and reduce, you look at which extent which companies will be able to survive, so if you look at traditional companies to what extent are we able to have improved processes that will not add anything to revenue base in the short.

What are the opportunities for lesson-drawing and policy transfer for small and medium-sized cities from large and mega-cities already adopting circularity activities?

It is important to know and learn what is going on in certain areas. Other cities can already serve as a blueprint for learning, however, as the transition process is still fairly new, there may not be a lot of experiences for the moment nor huge lessons to be learnt at this point in time, as people are still trying out things, but of course there are some pace setters in this process.

One thing is having the opportunity to look at the blueprint of other cities and how they started, what policies and things were in place to stimulate this kind of transition. So, it will be important to look at best practices those that have been completed, this can help you look at the options you have, to increase your performance. For example, as the focus is on water and energy in Friesland, what other cities have been busy in this area and what have been the challenges. These kinds of lessons help reduce some costs on what could have been prevented.

Linking up priority areas for cities therefore presents a good opportunity for lesson-drawing but it is important to pay attention to the different contexts of each cities, for example bigger cities could already be of advantage and have more resources, specific types of industries, adequate human and capital base, developed infrastructure. So each city should tailor-make their own circumstance, find out your capabilities and identify the level you want to carry out your activities/transitions but it is important to learn and develop certain expertise for example in terms technology, herein comes also the importance of collaborations to garner support from other cities and regional areas.

How can cities measure progress and capture the socio-economic and environmental benefits of circular economy in reducing CO2 emissions?

From the start, you need to have a kind of indicator, what you would be measuring and what will you base your progress on. It should be clear from the beginning, what will be the yard stick of measuring what kind of progress. A lot will happen in the long term, but the indicators can be in the short and long term, for example looking at the progress in terms of investment etc, but actual C02 emissions depends on how people have been able to achieve their targets for example a company being able to use the waste stream from another company, ie how much have you collected over the years, and has been able to be reused, so indicators are important. Calculations can be made on what has been reused and checking how it has reduced the use of raw materials and also check the costs that has been reduced to see if it is cost effective.

Generally, you can measure progress using the indicators set out from the beginning, if you are able to have this amount and calculate like the carbon footprints reduce. It is better if the environmental and economic benefits should go hand in hand.

How could you characterize Leeuwarden's municipality leadership in promoting circular economy activities?

I will look at it from a provincial level, as it is not about the municipality alone. The municipality of Leeuwarden is doing a lot with a big ambition and great stimulation from the Province level. So, it is about the ambition from the municipal and provincial government which helps set up/form certain bodies to be able to advance the transition to circular economy with help from certain bodies/institutions.

However, despite these ambitions, a lot needs to be in place in terms of policies and resources, I would not know to what extent funds have been directed to these initiatives but I know there is a lot of ambition.

I think generally, they are really quite active and working with various institutions as NHL in circular plastic recycling projects and Frisian Design Factory etc. They are trying to check priority areas, and the possibilities of taking recycling plastic to higher strategic and business level by creating markets etc through business cases.

What are some of the important short-term and long-term instruments required by cities in transition to a circular city simultaneously with meeting climate change mitigation goals?

We can talk about many instruments but first and foremost, these are policy related and the incentives that would be made available and which type/cluster of companies i.e those with a commitment based on own vision or mission to focus on the environment or the small companies whose core business is to survive. So what kind of policies and incentives do you have available to support these different categories of companies/organizations/institutions going to circular directions.

So, everything boils down to resources available for certain institutions/organizations etc generally, they may vary. Look at how to support local and regional stakeholders in different areas by providing targeted funding, access to knowledge and information as city to city learning as well as sharing events and networking opportunities/platforms.

Financial support to a circular economy can take various shapes and forms as loans, grants, investment guarantees, tax incentives which can be offered directly from public sectors or through other actors' businesses associations, business development agencies.

Will there be a need for shift in government policy and economic systems to support and enable the implementation of circular economy and existing climate change mitigation goals for cities?

There should be a shift, it is required because you are going from a regime where things have been done in a different way. So certain policies need to not just be made but be backed up by certain by certain new support systems, it is not just about talking and making policies but also incentives to support the nice and rosy ideas.

Just as the transition to renewable energy and sustainability as Germany for example made a lot of money available via subsidies for people to acquire certain renewable energy technologies which stimulated a lot in the past and many people took advantage of it. Government stimulation of certain things in this direction is important.

What is the future of the nexus between circular economy and climate change mitigation for cities?

Circular economy will stimulate a lot in terms of climate change. The whole transition in terms of mitigation climate change and renewable energy is not cheap, it will cost a lot of money for people who have the resources, capabilities and interest. The late majority are those who are just waiting for things to be cheap and when they will be able to afford certain things. For example, when talking about renewable energy transition, some people/cities with certain the capabilities and some incentives were able to acquire solar panels etc but also it needed some kind of investments but before you invest in such you need to believe in this kind of transition to channel the necessary resources

But when you look at circular economy, you find it is something that will improve processes and make businesses more competitive, but will mainly be advantageous in the long term. But how now do you move from the short-term to the long-term to be able to get there. So, it is something that can happen with the boost from the government coupled with own resource base.

There is a big future, circular economy will lead to reduction of resources and save costs, so it is not only about climate change mitigation. For some companies and organizations, it will happen indirectly as they are busy with other initiatives without sole aim not being able to solve climate change, but rather an attractive business companies. Most companies' core business is to make profits and be competitive and if moving in this direction means more money for them or more businesses or improved image, they will contribute to the climate change topic. So there is a big future but it has to be stimulated.

What kind of resources do cities require to effectively enable the nexus and what are the preconditions for its success?

The right kind of collaboration, incentives, technical know-how depending on the type of company you are, knowledge, information, infrastructure that should be made available in certain areas, what kind of partnerships will be able to work and contribute money etc.

The main question is how will it be provided and by whom? Is it only the responsibility of the government but also the big companies/establishments who also understand that the transition to a circular economy will enable them stay in business much longer and be able to improve their processes and make sure part of the major obligations they have in the society is to move more and more towards this direction. So, it will be a combination of what the government is able to do and the companies that have money.

I always think that this transition will work in stages, for example between SMEs and big companies, who needs incentives more at what stage?

Who are the most important stakeholders in the nexus?

At a local or regional level, you should find out what kind of stakeholders are doing what and at that level what are people busy with, is it with the food chain, water/energy companies etc. So the most important stakeholders will depend on what the city/region is busy with.

After identifying these stakeholders, start with the big companies who are already working with different technologies as they will be the ones to propagate change a bit faster with the local/regional government authorities.

What are the forward looking (practical) steps for cities in transition to circular cities and who are the enablers for such transitions?

The enablers are first the government supporting various other stakeholders/organizations busy with these initiatives and especially those who are not engaged, how you bring this message across.
The practical steps for cities could include those incentives we mentioned earlier, cities can initiate own projects or through regional establishments to give them the required direction. The cities can take particular steps but what are they looking at specifically? And what do you have? For example, a region with many innovative/big companies and does the transition involve making big infrastructural changes or are the steps are mainly dependent on the kind of resources available in relation with the obstacles identified and the capacity of the organizations to tackle these obstacles.

How do the enablers come together and find a mutual understanding of a transition context, and agree over the best course of action?
Through open innovation platforms where you have a kind of forum that invites governments, SMEs, local organizations etc certain initiatives in a forum to talk about their ambitions etc and what does circular innovation mean for them. It is important for people to understand their activities actually contribute to CE and to be motivated.
The small players can play a big role eg in Friesland they have innovation clusters-which brings together different players in different sectors.
Coming together and having a forum for these clusters of things is important, and the government has to be a big part of this, their role being very clear and identifying how to overcome the existing challenges and obstacles. For example, in the Living Lab approach stakeholders are discussing what is required to overcome the obstacles experienced and the certain expertise required by inviting knowledge institutions in these forums to inform Governments or other people with resources but they do not know which role to play. Government policies need to make sense at the local level.

