Chapter 10
A Sustainable Supply Chain Perspective in the Transition to Circular Cities

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Abstract Cities present a valuable opportunity for any form of transition processes in the post-global economy because of their unique ability to facilitate the interaction of extensive systems, structures and cultures within the same geographic space. In the recently adopted Sustainable Development Goals (SDGs), the theme of sustainable cities and communities is stand-alone goal 11, also known as the 'Urban SDG'. It identifies the potential of cities to enable social, economic and environmental advancements to *make cities and human settlements inclusive, safe, resilient and sustainable*. On the other hand, the concept of the circular economy and its restorative and regenerative nature by design presents practical and innovative opportunities for cities to retain the value of existing resources. At this point in time, there are extensive opportunities associated with the recovery of materials and resources across the value chain in a city. For instance, producers can retain the value of materials and the value chain by using recycled materials or using a leasing model rather than ownership. This will greatly reduce carbon footprints in the existing demand points in cities as well as in production, distribution, transportation and manufacturing. Consequently, the potential of cities to reduce greenhouse gas emissions under the auspices of the 2015 Paris Agreement that aims to strengthen the global response to the threat of climate change through circular economy business models and initiatives, is slowly featuring in academic discussions. Hence, this chapter identifies the nexus between circular economy and climate change mitigation for small and medium-sized cities (SMCs) in the context of sustainable supply chains. This chapter assesses SMCs in the Netherlands with a population range of between 50,000 and 250,000 namely Almere, Dordrecht, Zwolle, Haarlemmermeer and Venlo. Turin and The Hague (classified as large cities) are analysed 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 ultimate goal of this chapter is to

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contribute to the global discussions on Sustainable Development Goals and the 2015 Paris Agreement on climate change by identifying opportunities for sustainable supply chains in the transition to circular cities.

Keywords Circular economy · Circular cities · Sustainable supply chain · Collaborations

10.1 Introduction

In 2016, an estimated 54% 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 consume 75% of natural resources (UN Habitat 2016). The UN Habitat report on State of Cities identified the evolution of cities as centers of prosperity stating that cities in the twenty-first 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).

The future of Europe's 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 (ESPON 2013). This goes to show that urban areas in Europe are highly exposed to social, environmental and economic crises, if actions are not taken. The Netherlands are a highly urbanized country and considered as one of the most urbanized countries in Europe 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 Assessment 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 in South Holland primarily consists of four of the largest Dutch cities Amsterdam, Rotterdam, The Hague and Utrecht. 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. With the growing population, there is increased demand of products and services by the population requiring a properly designed and operational supply chain which is often not the case. The introduction and development of circularity concepts in cities, such as designing out waste and closing of the material cycle reduce inefficient resource use and synchronously fit in with climate change mitigation goals.

In 2012, the Ellen MacArthur Foundation brought together several complementary schools of thoughts in describing the concept of circular economy, giving it wider exposure and appeal. Circular economy is defined as a "*continuous positive development cycle that preserves and enhances natural capital, optimizes resource yields, and minimizes system risks by managing finite stocks and renewable flo*ws" (Ellen MacArthur Foundation 2016). The circular economy framework aims to generate practical and feasible solutions to current global challenges. Shorting the value chain of resources will allow companies to conserve the value of materials by using locally accessible raw/recycled materials in different forms or explore alternative options as the adoption of lease business models. For instance, in Almere, a Dutch SME called MUD Jeans applies the lease a jean concept where it leases its apparel to consumers and after 1 year, consumers can decide to keep the jeans or take-back/swap the jeans and continue leasing or return the jeans for recycling/upcycling. This business model integrates environmental concerns to keep as long as possible the value of resources to produce and 'consume' a pair of jeans, representing an 'added sustainable value'. Prendeville et al. (2017) identified the inadequate placement of circular economy in the borders of urban sustainability compared to the dominating business narrative. However, circular economy presents enormous opportunities in urban sustainability for two main reasons. First, through urban mining, which is the systematic reuse of anthropogenic materials from urban areas where technical and biological nutrients become aggregated within cities' boundaries and can be found in quantities worth harnessing (Brunner 2011). Secondly, the close geographic proximity of stakeholders within cities is effective in enabling collaborations to close resource loops and minimize waste. Bulkeley and Betsil (2003) concurred by discussing the innovative spaces cities offer to respond to climate change, from influencing value chains in the production and management of greenhouse gas emissions to the implementation of international agreements and policies. Circular economy initiatives and business models such as circular design, sharing platforms, product life extension and products-as-service provide innovative opportunities for the many challenges cities are facing as climate change.

