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The Origin and Implementation of the Smart-Sustainable City Concept

The Case of Malmö, Sweden

Gabrielle Freeman

Supervisor

Kes McCormick

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Tel: +46 – 46 222 02 00, Fax: +46 – 46 222 02 10, e-mail: iiiee@iiiee.lu.se.

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For the past few months, I have joked about the 'light at the end of the thesis tunnel', which felt especially relevant writing during the long and dark Swedish winter. In many other ways, this project felt like taking a trip down a tunnel, or rabbit hole if you will, with nothing but small light to guide you. I imagined that my thesis tunnel would resemble the allegory of Plato's cave, where I step out into the brightness of the other side enlightened. Turns this particular tunnel turned out to be more of a time-warp that magically fast-forwarded four months into the future. In any case, I digress and on more serious note have many people to thank for an overall enjoyable thesis semester and for the incredible experience of the past two years spent in the MESPOM program.

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Abstract

The concept of a smart-sustainable city (SSC) has recently come to dominate urban sustainability political agendas and academic discourses in Europe. This thesis investigates (1) the origination of the SSC concept, (2) how it is being framed as an approach to sustainable urban development, and (3) how it can be contextualized in concrete projects and urban planning initiatives in the city of Malmö, Sweden. The SSC is founded on the convergence of several prevailing international trends: the devolution of international environmental governance to the local level; the increasing use of information and communication technologies (ICT) in urban planning and development; and the decentralization of economic policymaking to municipal governments.

As a strategic approach to sustainable development, an SSC is one that promotes the use of ICT and collaborative public-private partnerships as the primary means of balancing green economic growth with low carbon, sustainable development. This concept is founded on the significant potential of ICT to promote energy and resource efficiency in urban services and systems and to drive behavioral changes as citizens make more data-informed decisions about their lifestyle and consumption patterns. Proponents argue that more collaborative partnerships in cities foster coordination, innovation and attract necessary resources to help cities address complex sustainability problems.

While the SSC concept has been criticized by some social science researchers for its overemphasis on technology and for reframing urban sustainability challenges as market opportunities for private companies and corporations, the case of Malmö reveals a more positive outlook. The Malmö example shows that ideas and strategies inherent within the SSC concept can successfully create technologically and ecologically advanced neighborhoods, but also risk excluding parts of the city and its population from accessing any benefits created. While the SSC concept is not without its faults, contradictions and hyperbole, this thesis concludes that the SSC model for sustainable development can offer opportunities to engage a diversity of actors in finding solutions to a city's most pressing and complex sustainability challenges.

Keywords: smart-sustainable cities, sustainable development, ICT, climate change

Executive Summary

For the past couple of decades, scholars and professionals in different fields have worked towards developing more convincing and robust models for urban sustainability. As a result, a plethora of concepts and terms have been introduced to the policy debate: 'sustainable city', 'smart city, 'livable city', 'intelligent city', 'knowledge, city', 'low carbon city', 'eco city', 'resilient city', and 'information city', to name a few. In Europe, the 'smart-sustainable city' (SSC) model has recently appeared prominently in policy agendas and academic discourses as a promising framework to guide sustainable urban development.

A smart-sustainable city can be described as an innovative city that uses information and communication technologies (ICT) and other means to improve quality of life, efficiency of urban operations and services, and competiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects. This thesis examines (1) the origination of the SSC concept, (2) how the concept is being framed as an approach to sustainable urban development, and (3) how it can be contextualized in concrete projects and urban planning initiatives in the city of Malmö, Sweden.