What is the role of technology (engineers) in all the related aspects to be facilitated to move infrastructure towards circular practices?
Very important, it is always the starting point but not the end point for example in the circular plastics, there are many products/experiments on what can be produced but it becomes interesting when you identify the market. Make transformation and improvement in technology and the businesses models relevant to make real economic benefits. Then it becomes interesting for certain companies.
So the role is important but not the end.

What are some of the key lessons learnt your experience in promoting and accelerating for circular economy from an academic perspective?
Everything starts with an academic sense; knowledge institutions are the ones going to help these organizations in the transition for example students working on certain projects while studying. Teaching and learning is important as it is not only about making knowledge sense, but putting it into practice. So, knowledge institutions are working closely to help companies understand what this transition means. Knowledge institutions will help companies accelerate this process.
Multi-disciplinary expertise is required for people to understand the transition through research and practice. It is a work in progress and changing currently as businesses are understanding the importance of this academic knowledge. It helps companies and they identify certain research

points which knowledge institutes can fill these gaps based on concrete questions from the field. There is much more working together now, through applied research with universities of applied sciences

Appendix B-Municipality Informants Questions and Answers

B.1 MUNICIPALITY OF ALMERE

What is your position at the Municipality and for how long have you been involved in this role?

Erwin Lindeijer-Energy planner and Environmental specialist at the Municipality of Almere focusing on energy transition related issues and has been in this role for about 15 years.

Which of the following challenges closely describes the challenges experienced by Almere in the context of being a medium-sized city? - (kindly prioritize next to the selected challenges)

- Out-of-date infrastructure ☐
- Dependence on traditional industry ☐
- Obsolete human capital base-3 ☒
- Declining regional competitiveness -1 ☒
- Weakened civic infrastructure and capacity ☐
- Limited access to resources-2 ☒
- Other

How is the municipality considering infrastructural changes to mitigate the impacts of climate change?

As you know Almere city is only about 30 years old. We are planning to reduce our heat consumption and we currently have a district heating network through which we have been able to reduce our CO2 emissions by 30%-50% from the start and we have been building on that. In another District called Almere 4 with about 13,000 equivalent households who have been able to reduce CO2 emissions by about 90% through the district heating system which captures waste heat from a power plant.

We also have a new District that will not have any gas pipes in it, we shut it already more than 5 years ago. They do not get gas and roads, the residents arrange everything themselves, the population is still low and are all pioneers. They are arranging everything themselves through meetings, from infrastructure, roads, sewage, heating etc, the only thing we are arranging for the district is electricity.

What are the priority areas for the municipality in reducing CO2 emissions?

Our focus is on sustainable energy production because it is a new town, our houses are pretty well installed. We are now arranging for a new energy park with about large 93 windmills. There will be a lot of sustainable energy production around Almere in the next coming years.

Also, we have the Energy Funds where people can loan money, most people are loaning money for solar panels and about 3 million euros has been asked already and by now more than 4500 solar panels have been installed this year by house owners.

Who are the stakeholders involved in climate change mitigation activities in the municipality and what are their roles?

Quite broad, from private house owners, private housebuilders (this is exceptional in the Netherlands but in Almere you find many people who want to build their own house), developers who build large groups of houses, housing companies, also banks as they are part of the people who arrange for new financial arrangements as sustainable energy is about pre-financing and you need a lot of upfront investments organized.

How is the municipality adopting circularity concepts?

Based on the definition of keeping materials local.

What we are doing is we are building an Upcycle platform where people are bringing their own stuff which are being demolished, or taken apart and resold. What we are doing is we are giving a platform for small companies to make new products from recycled materials, through the Upcycle platform. We are also building a big heating system to dry wet biomass for example water plants are too many and this is not good for the ships, so we remove and dry them and make paper. To dry the wet biomass, we have this huge heater that we are going to build and we invested about 1 or 2 million euros for that.

We also organize and finance innovation contests for companies to come up with ideas together to become more circular. We have two companies now which are working together and they wouldn't have met nor worked together had it not for this kind of contest. They work in areas as collecting food waste, make recycled concrete, recycle textile, etc.

We also invited Gunter Pauli the inventor of the Blue Economy concept and he is here for three days to help us come up with new business opportunities.

What are the impacts so far of the circularity activities adopted by the municipality?

The ability of the winners of the innovation contest to meet, know each other and work together was through organization. Also, on the circular activities that we promote as remaking of secondary clothes from recycled textile fibres, papers from old plants, making benches from local wood etc

Who are the stakeholders involved in implementing circularity concepts and what are their main roles?

We really focus on businesses. We ask them to make products from local resources and we ask them to keep it local and to sell it local.

Does the municipality offer any incentives to stakeholders implementing circularity concepts or initiatives linked to reducing CO2 emissions for example through lower prices for permits?

For circularity, we are finding how we can create a cooperation for circular companies, we are also one of the founding founders of a group of horticulture businesses who want to become 100% sustainable, so we are helping them with initiatives as district heating using biomass as a source. Also, we are helping reduce permits for renewable energy production that cost over 1 million euros as we want to encourage especially large steps.

We also arranged for 25ha of land for solar panels, and this is a really large area and we encourage companies to actually use this area for solar panels.

Has there been a need for shift in government policy and economic systems to enable the implementation of circular economy and existing climate change mitigation goals for cities?

Yes, of course. We have Energy policy which is really strong on sustainable energy, as we plan to be energy neural by 2022.For economic instruments, it is a pity but we have not been able to do a lot and this is important as for me I see circular economy is about keeping money as local as possible and it is important to keep money local through local financial systems and local money systems.

What are some of the greatest lessons learnt in the process?

You need policy that is one thing. For energy, there are a lot of people who opposed sustainable energy because it changed their environment and some do not like it, so you need to take people by hand. What I did is I used this CAR glasses-a 3D system which you can choose where in the town you live and for example where the wind mills will be and then they see actually it is not going to be a big problem and can accept changes in their environment.

As much as it is okay to make big steps, you also need all the citizens so we need to small steps at the same time, we are now looking for energy ambassadors just local citizens who are enthusiastic about the energy problem and we are helping them to raise awareness and get people to participate in their communities.

What is the future of the nexus between circular economy and climate change mitigation at a policy level for cities as Almere?

The big question we have is about biomass. That is where circular economy and climate change do not match. We want to use (renewable) wood for fuel from forests that are well managed but some people say you should not use wood for fuel. We decided with a group of experts from municipality that there some types of wood which are too small and cannot be used as wood material and there is more than enough of that we can use that, but the discussion comes back every time and again. So, I see there is more conflict between the two than I can see a nexus. There is a conflict in using biomass as a resource and also a conflict in land use, where you can use land for producing organic material or for building or for solar panels-energy etc, so it brings a conflict, and that is the thing am worried about.

Who are the most important stakeholders in the nexus?

Fundamentalistic people- people who only want to focus on climate change and those who want to focus on circular economy. The fact is you have to do both but that is also a conflict on the resources available (the money available to do things).

What is the adaptive capacity of the Municipality in enabling the nexus (based on availability of resources and the ability to coordinate responses)

We have about two or three FTE working in the municipality and we were able to hire more people and we are not able to finance that any more that will reduce the capacityy in our municipality unless the national government will take energy as a serious issue and allocate money to the municalities then it will be fair, as it is a huge ambition to become energy neutral by 2022.

What are the forward looking practical steps for cities in the transition to circular cities and who are the enablers for such transitions?

I would say, also make a local economy system, a local financial system. The organization of financial activities like that of the banks with interest rates but these local financial systems do not have this, instead the loaning is based on trust. This is already working in a small scale in other cities as Utrecht and especially in other southern American countries as Brazil.