This chapter explores the link between the two integral concepts in the transition of SMCs to circular cities. 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.). The research foremost identifies how the selected case cities are adopting and implementing circular economy through retaining resource values and further assesses if and how the initiatives are directly or indirectly linked to mitigating climate change. Towards addressing the issues aforementioned, the following research questions were developed:

(i) How can cities retain value and make more efficient use of their existing resources?
(ii) What are the (existing and potential future) 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?

10.1.1 Organisation of This Chapter

The subsequent sections of this chapter are as follows: The second section summarizes the literature reviewed to inform the research on the extent of previous works related to circular economy and its implementation in China as one of the pioneer countries that have adopted the concept, in addition to theories regarding cities and climate change. The third section describes the method applied to gain new knowledge towards addressing the research questions. The fourth section elaborates on the findings of the research and the fifth section discusses the research findings in relation to the literature review. The sixth section concludes with recommendations for cities, businesses and policy.

10.2 Literature Review

10.2.1 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. SMCs often appear to be less equipped in terms of critical mass, resources and organizing capacity (Giffinger et al. 2007). Further studies as of Siegel and Waxman (2001) found six challenges experienced by small cities: (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. Counterargument research indicates with increasing evidence that size alone is not a sufficient explanation of 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 and Camagni 2000). Moreover, the challenges faced by SMCs can be met more precisely with better knowledge and positioning of the cities. SMCs have specific potentials to compete with larger cities. Erickcek and McKinney (2006) identified that the larger the city size is, the more other agglomeration disadvantages as traffic congestion, high property prices, social segregation, crime and environmental pollution increase. This shows that SMCs present a manageable and controllable opportunity. Additionally, Hildreth (2007) found that SMCs could play multiple roles unlike large cities. For example, SMCs do not offer urbanization economies that is the economic advantages from larger market size, labour markets and knowledge exchange across the whole urban area (Hildreth 2007). Instead, they offer more localized economies within the industries they specialize in, developing in more diverse sectoral composition. Public policies have the potential to increase the economic viability of smaller metropolitan areas and cities (Erickcek and McKinney 2006).

10.2.2 Circular Economy

The concept of the circular economy is globally making headlines; however, this is nothing exceptionally new in the fields of research and practice. 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 refers to 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. According to Yuan et al. (2006), there are three levels where circularity concepts could be applied: micro, meso and macro levels. The micro (individual) refers to measuring performance at individual companies' level; the meso level refers to an eco-industrial network developed with different production systems and supply chain systems with environmental protection benefit and the macro level is where eco-provinces, eco-municipalities and eco-cities are developed. This chapter contributes to the macro level of the circular economy by reviewing the transition of SMCs to circular cities in relation to meeting climate change mitigation strategies. The subsequent section identifies the lessons learnt from China's experience in implementing circular economy as one of the first countries to adopt the concept.

10.2.3 Experience from China in Implementing Circular Economy

In China, the interest and promotion of circular economy is quickly shifting 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. 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 et al. 2013. The Ministry of Environmental Protection (MEP) and National Development and Reform Commission (NDRC) spearhead the implementation of circular economy in China through legislative, political, technical and financial measures (Su et al. 2013; UNEP 2006). Mathews and Tan (2011) found recycling and the interconnected processes in city/municipal level are vivaciously promoted through economic and administrative incentives (supporting Sustainable Supply Chains-SSC). 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. What has been fundamental for cities in China is the shift of government policy and economic systems to incorporate the transition and boost China to currently being one of the leading countries in adopting circular economy. Through the experience in China, this chapter identified the ongoing and planned shift in government policies and economic instruments in the SMCs evaluated.