This investigation employs a variety of research methods and uses a triangulation approach for data collection and analysis. First, a systematic literature review looks into the derivations of the SSC concept, with a particular emphasis on the theoretical underpinnings and initial construction of both the 'sustainable city' and 'smart city' concepts. Second, to examine its strategic approach to sustainable development, the SSC was framed within relevant European and Swedish policy documents and semi-structured interviews were conducted with various researchers in the field. The author also attended the International Conference on Smart Cities and Green ICT Systems (SMARTGREENS 2017) in Porto, Portugal to assess emerging trends and developments in SSC research and industrial applications. Third, a case study approach was used to demonstrate how this concept can be contextualized in ongoing sustainable development projects and urban planning strategies in the city of Malmö, including semi-structured interviews with a mixture of city officials, researchers and consultants.

The research conducted shows that the smart-sustainable city is not simply a new buzzword, urban label or abstract concept of a futuristic city. Rather, the SSC is an urban entrepreneurial ecosystem that is emerging from several prevailing international trends: the transference of international ambitions to address environmental issues such as climate change to the local level; the increasing use of ICT in urban planning and development; and the transfer of economic policymaking to city governments. As an approach to sustainable development, the SSC discourse reinforces neoliberal eco-modernist thinking by promoting ICT and public-private collaboration as the primary means to create green economic growth in cities.

This idea is based on the assumption that ICT has significant potential to help cities reach their climate targets by lowering energy use and green house gas emissions from other sectors through the optimization of urban systems and services. Its proponents argue that ICT can also enable more collaboration between diverse actors and empower citizens. From the Swedish perspective, which draws from the Scandinavian tradition of participatory design, open access to urban data will allow for more transparency, accountability and participation in urban governance and create a catalyst for sustainability solutions to be designed in partnership with people, or co-created.

However, many claims of SSC rhetoric have been criticized or rejected by the academic community. Some researchers view the SSC predominately as an economic agenda led by ICT companies who use sustainability awareness to successfully market their products to city

governments. In addition, some argue that the SSC is overall superficial and based on many powerful assumptions; first that ICTs are not viewed as a potential cause of environmental problems; and secondly that they could actively contribute to sustainable development. These assumptions contradict empirical findings that technology in cities tends to further entrench inequalities and social divides as well as create cultures of consumerism.

The city of Malmö gives a positive context for smart-sustainable urban development. Malmö was able to use the core strategies of an SSC, such as a business-oriented approach to development and a focus on urban sustainability, to create many technologically and ecologically advanced districts. Two examples are discussed in this research are the Bo01 district in the Western Harbor and the climate-smart district of Hyllie, although Malmö has many more successful examples. Arguably, part of Malmö's success in implementing the SSC model is that it has not focused on the technical interpretation of a smart city as much as it focused on engaging a range of stakeholders in its various projects, from the energy corporation Eon to universities and research institutes.

Moreover, Malmö has been able to market itself as a sustainable city, attracting environmentally-minded companies and investors that are interested in partnerships that can help the city meet its ambitious sustainability targets, including a climate target that the entire municipality will run on 100% renewable energy by 2030. Through its urban planning strategies and specific projects, Malmö has shown an important willingness to experiment and has built up an in-house expertise in creating innovative sustainability solutions, carrying knowledge and lessons over to each successive development. However, part of the city has been excluded from Malmö's success, and the city continues to struggle with social inequality. Hence, the city is currently focusing on more socially-oriented projects that also also have high environmental performances.

Overall, this thesis concludes that many of the more radical promises of the SSC concept, such as automated, fully-integrated urban infrastructures and more democratic forms of urban governance, seem unlikely in the near future and at odds with the privatization of public services. As the case of Malmö shows, public-private and other collaborative partnerships do offer promising opportunities for cities to make impressive investments in areas such as low carbon development. For the contemporary city, smart-sustainable development is a matter of balancing short-term (such as equity and economic issues) with long-term (such as climate change mitigation and resource management) goals and perspectives in order to understand what types of investments in physical and digital infrastructure and what partnerships provide the best benefits for both the environment and society.