How do the enablers come together and find a mutual understanding of a transition context, and agree over the best course of action?
This competition we made is very nice, we have few others up to now and we are going to use that instrument a lot. We give a little bit money to the good ideas in the competition and give money to the best companies to help realizes what we asked for.

What is the role of technology (engineers) in all the related aspects to be facilitated to move infrastructure towards circular practices?
Well, technology is an important aspect but it is not the only thing. Culture is much more important, for technology, there are enough smart people but they need trust from other people in the society to implement their technologies. So, it is a question of people getting used to new things and that is the hard part. So, technologies are crucial but it is really one part, you need much more than that.

How are cities measuring progress?
In the circular economy, we are not doing any monitoring or something because we are just trying to make some big steps and we could say we monitor by seeing how many companies are now engaged in the process. We made an inventory on how much materials is coming in and out Almere and that is about the potential we could circulate and maybe we can make another study in the future to see how much of the total material we managed to change.
But for energy we do a yearly survey, we do monitoring of our progress. We have five different aspects in our policy and target groups that we monitor each year how far we are year how far we are going.

B.2 MUNICIPALITY OF DORDRECHT

What is your position at the Municipality and for how long have you been involved in this role?
Martin Hulsebosch works as the Senior Policy Advisor Economic for one year and seven months and previously worked as a Policy Advisor for eight years from other roles at the Municipality of Dordrecht.

How is the municipality considering infrastructural changes to mitigate the impacts of climate change?
We have a large transformation project of our road and the objective is to be a sustainable road with CO2 neutral ambition. It connections is with the highways as A16 and the project will start next year, the road also connected to development of large business areas (50,000 ha). We have also demarcated some inner parts of the city which you cannot reach by car to help limit CO2 emissions. We are however not so big on mitigation measures; our city is more known for adaptation measures.

How is the municipality adopting circularity concepts?

Every city is trying to figure out what is their role and responsibility as a municipality, we are participating in the City Deal for Circular Economy in the Netherlands and what we are currently doing is stimulating business cases and local enterprises to be more circular. We entered a corporation one Business Club from the region who organize meetings with circular business cases and we contribute to that. This year we organized four sessions on four topics on circular economy where companies' advice one another on circular aspects. We had one case organized with a company called Coolrack which advices on the use re-use of electronics used within businesses. Another case was the use of waste products used during coffee roasting and can be used to improve soil for agriculture, and two other meetings we organized this year.
Also, we were a pilot region of the Ministry of Infrastructure and Environment of circular streams/products in this region. They mapped and showed us with the database of a few consultancy agencies the amount and size of different streams of materials within the region. They also mapped for us which sectors are bigger than the other and this gives as an overview of possible chances where circular concepts might be. For instance, the chemical sector is bigger than average for this region and for ourselves we focus on the streams that are scavenge and maintenance of the stream as part of the responsibilities of the municipality. We demand what the amount of stream is and do the follow-up, link up with stakeholders and see how we can use the stream.
We did a research on the chances for circular in the region, the research was conducted by a local start-up called Circle Lab and it really helped us identify chances for circular economy. We learnt that the recovery and the re-manufacturing sector is very large in this region if we want to create impact of circular economy in this region, we can focus on this region.

Which are the priority sectors/areas for implementing circularity concepts?
Based on the research, we identified our priority areas and identified few priority sectors as repair, re-manufacturing, recycling, chemical industry, logistics and heath care.

Has there been a need for shift in government policy and economic systems to enable the implementation of circular economy and existing climate change mitigation goals for cities?
Well the topic of climate change is for quite a long time a key topic for the city, especially the point of climate change adaptation because Dordrecht is a city that has a risk of flooding both from the sea and rivers, so we try to protect our islands surrounded by rivers to take adaptation measures for the areas surrounded by dike and by the banks, our historical centre for example is also an embark area that is inside the river and there we need adaptation measures for climate change. I think we are a frontrunner of this topic since 2008 more or less.
When it comes to circular economy it is a much newer project/political priority and I think you see a shift that goes from sustainability more to a circular economy concepts because sustainability is a little bit of a one side of approach that does not really have an economic model that the circular economy combines both, sustainability goals and economic model. I think this presents a much larger political landscape, the political party that is more oriented to stimulating the economy will be much more attracted by circular economy concepts than by just sustainability goals, that is an important shift you see there.

How the city is measuring the socio-economic and environmental progress of the circular economy?

That is an interesting question because we do not quite have a measurement model yet, all kinds of agencies and knowledge institutes are trying to develop instruments to measure the circular economy, which is also one of the topics of the City Deals Circle Economy. It is something a lot of agencies are working on, but there is no one model to measure the state of your circular economy yet, so we do not have a model to measure what is the state.

What is the future of the nexus between circular economy and climate change mitigation at a policy level for cities as Dordrecht?

(Long pause) Let me think about that, hadn't thought about this.

I think the problem with resources worldwide will get bigger and bigger especially for the oil industry and everything that relates to that, but also for other resources. And when the business models within the municipality are more focused on efficient resource management or recycling, re-use, re-manufacturing, it is a much smarter way to deal with our resources which will also have a local impact, I think if you can get the streams of resources more local oriented worldwide, you can have a local impact.

At the city or regional level, it is a good way of sharing products because sharing is one of the models of circular economy for example Uber, Air BnB, and these concepts can work very well at a local level, for instance we now try to create platforms for our local businesses where they can create and share products from our inventory to have less costs for expensive products. Those concepts can have great impacts.

B.3 MUNICIPALITY OF HAARLEMMERMEER

What is your position at the Municipality and for how long have you been involved in this role?

Maurits Korse. I am a sustainability and circularity advisor within the sustainability programme of the municipality. I have been in this function for 1,5 years.

Which of the following challenges closely describes the challenges experienced by Haarlemmermeer in the context of being a medium-sized city? -(kindly prioritize next to the selected challenges)

- Out-of-date infrastructure ☒
- Dependence on traditional industry ☐
- Obsolete human capital base ☐
- Declining regional competitiveness ☐
- Weakened civic infrastructure and capacity ☐
- Limited access to resources ☐
- Other
- Competition between growing industries (Airport related) and the need for developing additional residential areas (noise pollution) as well as importance of current agricultural areas in the circular and energy transition.

How is the municipality considering infrastructural changes to mitigate the impacts of climate change?

- We have developed various policy instruments (climate stress tests, etc.)
- In new developments and reconstruction we split the sewer (rain and residential)
- If necessary we implement drainage and allow residents to connect to it

What are the priority areas/steps for the municipality in reducing CO2 emissions?

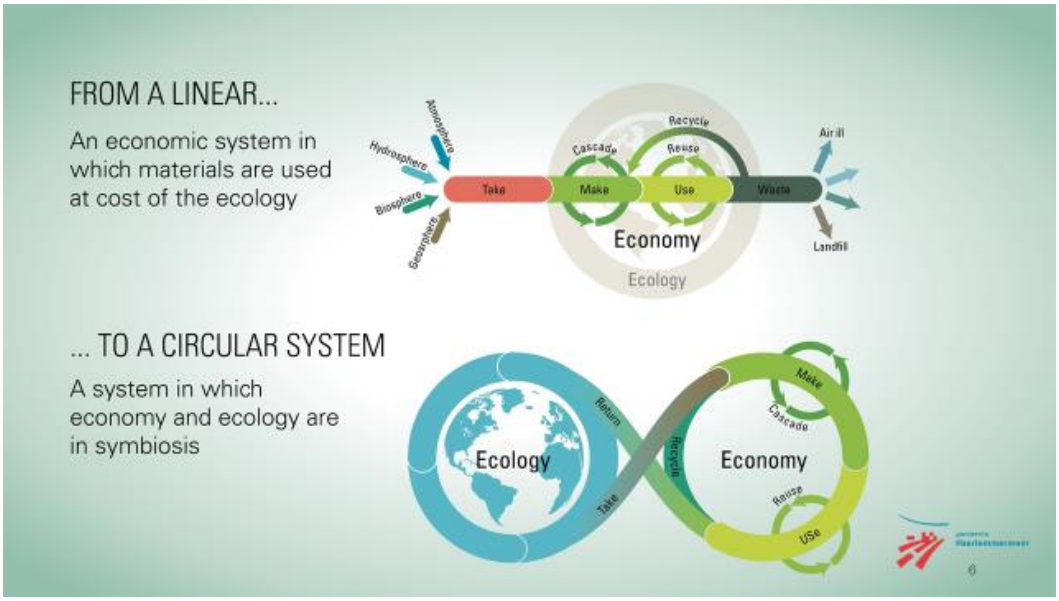
- Local sustainable energy production (our ambition is that Haarlemmermeer will be a net energy producer in the future)
- Circular procurement
- Using biobased materials instead of fossil based
- Enable electric transportation

Who are the stakeholders involved in climate change mitigation activities in the municipality and what are their roles?