10.2.4 Cities and Climate Change

One of the targets (11.b) of SDG 11 is to increase the number of cities and human settlements adopting and implementing integrated plans towards participatory inclusion, resource efficiency, mitigation and adaptation to climate change substantially (UN Habitat 2016). Bulkeley and Betsil (2003) explained four reasons why cities are significant arenas to address climate change and the influence of local governments in achieving national and international targets on emission reduction. Foremost, 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. Secondly, local authorities have a long-term engagement with sustainable development issues in an attempt to translate global rhetoric terms to local practice in ways that influence 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 and 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. This goes to show that cities are ideally the locus for change and venue where policies are realized hence experimenting at the city level is crucial in the post-global economy. On the other hand, the focus of actions to improve sustainability in supply chains is quickly shifting from environmental operations and policy, strategy, finance, product design, supplier relations and post-consumer product management to systemic issues (Linton et al. 2007). Hence, cities are comprised of core systemic issues that can be influenced by circular economy through sustainable supply chains in the case of product design, product life extension, product-end-of life and recovery processes at the end of life.

10.3 Methodology Reflection

The research described in this chapter applied multi-case study analysis method to approach data collection. Creswell (2013) defined a case study method as one that explores a real-life, contemporary bounded system/case or multi-bounded systems/cases overtime through detailed, in-depth data collection involving multiple sources of information and reports a case description and case themes. Cousin (2005) further explains that the case study method is not only aimed at analysing cases but it is a good way to define cases and explore a setting in order to understand it. The described research applied the multi-case study approach to gain a wider

understanding of the similarities and differences in the SMCs to assess the validity of the findings. In addition, the multi-case studies approach is considered strong and reliable (Baxter and Jack 2008) and creates a more convincing theory when the suggestions are intensely grounded in several empirical evidences (Gustafsson 2017). Document review of scientific articles on sustainable supply chains, climate change and cities and circular economy topics were located using databases as Science Direct, Scopus, Web of Science and Google Scholar. The researcher participated in one conference on the topic of Energy transition in cities by EUROCITIES in Antwerp, Belgium attended by Mayors, Deputy Mayors and City Officials from Amsterdam, Turin, Gent, Porto and Tilburg among others. In addition, the researcher joined a webinar hosted by the World Bank on sustainable cities gaining more insight particularly on the EU policies in cities and driving the SDG agenda through cities.

SMCs are the research object which can be defined as the phenomenon under study (Verschuren and Doorewaard 2010) whereas the research perspective is known as the 'spotlight' or 'lenses' used to study the research object closely. This chapter observes SMCs in the perspective of the nexus between circular economy and climate change mitigation in the context of sustainable supply chains.

Prior to the selection of circular SMCs to assess for the study, internet search-based research was conducted. Thereafter, a criterion was applied to select the case 'circular SMCs in the Netherlands' and to narrow down the number of those cities most relevant for this research. The Table 10.1 below summarizes the criteria for case selection.

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. From the eight cities, four were excluded as they did not meet the criteria of a SMC 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 addition of the fifth city – Zwolle – was a result of the snowballing effect through referral from the Project Leader Circular Economy in Overijssel in Oost NL. The selected case cities are as listed in Table 10.2 in addition to their location within the Netherlands and the population size as of 2015.

Table 10.1 Criteria applied for selecting case cities

Criteria	Determined by
Have a population of between 50,000 and 250,000 inhabitants	EU definition of a small and medium-sized city
Signed Circular City Deal in Netherlands	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

Table 10.2 Selected case cities

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

Comparatively, two large cities – Turin in Italy and The Hague in the Netherlands – were analysed 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. Erickcek and McKinney (2006) discussed on the potential public policies have to increase the economic viability of smaller metropolitan areas and cities. While Giffinger et al. (2007) concurred by describing 'policy transfer' and 'lesson-drawing' as the adoption of urban development strategies and experiences by learning trials, errors and efficiency of policy strategies already in operation. It is against this backdrop that Turin, a city in Italy with different legislations, culture and a front-runner in championing the transition to a circular economy, was selected to identify the experiences of other cities outside Netherlands for a broader analysis. The chapter was intended to also identify experiences in Copenhagen but communication with contact persons was limited by time.