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Abbreviations

GHG – Greenhouse gas
EIP – European Innovation Partnership
EIP-SCC – European Innovation Partnership for Smart Sustainable Cities
ETP – European Technology Platform
FG-SSC – Focus Group on Smart-Sustainable Cities
GIS – Geographical Information Systems
HEP – Hyllie Environmental Program
ICLEI – International Council for Local Environmental Initiatives
ICT – Information and communication technology
IoT – Internet of Things
IPCC – Intergovernmental Panel on Climate Change
ISO – International Organization for Standardization
ITU – International Telecommunication Union
KPI – Key performance indicator
MEP – Malmö Environmental Program
MIA – Malmö Innovation Arena
NZEB – Nearly zero energy building
OIP – Operational Implementation Plan
SDGs – Sustainable Development Goals
SIP – Strategic Implementation Plan
SIP-SSC – Strategic Innovation Program for Smart Sustainable Cities
SSC – Smart-sustainable city
UNDP – United Nations Development Program
UNEP – United Nations Environmental Program
UNESCO – United Nations Educational, Scientific and Cultural Organization
WCED – Word Commission on Environment and Development

1 Introduction

More than 200 years ago, the Industrial Revolution brought the first questions regarding the impacts of human civilization on the planet. From Thomas Malthus's 1798 prediction of global starvation due to overpopulation to Donella Meadow's warning of depleting the planet's finite resources in *The Limits to Growth* (1972), a growing number of intellectuals over the years have raised the alarm to the exponentially increasing effects of human development on the earth's resources and environment.

The current patterns and paradigms of human development have now been recognized on the international policy level as unsustainable—dependent on nonrenewable resources, especially fossil fuels, which result in greenhouse gas (GHG) emissions that are rapidly changing the planet's climate (IPCC, 2014). Humanity's cumulative ecological footprint currently exceeds the global carrying capacity and risks exceeding planetary boundaries for the vital ecosystem functions upon which life depends (Rockström et al., 2009). Extinction rates now exceed normal background rates by two to three orders of magnitude, with one-fifth of documented species classified as 'threatened' (Hoffman et al., 2010). The demands being placed on already threatened ecosystems continue to grow; world population, which reached 7.3 billion in 2015, is projected to exceed 9.7 billion by 2050 and 11.2 billion by 2100 (United Nations, 2015). Moreover, billions of people in developing nations legitimately seek to rise out of poverty and attain a lifestyle similar to those in the developed world with the higher levels of consumption that such a lifestyle entails, while those in the developed world expect an even higher standard of living than what they enjoy today.

From a more optimistic perspective, the notions of 'sustainable development' and 'sustainability' have become mainstream. As the world becomes increasingly urbanized, cities have become the frontlines in the battle to create more sustainable societies. Today, over 50% of the world's population lives in cities, a number that is expected to increase to 66% in 2050, adding 2 billion urban residents (United Nations, 2014). New and expanding cities present both challenges to and opportunities for sustainability. Due to high population densities and higher intensities of related socio-economic activities in urban areas, cities consume the majority of the world's resources, accounting for 60-80% of global energy consumption and more than 70% of global GHG emissions (UN-Habitat, 2016). Generally speaking, cities concentrate the most challenging global issues of the 21st century, including poverty, inequality, unemployment, environmental degradation, and climate change, to name but a few. Urban growth puts even more pressure on cities as they must also accommodate rising populations with infrastructure and services, address problems of urban sprawl or growing informal settlements, and address various other social and environmental issues.

Currently, many cities all over the world are grossly unprepared to deal with these challenges. However, urbanization is also a transformative force that can provide the foundation and momentum for a global shift towards sustainability. Over the last two decades, cities have emerged as the world's economic platform for production, innovation and trade, generating more than 80% of global GDP. Cities contribute more to national incomes than their share of the population. Paris for example, represents 16% of the population of France, but accounts for 27% of the national GDP, and metro Manila in the Philippines contains only 12% of the population of Philippines but contributes 47% (UN-Habitat, 2016). Cities have thus become a positive and potent force for addressing sustainable economic growth, development and prosperity, and for driving innovation, consumption and investment in both developed and developing countries. This dramatic shift towards urban life has profound implications for energy consumption, politics, food security and human progress. Although some of this change is positive, poorly planned urbanization can potentially cause economic disorder, congestion, pollution and civil unrest.