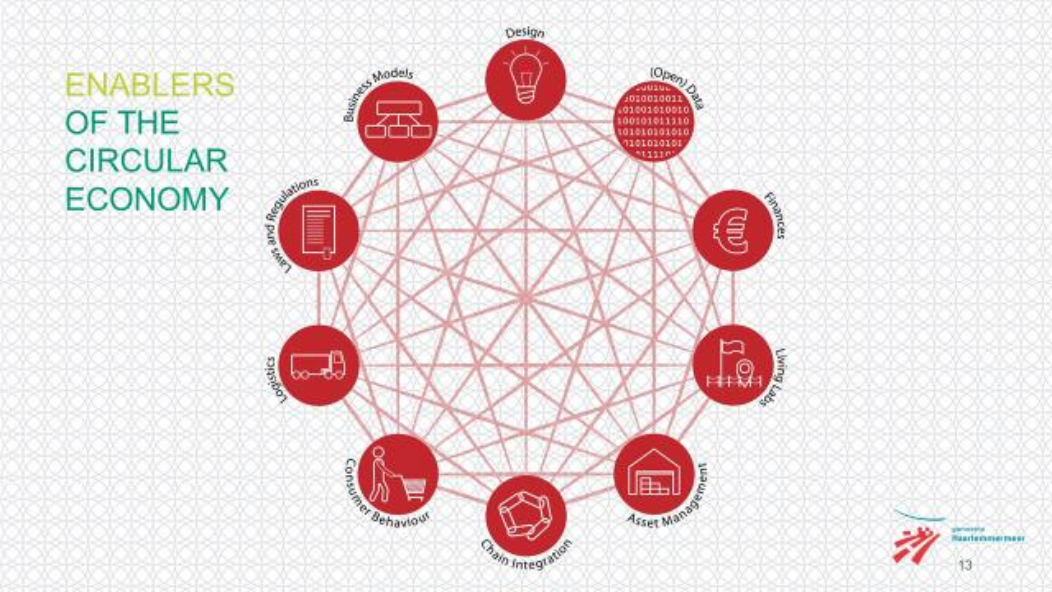
- Internal colleagues (water manager, policy makers on water, engineers with a focus on heat stress and water, drainage and sewers)
- Waterschap Rijnland
- Nature and environmental centre (NMCX) that supports citizens and has a public campaign: Haarlemmermeer Waterproof (http://www.haarlemmermeerwaterproof.nl)
- Citizens
- Developers

How is the municipality adopting circularity concepts?

- We aim to keep materials in the loop:



- We work on the conditions that make circularity possible:



- Within our procurement we have a KPI that focusses on circular concepts.

Which are the priority sectors/areas for implementing circularity concepts?

On regional level there are 9 value streams defined:

- Biomass;
- Construction and demolition waste;
- Electronic and electric waste;
- Textile/fabrics;
- Plastics;
- Incontinence material and diapers;
- Matrasses;
- Servers (IT);
- Metals

Within Haarlemmermeer we see a main focus on biomass, construction and demolition waste and electronic waste. Next to that, the focus on textiles and incontinence material and diapers is growing.

What are the impacts so far of the circularity activities adopted by the municipality?

- We have asked TNO to investigate the economic impact of our sustainability policy. One of the results was the amount of “circular jobs” in the municipality. These are jobs related to circular economic businesses. In Haarlemmermeer this is 9%.
- We are starting to see a decoupling between the economic growth and our local CO2 emissions. We are not sure yet whether this trend will continue, but the first signs are hopeful.
- One of the larger projects is about residential waste separation. In general we start to perform better in comparison to the average of the province and the Netherlands as a whole. Next to that there are a few pilots in which we focus on different means of separation based on the type of residential area. The first results show a very large improvement and are in line with the ambition of 5% residual waste.

Who are the stakeholders involved in implementing circularity concepts and what are their main roles?

- Internal colleagues (procurement, contract managers, budget holders, engineering department);
- Regional governments and partnerships;
- Nature and environmental centre (NMCX) (supports citizens);
- Meerlanden (municipal waste processor);
- Citizens
- Contractors

Does the municipality offer any incentives to stakeholders implementing circularity concepts or initiatives linked to reducing CO2 emissions for example through lower prices for permits?

- No, we do not have subsidies like these. We do however have for example projects for schools and sports clubs to reduce energy usage and produce sustainable energy.

What are the circularity activities implemented by the municipality that are aligned (directly or indirectly) towards emission reduction and retaining resource value for Haarlemmermeer?

- The circularity activities are not directly linked to emission reduction. For us circularity is about material resources (municipal waste, demolish and construction waste, etc), while emissions are mostly related to energy usage. Even though there is an indirect effect of more effective material usage on CO2 emissions it is hard to be an active actor and monitor this.
- Considering resource value we are focussing on activities like implementing TCO/LCC thinking, using biobased materials and reusing/refurbishing.

Has there been a need for shift in government policy and economic systems to enable the implementation of circular economy and existing climate change mitigation goals for cities?

- Yes, it requires a more integral approach to developments and projects. Next to that it also requires a proper identification of the roles of the government depending on the influence we have with society.

What are some of the greatest lessons learnt in the process?

- That most of the innovations are not held back by regulations or policy as many people suggest, but that it just requires more effort in how to approach issues different than we normally do. Sometimes we come across barriers that

What is the future of the nexus between circular economy and climate change mitigation at a policy level for cities as Haarlemmermeer?

- Considering circular economy the biggest impact can be made within building and construction of public space (roads, etc) and housing. Considering housing we have only limited influence on development, considering public space we have more influence using tenders/procurement.
- Considering climate change, we do not only focus on mitigation but also on adaptation. Even if we completely stop emitting CO2 right now, global temperature will still keep on rising for some decades causing heavier rainfall and droughts. Therefore we do not only focus on

mitigation but also on adaptation to keep the municipality a high quality living and working environment.
- We have done research on the impact of CO2 compensation (eg planting more trees) which shows that, by far, this will not be enough. Therefor reducing CO2 emissions has the biggest impact: through reduction of energy usage in mobility, reduction of certain fossil fuel based materials (tarmac), or other materials emitting CO2 (concrete). The problem is that we do not have direct influence on each of these, some are based on technological developments, cultural developments, autonomous developments, etc. We do however support and ask for biobased alternatives when possible, or in tenders we ask the market to come up with new innovations.

Who are the most important stakeholders in the nexus?
- Basically everyone: anyone has its part (also see the diagram at question 6) as it is a system transition.