Primary and secondary informational sources were gathered through literature review and a series of 11 interviews with key informants from Netherlands and Italy. In choosing the key informants, the research applied convenience sampling[1] which involved choosing the informants willing to take part in the research within the time available. Examples include Nadine Galle from Metabolic, Joke Dufourmount from Circle Economy, and Jan Harko Post from The Hague. Theoretical sampling[2] was applied in selecting Prof. Cramer to provide insights on previous research, and 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[3] were 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 sus-

[1] Convenience sampling- this is a type of non-probability or non-random sampling whereby the target population included in the study meet certain practical criteria such as easy accessibility, availability at given time, willingness to participate and geographical proximity (Etikan et al. 2016).

[2] Theoretical sampling- is guided by emerging theory where the process of data collection is directed by evolving theory rather than by pre-determined population (Drauka et al. 2009).

[3] Snowball sampling technique- is a non-probability technique whereby the existing research subject refers to another subject who in turn refers to another subject and so on (Atkinson and Flint 2004).

tainability issues with a focus on the transition to circular cities. Largely, this was achieved and Table 10.3 below is a brief professional description of the interviewees, their affiliations and roles, and type of interview conducted.

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 and existing climate change mitigation policies and goals, with the intention of identifying areas of a nexus. To make recommendations, the study used content analysis techniques such as coding. Content analysis is a systematic, rigorous approach to analysing documents obtained or generated in the course of research (White and Marsh 2006). Content analysis is detailed with procedures described, examples of its application provided and controversial issues included with external validity as a goal (Downe-Wamboldt 1992). Three complimentary coding techniques and procedures were adopted to aid in the controllability of data collected qualitatively. (i) *Open coding* – where all sources are made available while the intriguing/inspiring concepts become gradually precise (Verschuren and Doorewaard 2010). Actual research activities included taking notes during interviews and formulating concepts that could interpret the identified phenomena. 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 (Verschuren and Doorewaard 2010). 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 in cities were indicated and crucial success factors identified. (iii) *Selective coding* – phenomena were described, concepts formulated and key words reduced to a concise description (Verschuren and Doorewaard 2010). Key concepts were determined based on their relations in a specific line of argumentation, which in this case is the transition process in cities. Specific words, phrases and sentences that were emphasized or repeated by interviewees or deemed important or emergent by the researcher were identified, analysed and coded in different colours.

10.4 Findings

This section presents the research findings based on data collected through content analysis of documentation and semi-structured interviews with the 11 key informants.

Table 10.3 Professional description of the interviewees and their affiliation

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 min' 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[a] 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	PhD Candidate Prefers to remain anonymous	One-hour Skype interview
Mrs. Bekker Milene	Municipality of Venlo	Mrs. Bekkers is a *Senior Policy Advisor on Sustainability and 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	One-hour, face-to-face interview
Mr. Martin Hulsebosch	Municipality of Dordrecht	Mr. Hulsebosch is a *Senior Policy Advisor Economic affair* and previously worked as a Policy Advisor for about 8 years from other roles	30 min' 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 min' 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

(continued)

Table 10.3 (continued)

Expert	Affiliation	Title and role	Type of interview
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	Office of the Deputy Mayor	40-min Skype interview
		Prefers to remain anonymous	

[a]Buiksloterham- a former industrial area in Amsterdam North 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 (de Lange et al. 2016)

10.4.1 Important Elements in the Transition Process

The research identified the following important elements in the transition process based on the experience of the analysed cities. The importance of *defining and contextualizing circular economy* was reiterated. Representatives of cities should ask the right questions in forging towards circularity for instance if circular economy considers materials, energy, water, and social aspects, current or future recycling possibilities amongst others. This kind of questions will help cities make it right from the start as opposed to less bad. Conducting risk assessments and current state analysis to identify problematic areas (priority) emerged fundamental to inform the diagnosis process while areas of new development within SMCs presented high potential for circularity in applying new techniques. Equally important is that cities should analyse their current material flow systems to understand what is happening within their boundaries and how the current systems are functioning. This is a core aspect of sustainable supply chains towards putting into perspective the social, economic and environment impacts of material flows within a system. In that case, the research found *developing sound and flexible methodologies* to be important in the process. This could be through *an integral approach* to developments and projects. For example, Venlo is in the process of developing new policies that integrate circular economy and cradle-to-cradle principles. Venlo is also encouraging education institutes to integrate cradle-to-cradle and circular economy concepts into their school curriculum in an attempt to build and maintain knowledge and capacities within the city. Such local practical efforts and solutions are important to inform policy formulation to prevent counter productiveness in innovation. In addition, there is strong urge and need to *shift from the old typical master plan system in cities to flexible zoning plans* that will adopt and promote circularity concepts. This is evident in the Buiksloterham project where a former industrial area North of