The transformative power of urbanization has, in part, been facilitated by the rapid deployment of information and communications technology (ICT), and by a revolution in the collection and utilization of city data to inform decision-making and drive a global movement of smart cities. Townsend (2013) portrays increasing ICT development and urbanization as a form of symbiosis, evoking a mutually beneficial relationship between these two global trends. Cities' concentrated populations facilitate knowledge exchange and can speed up innovation processes. Similarly, planning cities for sustainability also requires innovative ideas, collaboration and sophisticated techniques which could be abetted by ICT. ICT is now widely recognized as conducive, and even necessary, to effectively planning and managing dynamic urban environments in a sustainable manner (Bibri & Krogstie, 2017b). Moreover, it has long been recognized that sustainable development efforts need to be concentrated at the local level so that it can be most compatible to the specific needs of communities, taking factors such as culture and ecological context into account (United Nations, 1992). In brief, cities make the perfect testing-ground for generating, experimenting, developing and scaling the solutions needed for more sustainable societies (Childers et al., 2014).

When discussing sustainability and ICT in the urban environment, reference is now most commonly made to the two concepts of 'sustainable cities' and 'smart cities' (de Jong et al., 2015). Scholars from different disciplines and practitioners from different professional fields have, over the past two decades or so, worked on developing more convincing and robust sustainable city models (Bibri & Krogstie, 2017b). As a result, a plethora of models and terms have been introduced in the policy debate: 'sustainable city', 'smart city, 'livable city', 'intelligent city', 'knowledge, city', 'low carbon city', 'eco city', 'resilient city', 'information city' among other city categories. All of these terms aim to create the impression that social, economic, and environmental dimensions of sustainability can go hand in hand, and cities themselves have taken to using these terms themselves as a label to enhance their own attractiveness and competitiveness (de Jong et al., 2015).

1.1 Problem Definition

The diversity of the urban sustainability discourse shows that it has not only been difficult to translate sustainability into the built form of cities but also to evaluate the extent to which these so-called sustainable city models actually contribute to the goals of sustainable development. In one study, de Jong et al. (2015) mapped the use and evolution of the twelve most recognized terms in international academic literature relating to sustainable urban development. The result, as shown in Figure 1-1, shows that although the 'sustainable city' has traditionally been the most preferred and frequently used term, the use of 'smart city' has recently gained traction and is "on its way to become [the] leading driver of urban sustainability and regeneration initiatives" (de Jong et al. 2015, p.12).

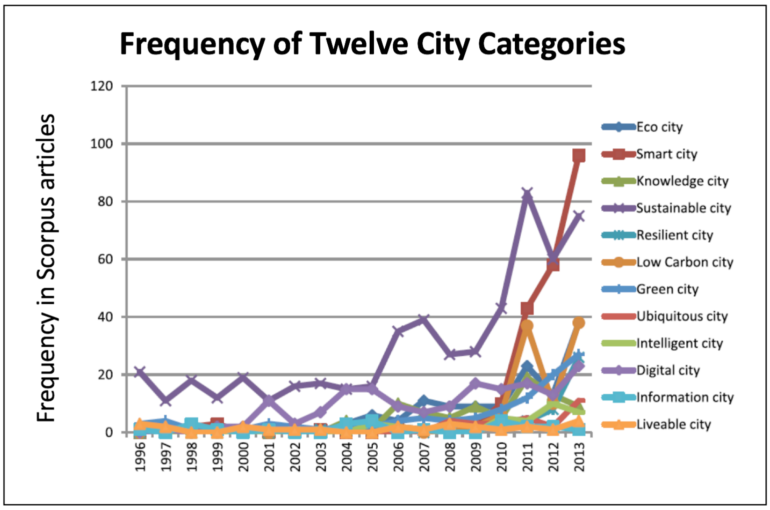

Figure 1-1. Evolution of twelve city categories over time (frequency in Scorpus articles)