What are the forward looking practical steps for cities in the transition to circular cities and who are the enablers for such transitions?
- Define for oneself the definition of circular economy (there are many different definitions); does it consider materials, energy, water, social aspects, etc, is it about using recycled materials or only about future recycling possibilities, what is the role of the environment/nature in relation to the circular economy/circularity?
- Identify the current situation (where is the biggest potential)
- Define projects in collaboration with businesses, universities, citizens and other governments (local, regional and national)
- Monitor the effects
- also see the diagram at question 6

What is the role of technology (engineers) in all the related aspects to be facilitated to move infrastructure towards circular practices?
- Depending on which engineer you focus there might be some difference what their specific role is. In general they should ask the right question; whether it is the municipality engineer setting up a tender or the engineer of the construction company developing new products. In the end they should focus on functionality and create solutions for the required functionality with as little as possible environmental impact at balanced life cycle costs and social impact.

B.4 MUNICIPALITY OF VENLO

What is your position at the Municipality and for how long have you been involved in this role?

Milene Bekkers-Senior Policy Advisor on Sustainability and Circular Economy and I am working in these area for more than 15 years now. I do several things here, at first I was working more on environment and now you see more shift to circular economy and cradle to cradle.

Which of the following challenges closely describes the challenges experienced by Venlo in the context of being a medium-sized city? - (kindly prioritize next to the selected challenges)

- **Out-of-date infrastructure** ☐

- **Dependence on traditional industry** ☐
- **Obsolete human capital base** ☒
- **Declining regional competitiveness** ☐
- **Weakened civic infrastructure and capacity** ☐
- **Limited access to resources** ☐
- **Other**

What we see here in the region, younger people are leaving to study and do not come back, so quality leaves the region. We also face the problem of aging and these developments influence many challenges. We want to face these challenges using cradle to cradle because it is an innovative principle and you find innovative principles attract young people. We try to attract some students from HBO and some Universities colleges but of course you cannot compare Venlo with major students' city as Delft or Enschede. We try to attract many young people through cradle to cradle. This innovative concept of cradle to cradle helps far reaching sustainability to go hand in hand with profits and it is important for us to incorporate these concepts to higher education institutions who connect with companies here in the region.

How is the municipality considering infrastructural changes to mitigate the impacts of climate change?

The main measure here is on the River Meuse where Rijkswaterstaat-a Government Authority in charge of the public works and waterways in the Netherlands advised Venlo to construct a wall two meters high to prevent the city from flooding, which already happened twice in the last twenty years. But as Venlo city, we do not want to do this because we will disappear behind the wall and we do not have any other connection with the River Meuse. What we try to do instead is to create a natural water storage in the river by creating a reservoir.

What are the priority areas for the municipality in reducing CO2 emissions?

We are focusing on companies. With some types of permits we can do some regulations through the ministry and these regulations restrict companies when they do their processing and manufacturing. We apply them and have some extra programme for companies to reduce CO2 emissions on a voluntary basis. We encourage them to do energy saving on their own commitment with each other, for example 20% extra energy savings above the ones they are obliged to. This is open for all companies and not sector specific, we approach them and inquire if they want to join this programme and some do, others don't.

Who are the stakeholders involved in climate change mitigation activities in the municipality and what are their roles?

Waterscope-the Governmental authority on water and the Government.

How is the municipality adopting circularity concepts?

Our focus is cradle to cradle because we really want the added value, we want to go for quality because circularity concepts often also consider recycling, for example plastic cup recycled to chairs, you still have plastic, but we say you have to design a product in a way that it is healthy without toxic materials and you can make the same product again. This helps avoid the loss of quality and loss of resources. We focus on doing it right at first time instead of less bad. This Municipality's iconic city hall building is built on the principles of cradle to cradle.

Which are the priority sectors/areas for implementing circularity concepts?
Circular economy is very broad, you can put everything in it, or not. But for climate change there is some kind of necessity to apply some measures because of the higher water level, so the government feels like it has a necessity to do things and in Venlo when we use materials, we look if there are materials that are healthy and if it can come back in the cycle, but it is not done everywhere because you find there are a lot of people who make decisions. Hence, the two relate together but they are also two separate parts because climate change needs adaptation in the physical environment.

What are the impacts so far of the circularity activities adopted by the municipality?
We look at building and projects when we have a bigger span of control and can decide what we want to do in these buildings, but when there is a private party who wants to build something, we have less possibilities, we try to persuade and inspire them but we cannot force them to do it. What is important for us is the building area development and we try to challenge companies to strengthen the region with a circular economy or a cradle to cradle production process and further, we try to inspire educational institutes to get cradle to cradle and circular economy into their education process. The progress differs, everything depends on the enthusiasm of the people but the situation nowadays compared to ten years ago for example, everyone is inspired to do something regarding climate change and circular economy, it is not a new issue or a controversial issue. Now it is a normal issue.
The impact so far is more awareness, and as a region we are known for our circularity and we can position ourselves as a circular city and we really make quality of life, because people can work in this building and see it is healthy and sustainable, and that it is possible, this presents a positive business case. It is important to prove it and show it is also financially attractive to do it.

Who are the stakeholders involved in implementing circularity concepts and what are their main roles?
There are all kinds of different stakeholders, companies, educational institutes, ministry, economic development boards, citizens, very diverse stakeholders.

Does the municipality offer any incentives to stakeholders implementing circularity concepts or initiatives linked to reducing CO2 emissions for example through lower prices for permits?
Our incentive is more on organizing meetings and bringing people together, hosting inspiration sessions and workshops, but we do have subsidies for instance, we just create inspiration as stakeholders are doing their thing. We feel that subsidises are attractive but there is also the other side, we have financial problems in the community and if we offer financial incentives it may not seem fair as other areas need it more. Also, the disadvantages of financial tools are when the subsidies are not available anymore, people retract but subsidy is not a reason to do things- yes or no. This building is for example was built without a subsidy.

Has there been a need for shift in government policy and economic systems to enable the implementation of circular economy and existing climate change mitigation goals for cities?

It is more a growing process, it is not a sudden shift. We are working already for 8 years on cradle to cradle, and then the term circular economy was not invented yet. So, it is more a growing process also in the minds of people, and mindsets take some time.
Currently we are making new policies to integrate cradle to cradle and circular economy, but when you have the policies but then afterwards people should act and that is where the real behavioural changes and adaptation, so it really is a long process.
You have the front runners change, then the middle group comes and then you have the ones who stay back and it takes a long time before they really change their behaviour. Now, we are really working with the front runners and the most difficult phase is to attract the middle groups and this needs a lot of convincing, giving them tools.

What is the future of the nexus between circular economy and climate change mitigation at a policy level for cities as Venlo?
Well, actually, it is one story because of climate change and resource scarcity, not only are there changes in the physical environment but also in the economy. We have to get along better with Mother Nature, and that is an important message to governments, businesses/companies, citizens and there, an economic shift is very important because we have to do it. Maybe we first have to get into an emergency situation for people to really realize the water level is rising. Currently the urgency is felt by a little group and not the bigger group, as the main residents of Venlo are not engaged, instead they lean back. But with situations as high water levels, dry agricultural lands etc, the sense of urgency increases/comes in.

Who are the most important stakeholders in the nexus?
At first the government to create more emphasis of the connection. For example, currently you see the ministries in the government are very one pointed, you find each ministry does its own thing but form my experience, even the ministries do not have the experience that we have at the local level. At the local level, we are far more innovative than the government is.
So, this needs both top-down and bottom-up. Top-down to show the good practices people are just starting with but then also legally arrange things that some things people are just obliged to do with legislations.

What are the forward looking practical steps for cities in the transition to circular cities and who are the enablers for such transitions?
The transition process starts with the minds. You need people in the organization to start working towards this kind of transition for cities are connected too much with water and you find land is close to water and the challenges with climate change vary per area.
It really is about what are the priority challenging areas for cities for example in Venlo water is the priority and heat stress in the built environment, so you have to do something to make the climate better in the city. The practical steps depends on the situation of the city for example an agricultural city will focus on agriculture.