Amsterdam is redeveloped into a working/housing area by public and private parties with high ambitions in respect to circularity (de Lange et al. 2016). Correspondingly, what is ongoing in cities is the use of green public procurement and sustainability tenders to stir creative and sustainable competition. SMEs are consulting with cities to develop sound methodologies such as the development of guidebooks with indicators used in the tendering process to give circularity scores. Also used is the evaluation and quantifying of circularity efforts to better decision-making processes in the transition.

10.4.2 The Use of Innovative Instruments

SMCs are adopting innovative instruments to facilitate the transitions' intention of retaining value of resources. This chapter 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. Examples of such instruments include the use of circular procurement and sustainability tenders as part of the cities' procurement policy. The aim of such instruments is to help monitor the extent and potential of resources and materials recycling within the cities' boundaries. Such an example was evident in Haarlemmermeer where the municipality had included key performance indicators (KPI) on circular concepts in their procurement procedures.

The chapter also identified the importance of city contractors producing an assembly and disassembly plan and materials passport to elaborate on the kind of material going to a building/city and how they can be re-used or recycled at the end of the life cycle. To understand such flows, networks within cities provide a platform to share experiences and find out what is (not) functioning and enable cross sector and cross-value chain collaborations. These types of networks are achievable locally through both digital and offline platforms, which can help achieve circular waste streams in neighbourhoods and districts, boosting local economies. For example, Almere is encouraging its local entrepreneurs to produce and sell locally in addition to establishing an Upcycle platform where people bring their old belongings. The products are demolished or taken apart and resold in whole or in parts presenting a case example of an expanded value chain.

The trend in regions with SMCs is that the younger population leave to pursue further studies and not come back, leaving an aging population. Discussion with key informants brought to light the aspect of generating and maintaining (new) knowledge, to ensure quality does not leave SMCs, as a resource in the transition to circular cities. For example, Venlo is creating innovative projects through cradle-to-cradle concepts with young talents in education institutions (university of applied sciences and universities/colleges) in collaboration with companies working in the municipality. The projects are mainly in line with sustainability and profit making

and the companies sometimes absorb students upon completing school. Such intentional actions by municipalities help retain (new) knowledge within the city, especially from young skilled people who often leave to bigger cities to seek better opportunities. Correspondingly, education and science through research institutions emerged as important areas in communicating lines of resources to customize innovation, and not necessarily create new ones, in the transition to circular cities.

Monitoring and measurement systems are central in the transition process as SMCs should be able to identify the impacts of their actions, both positive and negative. However, there is no specific measurement system/method predominantly identified by the chapter as much as they may exist. Some examples of the identified monitoring and measurement systems include a 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, among others. Hard data measurements in combination with qualitative measurements of the impacts of circular economy initiatives in different sectors can be discussed in relation to areas of improvement. To give an example, Venlo in collaboration with the Universities of Berkley in the USA and Maastricht are qualitatively investigating the impact of the new Municipality building built on cradle-to-cradle principles on the staff health and translating this financially on what it means for the city (Milene, personal communication 2017).

10.4.3 Collaborative Platforms

The technical capacities of stakeholders working in the transition to circular cities can be tapped through different forms of consortiums that define the roles of each stakeholder. The consortiums help to capitalize on the stakeholders' strengths and operationalize circular initiatives. Examples include smart coalitions in Zwolle and Circular Companies' Cooperation developed in Almere. Another example is the innovation contest organized by the municipality of Almere where companies collaborate on projects and the best ideas are supported by the municipality. What is central in the described partnerships and schemes is being able to identify actors who can orchestrate or steer the process and bring people together in addition to identifying the different stakeholders' level of influence in the society. For example, Haarlemmermeer found 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'*.

10.4.4 Leadership and Trust

Active, present and *visible* were repeatedly mentioned to refer to the municipality's leadership in the transition process. The City Hall of Venlo Municipality is a vivid example with its monumental building constructed on the principles of cradle-to-cradle uniquely serving as a communication tool for the public.