Source: de Jong et al., 2015

Despite the attention given to both of these concepts in academic research and discourses, both the sustainable and smart city models present significant challenges and raise many issues, especially when it comes to their incorporation of the fundamental goals of sustainable development, goals which themselves have been contested. The smart city concept especially has faced a growing amount of criticism from academics who view it as a technocentric approach to creating sustainable cities and question its transformative claims (e.g. Hollands, 2008). In response to their respective challenges and criticisms, recent research endeavors have started which focus on how to better incorporate sustainability in smart city approaches and how to sustainable city models smarter (Kramers et al., 2014; Shahrokni et al., 2015; Al-Nasrawi et al., 2015).

Integrating these two pre-existing approaches to urban development has recently resulted in the concept of a 'smart-sustainable city' (SSC). Building on the momentum of smart cities, the SSC concept is being pushed by governments and the private sector as the primary means to drive urban transformation and sustainable development. Given the broad nature of the term, there are a growing number of definitions attempting to accurately describe what an SSC is. One example provided by the International Telecommunication Union (ITU) (2015 p. 1) describes it as "an innovative city that uses ITC and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, and environmental aspects."

Overall, research in the SSC field is still in its early stages (Bibri & Krogstie, 2017b). As a techno-normative vision for urban development, it is still remains theoretically unclear what an SSC should be. This is further complicated by the fact that the SSC concept brings together two separate urban agendas with conflicting values, objectives and impacts (Hollands, 2008; Viitanen & Kingston, 2014). Little detailed analysis has been conducted into how smart city thinking may be reshaping particular aspects of sustainable city thinking (and visa versa) (Haarstad, 2016). Moreover, there is still a limited understanding of the opportunities and challenges created by actually incorporating more ICT into cities for smart-sustainable urban development (Kitchin, 2014) Briefly put, researchers lack both the theoretical insight and empirical evidence required to accurately assess the implications of this potentially transformative concept, and there is a need to engage with "why, how, for whom and with what consequences" the SSC paradigm is emerging in different urban contexts. (Luque-Ayala & Marvin, 2015 p. 2106).

In Sweden, a significant amount of attention and resources has been given to formulating a national SSC agenda (Kordas et al., 2015). The Strategic Innovation Program for Smart Sustainable Cities (SIP-SSC), released to the public in 2015, provides a basis to critically engage with why, how, for whom and with what consequences the SSC concept is emerging in the Swedish context. Given Sweden's historical ties to environmentalism and its current position as one of the most sustainable countries in the world—a ranking it earned thanks to its use of renewable energy sources, low GHG emissions and governance practices—it is very likely that the Swedish model for a SSC will imitated elsewhere (RobescoSAM, 2016). Additionally, in its SSC agenda, Sweden stated its strong potential to export its SSC solutions abroad. Sweden already has several competitive advantages in the global SSC-solutions market, such as existing digital infrastructure, an innovative environment and the political will to tackle sustainability challenges (SIP-SSC, 2015).

Many city developments in Sweden have already gained international recognition for their sustainability efforts. Malmö, Sweden's third largest city, has been successful in creating world-leading examples of sustainable urban development; the most famous example being the Bo01 district, also known as the 'City of Tomorrow', constructed to unite modern architecture with ecological sustainability. The city of Malmö is continuing to invest in new sustainable development projects, including the creation of climate-smart district in Hyllie. As arguably one of the forerunners of global sustainable development, Malmö makes for a fitting case city for exploring and analyzing how principles and characteristics inherent within SSC concept fit into concrete urban planning strategies and development projects, and doing so can shed light on which aspects of SSC thinking can legitimately unleash the 'transformative power of urbanization' to solve various sustainability challenges and which aspects are more superficial or even detrimental to sustainability efforts.