How do the enablers come together and find a mutual understanding of a transition context, and agree over the best course of action?
We do it through inspirational workshops and try to bring people together to communicate the message. Then we try to create agreements on how to act in the future, these agreements are not legal, they are always on a voluntary basis.

However, for the transitions the legislations become an important tool but these legislations should connect with practical situations which is not the state nowadays, even worse, they are counterproductive. We also see that legislation is counterproductive to innovation, because it (legislation) is always ten years behind.

What is the role of technology (engineers) in all the related aspects to be facilitated to move infrastructure towards circular practices?
Companies are showing the improvement in technology as you can see from the development of new diverse products.

What are some of the greatest lessons learnt in the process?
Cradle to cradle is a very positive story, it is about innovation, it is about doing the right things and not doing less bad. In the traditional sustainability thinking, it was always you are doing bad, you are using energy etc but cradle to cradle says it is okay of you use energy, if you use solar there is a lot energy put on earth by sun than you need, and if you design your products in a healthy way and you keep reusing them in the production process then you are free to consume, it is a total different concept.
It is important to challenge people in a positive way, not in a negative way. This helps make another connection, a different connection with people.

How can cities measure this progress and the socio-economic and environmental benefits of a circular economy?
By using investigations tools, etc, there are a lot of ways of measuring but you have to measure the right things. Because for example the BREEAM certification could have earned us points by saving drinking water but in this building we use rain water to flash our toilets but we did not earn points.
Now BREEAM has improved/changed but when we started out with the building, our ambitions did not fit into BREEAM. Therefore, in measuring progress you really need to look at what you registrate, so we have our own registration system for this building we record hard data on water, energy etc quantitatively. Important is you always have to ask yourself if it is registration the right things.
What we also do is try to investigate the impact of the healthy building on sickness, which is a qualitative factor we are doing with University of Berkley and Maastricht and we can translate this financially on what it means on the city.

Challenges of working with this kind of new initiatives in the transition process?
To translate your principles on all kinds of different parts as companies, educational institutes, own colleagues etc. The challenge is to reach the new group, we are the front runners and now the middle group also to show that our citizens can see and experience these things and that is is good for them, and this is difficult as citizens do not make the connections that easily or directly, as you find it is difficult for them to understand for example this building is good for the financial situation of Venlo, they can just see and like it but is it difficult to understand.

B.5 MUNICIPALITY OF ZWOLLE

Interviewee: Mr. Paul Kok, Economic Advisor- Municipality of Zwolle

How is Zwolle adopting circularity concepts and climate change mitigation policies?

Zwolle is busy with environmental sustainability and climate related issues for 10-15 years, all kinds of small initiatives have been taking place and continue to take place, but big steps have not yet been made within this period. Now that we are investigating circular economy, it is coming out pretty fast perhaps as a different point of departure with CO2 reduction, energy transitions etc and this helps to boast the process.

We however did not take it as a goal, but instead looked at circular economy as a common issue where companies and organizations even in the Greek/Roman times had to deal with the availability of raw materials and its quality and quantity. Globally, major changes have taken place and are continuing to take place, hence raw materials will continue to be less available and less guaranteed. This gives Zwolle a main ambition point, which is to ensure we do not lack raw materials, an approach that is different from other cities who focus mainly on sustainability. We accept that because raw materials will become a problem we need to take care that our city pre-positions by changing the direction and preparing our strategy in such a way that the Zwolle is prepared when raw materials do become a problem.

How does Zwolle engage with different stakeholders in the transition process?

Our approach in working with stakeholders is also a bit different. First, we understand the challenge of the current economy and what is happening and that for this reason, if we do nothing, the city is still in transition. Henceforth, we have three reasons as to why we engage in the activities of this subject in our city:

- The economy of our city is dependent on small companies (normally with less than 10 employers) and there are thousands of these companies. If we do not do anything, and business continues as usual in these companies' product chain, they could be too late to react when the availability of raw materials do become a problem. We will get into trouble as a city as we understand these companies have limited time, money and knowledge to invest in circular economy.
- Labour is an important issue in our region and is mostly dependent on small companies and services for instance public, commercial, banking and finance etc. In both we understand that in the next decades it could be an issue as innovations for example robots to banking applications etc are taking over making this type of labour unnecessary.
- For the services in the city to understand how to keep resources in use for as long as possible, extract the maximum value from them whilst in use, then recover and regenerate products and materials at the end of each service life.

We therefore do not make different project teams and so forth, but instead we get into the city where the energy and action is in people and organisations to invite them to connect in smart coalitions to make it happen. Our role is to connect people and to make it possible so that people feel the need to transition and can do it.

How do enablers come together and find a mutual understanding of a transition context, and agree over the best course of action?

We work through Smart Coalitions which helps us identify technical solutions that exist, problems to be solved, finance capabilities, our roles and rules. Then we put together three or four companies working on the same issue, include other stakeholders as universities and knowledge institutions, put some law and rules together and we support these solutions with some little money. These kinds of solutions are projected to and made available for other companies, creating some sort of ripple effect.

Has there been a need for shift in government policies to support the transition?
If you want to make a shift with major interventions, a lot of goals and stakeholders are involved. But you need to be careful where you put your scarce money and energy to make the shift happen. As an example, in Zwolle, we made an area free of rules and told people to just go ahead and implement initiatives. When we evaluated the initiatives a year or two later, we found those who earlier mentioned that they could not pick up some initiatives because of the rules, still do not engage without them. While the successful ones had to deal with many other different reasons to get successful than the government rules.
Where we see that rules can be a blockage, be creative. If you can, do avoid making a shift to change people. It takes a lot of effort and the outcome is unsure. It is better to level creatively with what is already possible than to try change behaviours. The Smart Coalition for instance is supported by small groups of people who can execute or forgo certain rules and still make things happen.

What is the role of technology in the transition process?
The only limitation is your own fantasy and creativity. Because the technology is already there. Tomorrow it will be nicer, better, cheaper and easier but that should not prohibit you to start. Education and science are particularly important in communicating lines of resources to customize innovations because this is not the time to create new and innovative technologies, we need to be careful how we spend our money here.
Furthermore, technology was never a problem, the ability of technology to make things happen is evident already, however, the challenge is to make it happen in your city/company/organization etc. We should not concentrate on the technology itself but 'just do it' because it is possible.

How can cities measure progress of the transition process?
We have a plan to work on certain monitors. We want to measure each year the ongoing initiatives using the principles of Lansink ladder and see where we are now (as a sector, company, organization etc), how much are we dumping and how much raw materials are we reusing raw materials.

What kind of resources are required for Small and Medium-sized Cities in transition in relation to other bigger cities?
There is really no difference in the transition as we talk about people and this problem is the same everywhere. What we realize is that land is the main issue as you need space if you want to go to circular economy. There are however three major issues in the transition process and they are*:* ***return logistics*****,** this is really an issue and you need space to effect this, second issue is ***finance*** which you need to get from different structures, the third issue are ***rules and regulation***s which hinder for instance intentions as taking apart some components to reuse. Generally, it is easier to deal with these issues in smaller cities, because the volumes are smaller, land complicated

issues are controllable and it is easier to get people together compared to in bigger cities. It is just important for people to step-up together and do something.

What is the future of the nexus between climate change mitigation goals and circular economy for cities?

It goes very fast from now on for example in 20 years nobody will talk about circular economy again, it will be mainstream and normal. The major innovation will be in two areas, one in the ***building and construction streams*** (houses, roads, etc) as there are many capable ways of constructing in a sustainable way. The shift is big and people will no longer invest in building or construction that are not based on the principles of circular economy. The defunct volumes will in turn help reduce CO2 emissions a great deal.

Another area of innovation is ***mindset of people*** and mentality are changing rapidly. The products that we currently develop are sophisticated but you find we do not need as many products as we own. In industrial and residential areas, people will create a small economy system that is interconnected.