Trust is equally an important issue, and the informants frequently mentioned this. The transition involves giving and taking sufficient trust from different stakeholders that foster the process to move faster through demonstrating success and lessons learnt. Municipalities as that in Zwolle have designated an area for citizens to experiment with circular economy activities and in the new District in Almere, citizens are independently organizing issues as waste collection and management. 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, as citizens are encouraged to support the experimental and disruptive nature of the transition to circular and co-creation[4] whereby different actors from different sectors collaborate to identify means of restoring existing systems in neighbourhoods, districts etcetra.

10.4.5 Size of the City in Relation to Transition

The term 'pace setter city' or 'leading city' is often used to describe cities in the forefront of the transition process and these are often assumed to be comparatively large cities. 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. For Almere, for instance, 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. To some extent, this provides these cities with additional advantages like 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

[4] Co-creation- defined as the collaborative development of new value (concepts, solutions, product and services) with experts and/or stakeholders (such as customers, suppliers) (Fronteer 2018).

considering circular economy initiatives require creativity, innovation and experimentation, commonly characterized of 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 and the development of residential areas facing noise pollution issues. Despite the challenges, the potential of SMCs is still relatively high in the transition process, as to this research extent the large cities investigated have not made comparatively large steps. As Capello and Camagni (2000) mentioned, with better knowledge and position of small and medium-sized cities, the challenges faced can be met more precisely. An example is the organization of local sharing platforms as in the case of Almere's Upcycle platform. This is more feasible and practical in smaller cities compared to larger cities. For instance, Amsterdam faces social segregation and crime issues according to Erickcek and McKinney (2006), which can greatly impede such initiatives. This means that front-runner SMCs can take such advantages, 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 (Mathews and Tan 2011).

10.4.6 Interrelationship Between Circular Economy and Climate Change Mitigation

The majority of the interviewees find the issue of circular economy and climate change to be 'one story' with the nexus becoming more apparent increasing the possibilities of exploring sustainable supply chain principles. The deteriorating physical environment and economy through global trade dependant on reliable and inexpensive transportation along complex long-distance supply (Curtis 2009) are evident examples of challenges posed by climate change. The opportunities presented by circular economy in reducing resource scarcity through effective supply chain increases the resilience potential of the physical environment greatly impacting climate change. With shortened supply chains, the production of goods will be located closer to where they are consumed (Curtis 2009). The trickle down all along the supply/value chain in changing the use of natural resources through circular economy will help in mitigating the impacts of climate change. Individual companies are developing capacities through their value chain to meet specific targets such as CO_2 reduction and energy transitions. Hence, closing loops in terms of energy, raw materials, water etc. brings a financial bargain to companies and subsequently influence cities to be more resilient and adaptive.

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. The 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, there is 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. (ii) The use of *bio-based alternatives,* where Haarlemmermeer is already supporting such initiatives while Almere is adopting the use of (renewable) wood for fuel. (iii) The *mobility* sector especially with the issue of return logistics and mobility being highly present in cities. Some examples mentioned include the principles of *sharing economy* observed in Uber. (iv) *Nature-based solutions* present an opportunity of overlap of both issues. Lastly, the subject of (v) *People's changing mind-set* whereby, compared to the past, there is growing knowledge and awareness on alternative consumption options than the current sophisticated products. This section concludes with a summary of the lessons learnt by the interviewees in the transition process in relation to the emerging transition success factors (see Table 10.4).

10.5 Discussion

There is great potential for front-runner SMCs to capitalize on the strengths of their relatively fast decision-making systems and processes to develop in a circular manner. As discussed by one of the key informants, SMCs are *large enough to make a difference but small enough to make it happen.* Hence, the opportunity to experiment with different types and scales of circular initiatives is idealistic in SMCs. A core aspect of circular economy in its restorative and regenerative nature is 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 through value identification in the supply chain. 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, cities should conduct material flow analysis and create a portfolio indicating the current state analysis of materials and resources in neighbourhoods, productive sectors etc. This will help favourably inform the diagnosis and decision-making processes on retaining value of existing resources. This aspect was not evident in the case cities, to this extent of research. Some of the activities identified in this process include conducting Total Cost Ownership/Life Cycle Costing[5] thinking which use a lifecycle of the product approach, greatly encompassing a supply chain scope. Similarly, most of the SMCs are already adopting green public procurement procedures such as circular procurement and sustainability tenders in the municipalities as it deems promising to help cities in transition. Examples of

[5] Total Cost Ownership is an estimate of the total costs of goods or services over the whole of their life (New Zealand Government 2013). Life Cycle Cost refers to the sum of all costs incurred during the lifetime of an item (Dhillon 2013).