1.2 Research Questions

The purpose of this research is to examine (1) the origination of the SSC concept, (2) how the concept is being framed as an approach to sustainable urban development, and (3) how it can be contextualized in concrete projects and urban planning initiatives in the city of Malmö, Sweden. The main added value of this thesis is to highlight the need for ICT development and innovation to be linked with sustainable development, and accordingly for future related investments to be justified by environmental concerns and socio-economic needs, rather than technical advancement and industrial competitiveness.

The core question guiding this research is simply—what is a smart-sustainable city? This thesis attempts to provide an answer by systematically and comprehensively mapping the concept in terms of its theoretical foundations and state-of-the-art research and development. Specifically, this paper will look into how this particular model for urban development emerged out of its two defining discourses of the sustainable city and the smart city and how they have been incorporated into the hybrid concept of an SSC. Ultimately this paper aims to assess the potential implications of this coupling for sustainable urban development. With idealistic yet vague concepts such as an SSC, context is crucial. Therefore, this research will investigate how the SSC concept is promoted as an approach to sustainable development in Europe, framing it within European and Swedish policy documents. The case city of Malmö, Sweden will further contextualize how concrete urban planning strategies and projects reflect the style of urban development characterized by the SSC concept. The

City of Malmö can provide a contextualized window to more closely examine a concept that can be described as largely theoretical and still empirically unfounded.

1.3 Limitations and Scope

Given the wide spectrum and rapidly increasing number of SSC interpretations, definitions and projects, it is beyond the scope of this research to address every practice and form under this all-encompassing concept. Instead, this research limits itself to academic literature concerned with smart and sustainable cities and the European perspective, looking closely at one specific case city. The case city, Malmö, was selected due to its recent history and political willingness to pursue smart-sustainable urban development. The recently announced SIP-SSC in Sweden also made Malmö ideal for investigating the SSC field. This research was conducted in conjunction with the International Institute for Industrial Environmental Economics (IIIEE) at Lund University in Sweden, providing contacts and access to certain professionals working with the City of Malmö along with active researchers working in the general SSC field in the European context.

1.4 Ethical Considerations

In conducting interviews, this thesis strives to honor and respect all interviewees' anonymity unless they consented to information disclosure.

1.5 Audience

This thesis is written as part of the final semester in the Erasmus Mundus Masters program in Environmental Sciences, Policy and Management (MESPOM) run through Central European University (CEU) and the International Institute for Industrial Environmental Economics (IIIEE) at Lund University in Lund, Sweden. The research conducted aims to provide clarity on the various aspects of the SSC field in European, and especially Swedish, contexts. The research conducted and conclusions purported are addressed towards a wide-ranging audience from academia to urban planning and other readers interested in urban development discourses at the intersection of smart and sustainable cities.

1.6 Disposition

The thesis is a comprehensive account of many areas of study regarding the SSC concept with a particular focus on the European and Swedish contexts and the City of Malmö.

Chapter 2 presents the three main methods for data collection and analysis: a systematic literature review, discourse framing in European and Swedish policy documents, and the case city of Malmö.

Chapter 3 consists of a comprehensive literature review on the SSC concept looking thematically at the concepts of sustainability and the sustainable city followed by the emergence of ICT in urban planning development and the smart city.

Chapter 4 engages with the SSC concept as an urban vision and gives a broad overview of what an SSC entails in terms of characteristics and urban systems and services.

Chapter 4 examines how the SSC concept is framed as a techno-political agenda for sustainable urban development in boarder European policymaking, looking at relevant policy documents and programs.

Chapter 5 focuses in on the SSC concept a national agenda in Sweden and discusses the recent SIP-SSC.

Chapter 6 discusses the City of Malmö and its unique history of sustainable development. Two high-profile districts, Bo01 and Hyllie, are highlighted as modern day examples of smart-sustainable development.