What are some of the lessons learnt from your experience so far in promoting the transition to circular cities?

The idea to invest in best practises and examples is important but doesn't work if people do not recognise the meaning and value for their own business of home. If you want to get people on the move, it should be meaningful and of value for his/her benefit. You need to translate your message and intentions to be meaningful and of value to people. That is why as Zwolle, we are very close to our people to make it happen.

B.6 MUNICIPALITY OF THE HAGUE

What is your position at the Municipality and for how long have you been involved in this role?

Interviewee: Jan Harko Post.

I am a policy advisor at the department for city management, specialised in environmental issues, waste management and European affairs. I've been involved in this role for about 25 years.

How is the municipality considering infrastructural changes to mitigate the impacts of climate change?

The main focus is on the energy infrastructure, in particular district heating and cooling from renewable energy sources (hot/cold storage, geo thermal wells, seawater, etc.).

Other investments that contribute to mitigation are in high speed tram networks (within the city as well as regional), bicycle infrastructure (not only the network but also parking facilities) and railway hubs (Central Station and Hollands Spoor Station).

Another policy area where mitigation and adaptation meet is that of green areas, parks and nature conservation. The city of The Hague has a lot of large green areas that are actively maintained, protected and developed (enhancing biodiversity).

What are the priority areas for the Municipality in reducing CO2 emissions?

The two main priorities are traffic and buildings. In addition to the answer to the previous question, I would like to mention the low emission zone for the city centre, demolition subsidies for older cars and charging networks for electric cars.

As for buildings, there is a range of support and grant facilities as an incentive for home owners to invest in energy efficiency and renewable (sun, hot/cold storage). Being a center of government another focus is on energy efficiency of government offices. One example is a project to optimise district heating and cooling facilities in the city center by 'hooking' up as many government office buildings as possible, facilitating offer and demand for heating and cooling and minimising energy losses.

Who are the stakeholders involved in climate change mitigation activities in the Municipality and what are their roles?
Within the municipality, the main stakeholders are the department for spatial planning (incl. traffic and economic department) and the department for city management. The planning department is responsible for city planning as a whole (including all infrastructures). The same department is also involved in individual projects of developers and property owners, thus being able to bring sustainability issues to the table in direct negotiations with them.
The city management department is responsible for conducting environmental impact assessments for plans and projects. This is one important legal tool that we have to secure that sustainability issues like mitigation and adaptation are addressed and the appropriate measures are taken.

How is the Municipality adopting circularity concepts?
At the moment we are focussing on three policy areas: (1) community based initiatives (what's going on in the city and what incentives can the city offer to stimulate and facilitate?), (2) mapping of resources as part of the transition from urban waste management to urban resource management and (3) circular public procurement.

Which are the priority sectors/areas for implementing circularity concepts?
The priority sectors are government services, trade and building. These sectors have been identified as having the largest impact in terms of GHG-emissions, economic (added) value for the city and jobs. So these sectors offer the greatest challenges and opportunities to implement circularity concepts.

What are the impacts so far of the circularity activities adopted by the Municipality?
The main impacts at the moment are in the area of coalition building and gaining more insight into the potential of circularity in our city. This is however a consequence of the fact that we've only just started on this journey. Real effects in terms of impact on resources and economic activity will certainly spin-off in the years to come, but are not yet very visible in terms of size.

Does the Municipality offer any incentives to stakeholders implementing circularity concepts or initiatives linked to reducing CO2 emissions for example through lower prices for permits?
No, not yet. We are still in a phase where we are trying to get some basic understanding of what the potential of circularity is in our city. One important focus is on resource management (as opposed to waste management). At the moment we're experimenting in one relatively small area with the concept of a resource broker who helps businesses understand the value of their waste streams as resources for other businesses, and linking businesses in an effort to extract maximum

added value from their waste streams by treating them as resources. We think that this type of 'facilitating circularity concepts' is more effective than cheaper permits.

What are the circularity activities implemented by the Municipality that are aligned (directly or indirectly) towards emission reduction and retaining resource value for The Hague?
The most important activities at this point in time are focussed on resource mapping and identifying the major economic sectors that have the best potential for developing circular business models on the basis of that mapping exercise.

Has there been a need for shift in government policy and economic systems to enable the implementation of circular economy and existing climate change mitigation goals for cities?
Absolutely. We can see that especially the subject of circular economy is receiving far more attention at local level (politics and business) since the Dutch government has launched its national circular action plan.

What are some of the greatest lessons learnt in the process?
One of the most important lessons is that circular economy is not a project and cannot become reality by simply implementing an action plan. We are talking about a transition here. And as most great transitions in history, you need 'creative disruption' to take steps forward. And in general creative disruption begins with a small number of individuals and not with big government action plans. So government should be modest and stick to the task of nudging and enabling to stimulate what is valuable, and regulate what could have adverse effects on society (for example the negative impact that initiatives like Air BnB has on the social fabric in parts of some cities).

In your opinion, what are some of the immediate and long-term instruments to support cities in their transition to circular cities?
In short knowledge and regulatory and financial arrangements and incentives for innovation.

What is the future of the nexus between circular economy and climate change mitigation at a policy level for cities as The Hague?
The most important one will probably be the transition from waste management to resource management, not only within the municipality but also within businesses. The benefits of resource efficiency are expected to translate into energy efficiency, thus contributing significantly to climate change mitigation.
A similar case could probably be made for the transition from goods to services (the case of Philips lighting) and concepts of sharing economy.

Who are the most important stakeholders in the nexus?
As with most societal issues this will be citizens, business and government in the vast variety of economic and societal roles they have. But key is the ability for business to develop circular solutions for everyday problems at a reasonable price for consumers. If they succeed in doing that, circularity will no longer be an issue but a reality of everyday life.

What are the forward looking practical steps for cities in the transition to circular cities and who are the enablers for such transitions?

This question is very hard to answer at this stage. At this point in time cities are embarking upon a search for what may work and what may not work and what is needed to support the circular economy. Referring to the famous phrase by Bill Clinton: It's the economy, stupid!, it is fair to say that the most important enablers are businesses and consumers. Municipalities can of course nudge, facilitate and regulate. But more importantly cities can function as living labs for proof of concept because cities are large enough to make a difference, but small enough to make it happen. In other words: cities have the right scale to experiment and find out what does and does not work.

How do the enablers come together and find a mutual understanding of a transition context, and agree over the best course of action?

First of all I would say there is no best course of action. There are more roads that lead to Rome as the saying goes. Having said that, I think it is important to bear in mind that there are different ways that enablers and stakeholders can contribute to the transition. Local communities by shaping the sharing economy to their own needs, businesses by developing new products and services, consumers (individuals and organisations) by using their purchasing power to support the market uptake of innovations, government (local, national and international) by putting in place the right incentives for businesses an citizens (eco-design regulations, tax incentives), etc. Enablers and stakeholders will come together as soon as they recognize mutual gains or, as in the case of government, the see bottlenecks to be solved. One example of this is the partnership on circular economy under the European urban agenda.

What is the role of technology (engineers) in all the related aspects to be facilitated to move infrastructure towards circular practices?

Technology will be an important driver for circular practices. Two examples have already proven their value: 3D-printing and digital platforms. Digital platforms are of great importance of disclosing markets for new products and services and for enabling communities to develop concepts of (local) sharing economies in a hands-on and affordable manner. 3D-printing has enormous potential when it comes to resource efficiency for example (on demand delivery of goods instead of mass production for stock) and recycling of materials (for example plastics bottles can be recycled in materials that can be used for 3D-printing).

B.7 MUNICIPALITY OF TURIN

How is the City of Turin considering infrastructural changes to mitigate the impacts of climate change?