Table 10.4 Summary of lessons learnt in the transition

Success factors/ conditions	Lesson learnt
Use innovative 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 them to help raise awareness and involve communities to participate (Lindjier, personal communication 2017)
	Policies or regulations do not always hold back innovations as many people suggest; what is required instead is to approach issues differently than we currently do (Korse, written communication 2017)
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 (Galle, personal communication 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 (Dufourmount, personal communication 2017)
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 (Cramer, personal communication 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 2017)
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 (Kok, personal communication 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 (Milene, personal communication 2017)

identified activities in this process include developing material passports and material assembly/disassembly plans in the construction sector to help cities understand what types of resources are used to the end of its life cycle. The shift in thinking from waste management to resource management is a fundamental prerequisite to foster cross-sector and cross-value chain collaborations. This process helps cities realize the wealth of resources that lie as waste and in turn strive towards value retention. 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 that at the moment are mainly in an experimental and trial and error phase. Incontestably, the transition process requires diverse stakeholders to come together for their diverse actions to trigger systems change. At this instant, collaboration schemes are based on the roles and capacities of the different actors in addition to their level of influence in the society. 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. Granted that population continues to rise, the issue of resource scarcity in the current global economic system persists and business as usual is no longer tolerable. China took a significant step in 2008 by proclaiming circular economy as its central goal and enacted the Circular Economy Promotion Law (Zhu and Qiu 2008).

The research confirmed that, albeit indirectly, a true functioning circular economy will in a great deal help cities reduce their emissions.

Projecting into the future, the research found the following areas to present high potential for the nexus of climate change mitigation and the transition to circular cities: (i) building and construction sector; (ii) the use of bio-based alternatives; (iii) mobility; (iv) nature-based solutions and (v) people's mind-sets. In the final analysis, the research that informed this chapter found the most prominent conditions for the transition to circular cities to be: (a) use of innovative 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, etc.; (d) give and take a great deal of trust in the transition process.

Circular economy principles will greatly influence decisions made in cities towards meeting set goals and ambitions. Fundamental changes are going to be evident in the supply chain systems within cities as the initial step towards broader systemic changes. The ambitions and targets set for the global sustainable development goals are part of ongoing processes which will be accelerated by the principles of circular economy in its intentions to maintain the value of resources for as long as possible. Energy, transport and waste systems are examples of core functions in cities that greatly contribute to greenhouse gas emissions. The main question for companies, businesses, local governments, citizens etc. is how to ensure the functioning systems within a city are effective and efficient towards meeting set ambitions and contribution to common agenda as those set by the SDGs.

10.6 Conclusion

The opportunity to deliver the ambitions of SDGs in cities through circular economy is made evident through this chapter by capitalizing on sustainable supply chains in cities. What is important for cities to note in this process is how to create interlinkages with climate change mitigation goals and strategies. SMCs can bring together actors in the five identified areas of nexus and share resources and knowledge to develop circular initiatives, activities or business models that aid in reducing carbon emissions among other ambitions of the sustainable development goals. By identifying this intervention points, SMCs acquire competitive advantages in the near future with regards to access to resources and meeting global targets. Furthermore, more opportunities are identified through the success factors for cities in transition such as adopting circular procurement and sustainability tenders to monitor the supply chain; encouraging flexibility at all levels, facilitating cross-sector and cross-value chain collaboration schemes and maintaining a great deal of trust in the process.

Table 10.5 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.

Local governments in SMCs might 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. With all being said, cities should take speedy actions and reduce CO_2 emissions from their industries, infrastructure, waste streams and so forth through circular economy.

Table 10.5 Summary of the recommendation, time-scale and indicators based on the success factors/conditions in the transition process

Time scale	Short-term		Medium-term		Long-term	
Success factors/ conditions	Recommendation	Indicator	Recommendation	Indicator	Recommendation	Indicator
1. Use innovative 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

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