Chapter 6 offers reflections and conclusions on the possible synergies and inherent contradictions for sustainable urban development embodied by the SSC concept.

2 Methodology

Overall, this thesis uses a qualitative methodology for data collection and analysis, which is preferred when the phenomenon is new (Yin, 2014). This research is based on a triangulation approach (Denzin, 1978) in that it uses more than one kind of method to study a phenomenon, in this case the smart-sustainable city (SSC) concept. Methodological triangulation has been found to be beneficial in providing confirmation of findings, more comprehensive data, increased validity and enhanced understanding of the studied phenomenon (Rothbauer, 2008).

The primary methods used in this thesis are a systematic literature review, discourse framing, semi-structured interviews and a case study. The systematic literature review acts as the starting point for data collection and analysis to investigate the origination and meanings of the SSC concept, providing an overview of its key components, theories and discourses. Given that the SSC field is profoundly interdisciplinary, the literature review includes an extensive and broad array of material (including journal articles, books, reports, conference proceedings, dissertations, theses and policy documents) at the intersection of various relevant disciplines.

The literature review is organized thematically to develop a process-based understanding of how the SSC concept has evolved out of sustainability and smartness discourses, with a particular focus on the theoretical underpinnings and original construction of both the smart city and sustainable city concepts. To comb through the literature and gather relevant resources, standard search strategies were used to identify articles and studies on smart (and) sustainable cities. Searches were conducted on numerous electronic (cross-disciplinarily) research databases available through EBSCOhost, including (but not limited to) Elesiver, IEEExplore, Science Direct, Scorpus and SpringerLink.

The examined time period for sustainable cities was primarily from 2005 to 2016, and for smart cities was from 2008 to 2017. Considering that the SSC concept only appeared around the 2010s, the examined period was from 2015 onwards. Searched keywords included 'smart cities'; 'smart cities AND sustainability'; 'sustainable cities'; 'smart sustainable cities'; as well as derivatives of these terms. For concepts, theories and academic discourses, the searched keywords included 'sustainability'; 'sustainable development'; 'urban sustainability'; 'sustainable urban development'; 'urban planning and development'; 'urban ICT'; and 'urban computing'. Articles were selected based on both their relevance (in terms of their keywords, title and abstracts) and in terms of their quality, which has been defined as appropriate breadth and depth, rigor and consistency, clarity and brevity, and effective analysis and synthesis (Hart, 1998). Due to the shortcomings associated with relying on the keyword approach (Levy & Ellis, 2006); a backward literature search (backward authors and backward references) and a forward literature search (forward authors and forward references) were also used (Webster & Watson, 2002).

To examine how the SSC concept is being framed as an approach to sustainable urban development, multiple prominent researchers in the field were contacted for semi-structured interviews, including: James Evans at the University of Manchester; Andrew Karvonen at the KTH Royal Institute of Technology in Stockholm; Chris Martin at Durham University, Lena Neij the director of the IIIEE at Lund University; Darcy Parks at Linköping University, Frans Sengers at Utrecht University; and Nora Smelby and Lucie Zvolska at the IIIEE. In addition, the author attended the 6^{th} International Conference on Smart Cities and Green

ICT Systems (SMARTGREENS 2017) in Porto, Portugal in the spring of 2017 to gauge the most up-to-date research developments and emerging scientific and technological trends relating to smart and sustainable cities, which was essential given how rapidly the SSC field is evolving both technologically and theoretically.