In terms of mitigation, we are primarily focused on the energy transition piece (as well as adaptation). We assign the government of mayors and we have an action plan for energy that we have been implementing and monitoring progress for two years now. The target was to reduce by CO2 by 30% levels by 1991 level by 2020 and as of 2014 we were at 22% reduction already well on our way, and now we are working on the remaining 8%.

What are the priority areas/steps in reducing CO2 emissions of Turin?

The district heating has been the lion's share of the progress, over half of the city is heated by natural gas (methane) which is a big transition. Transportation has also been a big piece we have a metro line and increased (improved) public transport service. Also, the green carbon procurement.

Who are the main stakeholders involved in climate change mitigation activities in the Municipality and what are their roles?

Energy company (especially for the district heating) as well as the municipal owned public transit corporation are the two main stakeholders. Our energy managers are however working externally to ensure energy efficiency in school buildings etc, so I would say internal departments as well as external stakeholders for example the energy companies that we have municipal contracts with.

We are also working with SMEs to develop climate adaptation plans/strategies for their own strategies.

How is the City of Turin adopting circularity concepts?

We (long pause) adhered to the Seville declaration on circular economy, our deputy mayor attended the launch of the declaration. We also participated in a global hackathon in the fall and chose the topic of climate adaptation and the three start-ups that won were focused on the circular economy principles. We are in the process of developing a circular economy strategy for the city that we do not have yet.

Which are the priority sectors/areas for implementing circularity concepts?

-One is food waste, we are doing several things in that realm, also in reducing food packing, the throw away.

-The re-use of materials is also another priority sector, from used goods. There is a network of actors engaged in the making products from used products available for new users, there is a table of stakeholder involved in the reuse of things as bikes, small appliances and other small products. These group of stakeholders meets regularly for the past six months to develop synergies and strategies with each other.

-We are working hard to meet our 65% recycling of all sortable waste in the city. This year we are expanding to 70,000 more residents through door-to-door systems and this will bring us to about 50% of our population and to about 45% of all waste being recycled.

What are the impacts of the circularity activities adopted so far by the City of Turin?

Going to be a bit hard for me to quantify, but clearly in the recycling part tonnes of materials is not going to landfill. Also in the food waste, we have quite a number of projects and you find one project is recovering over 200-400kgs of food that would go to waste per day from one single market, so clearly the impact is significant. I do not have specific quantifiable number.

Also, this is similarly related from the amount of material that is being diverted from the end-of-life treatment.

Who are the stakeholders involved in implementing circularity concepts and what are their main roles?

The stakeholders are varied. We have a regional research centre that focuses on environmental innovation and they are a primary stakeholder. Two universities help us organize the Climathon hackathon (University of Turin and Polytechnic of Turino). There is a local foundation, the biggest charity foundation is also involved and engaged in the process especially in the re-use side. There are a number of food vendors and market organizations that are helping with the food waste (local merchants), also a couple of NGOs are involved and they help us organize a number of activities in the markets and also asylum seekers who help us recover food that would otherwise go to waste.

The stakeholders I would say are numerous and varied, this is probably not all of them, but just on top of my head those are some.

Does the Municipality offer any incentives to stakeholders implementing circularity concepts or initiatives linked to reducing CO2 emissions for example through lower prices for permits? If yes, please share some examples.

We do have a mechanism by which we incentivize construction companies to essentially calculate their CO2 emissions during a construction project and then compensate the city for those emissions by doing some other kind of planting or forestry related activities which is also another sort of mitigation strategy. It is an incentive as it is part of a public bid process when a company bids on a certain job, they must express their willingness to participate in this program.

We are also working on developing a municipal regulation for essentially giving incentives to people who organize events in a more sustainable fashion, we are working with a local university to develop the regulations with municipal ordinates. We do not have yet financial incentives but it is one of the things that will come out of the regulations.

What are the circularity activities implemented by the Municipality that are aligned (directly or indirectly) towards emission reduction and retaining resource value for Turin?

I think mitigation and circular economy strategies are not directly distinct but they are indirectly linked, more than anything else the thing that comes to mind is that we are working on a European project called Urban Wins in which we are mapping and discussing the urban metabolism in the context of wanting to develop a strategic plan to manage our waste cycle more strategically. In this process, the two initiatives are more practically aligned as the urban metabolism piece is very much aligned to CO2 reduction while the waste cycle is on circular economy.

There is however several indirect links, for instance the food recovery, a big piece of the food distribution chain is the energy produced to and transport distribute food to urban dwellers, so I would say to by reducing food waste we are mitigating the amount of CO2 produced in the chain of events. That is sort of true in the re-use activity, less emission reduced in its treatment but more into the life cycle of products that we are somehow reducing the amount of CO2 by substituting the amount of CO2 used in a more frequent basis. There are some tangible indirect links, but we will develop more direct links through this Urban Wins project and also, we are going to develop some activities through our climate adaptation plan, as our action plans are already covering the mitigation piece in a great deal.

Has there been a need for shift in government policy and economic systems to enable the implementation of circular economy and existing climate change mitigation goals in Turin?

There is some shift in terms of energy, especially in the mitigation side of things. Our energy policy has changed to promote the district heating and the switch to natural gas from other more emitting resources. Also in the food recovery and food waste piece there has been a shift in national legislations because it was a bit difficult to organize such activities because of strict government regulations around food, but now a national law has passed essentially forcing a number of actors across all levels to reduce the number of food waste, to make it easier for this to work.

What are some of the greatest lessons learnt in the process?

I have not been directly involved long enough to have a good sense of lessons learnt.

But I guess one lesson, is that when you start making the energy transition for example, you go for things that produce best results with the least investment, but then after that things tend to get more expensive rapidly to intervene in the system**.**

What is the future of the nexus between circular economy and climate change mitigation for cities as Turin?

I think the nexus is the concept of urban metabolism and climate planning, it is about analysing the flows of good and materials and resources and energy and search through the city and identifying the areas we can make improvements in metabolisms in line and in sync with circular economy principles.

Who are the most important stakeholders in the nexus?

May be hard to say right now, but we are certainly involving private sectors, universities, municipally owned privatized services as waste management, water distribution, energy distribution and I think I would obviously say people/residents of the city who are adopting more circular behaviours.

What is the role of technology (engineers) in all the related aspects to be facilitated to move infrastructure towards circular practices?

Engineers are key in the energy transition piece and in the energy management. We are also working closely with some universities to develop alternative energy possibilities herein Turin, from electric mobility to hydrogen fuelled cells, and there is a significant technology component to that. We are working Universities and the regional environmental innovation centre.

We are also working very closely with the deputy mayor of innovation in terms of new sensors and all kinds of data gathering and management systems that can help us monitor how the flow of our metabolism and the function of it, so we can identify places to intervene in the system. There is actually a great technology and innovation component even when looking at the district heating piece, it requires a large technology barge.

The data also helps to innovate, because once we have data we can know what is working, what isn't and we can also ask people to offer new solutions based on how things are organized.

What are the forward looking practical steps for cities as Turin in the transition to circular cities and who are the enablers for such transitions?

The most practical piece is getting the different stakeholders in the room together for example through the Urban Wins initiative to essentially broaden the conversation to as many stakeholders as possible and to invite innovations from outside the administration. The Urban Wins project allows us to confront different stakeholders in a facilitated, set of participatory processes is key to identify specific needs and specific sectors. Stakeholder engagement is practical to foster awareness, behaviour change and innovation.

The initiative should come from both sides (municipality to people and other way), for example by the city organizing the climathon, it is opening ups to new ideas from people but then things as district heating plans or expanding the door-to-door system were more policy oriented and required government policy and intervention to realize them. However, in the circular economy side of things, most of the initiatives are bottom-up, they are local and the government just has a role in bringing people together to help a network to emerge, especially true in the food waste sector, on the one hand, you start working on food in the systemic way it requires policy, so it really is both.