Framing analysis was used to contextualize how European and Swedish policymakers are promoting the SSC concept for urban sustainability. Framing has long been recognized as an important tool used to understand the challenges of sustainability (Feindt & Oels, 2005; Hajer & Versteeg, 2005). Haarstad (2016) posits that both 'smart' and 'sustainable' are relatively open signifiers—terms that can be employed on behalf of a diverse set of strategies and goals; it is therefore useful to examine how authoritative institutions frame urban smartness and sustainability, and to trace what happens when these framings are contextualized and implemented in particular cities. Specifically, this research looks at four relevant EU-level documents: the Europe 2020 Strategy; the EU Communication on the European Innovation Partnership on Smart Cities and Communities (EIP-SCC); and the EIP's Strategic Implementation Plan and Operational Implementation Plan. On the Swedish level, the application and official communication of the Strategic Innovation Program for Smart-Sustainable Cities are used for analysis.

The City of Malmö is used as a case study, which allows for an in-depth, multi-faceted exploration of complex concepts in their actualized settings (Yin, 2014). The case study takes into account Malmö's history, its socio-political and cultural contexts and looks at two of its most well known examples of smart-sustainable development—the Bo01 district in the Western Harbor and the ongoing developments in Hyllie. Malmö's urban planning and development strategies are compared to six SSC characteristics as defined in a widely-cited article by Caragliu et al. (2011), shown in the following table.

Table 2-1. SSC characteristics from a study on European cities

SSC characteristics
1. The use of networked infrastructure to improve economic and political efficiency and enable social, cultural and urban development
2. An underlying emphasis on business-oriented urban development
3. A strong focus on the goal of realizing the social inclusion of different kinds of urban residents in public services
4. A stress on the significant role of high-tech and creative industries in long-term growth
5. Profound attention to the function of social and relational capital in urban development
6. Social and environmental sustainability as a major strategic component of urban development

Source: Caragliu et al., 2011

The author also conducted semi-structured interviews with city officials and consultants, including: Roland Zinkernagel, the EU Coordinator and Sustainability Strategist; Kerstin Rubenson, Project Leader for Hyllie and Sustainability Strategist; Juliet Leonette-Lindgren, Project Leader for Sege Park and Sustainability Strategist; and Trevor Graham Sustainability Consultant for Malmö and Director at Urbanisland.

Finally, this research also mapped a number of smaller projects going on within the City of Malmö relating to smart-sustainable urban development. Different projects were identified based on information published by the City of Malmö as well as interviews with city officials. The projects analyzed have different (though often overlapping) focal areas, goals, funding mechanisms, partnership types, and often have smaller projects nested within them. The projects included in this research are also diverse in scale and form, ranging from a project to build more green and blue infrastructure for ecosystem services in Malmö to the establishment of a municipality-wide platform for innovation. By mapping out the obvious characteristics of these diverse projects (goals, applied sector, funding mechanisms, partnership types), this thesis strives to identify the main trends in Malmo's smart-sustainable urban development and show how they relate to established characteristics of an SSC (Caragliu et al., 2011).

To summarize, this thesis seeks to explain the origins of the SSC concept through its theoretical roots and to describe what approach or vision the SSC model offers for sustainable urban development. Next, this thesis will address the implementation of the SSC concept both as an agenda promoted by policymakers and ICT corporations and concrete urban development projects in the context of Malmö. Ultimately this thesis hopes to reflect on the implications of the observed shift from sustainable development to smart-sustainable development and uncover "how, why, for whom and with what consequences" the SSC concept is gaining traction in Europe. The overarching analytical framework guiding this thesis is visualized in Figure 2-1.

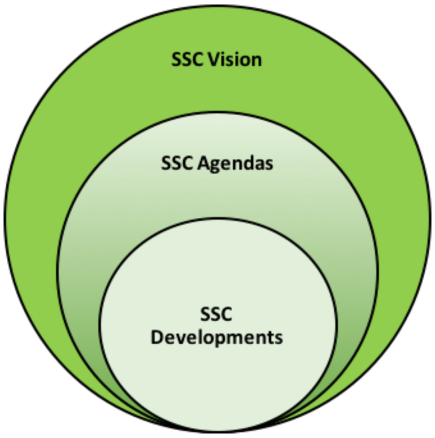

Figure 2-1. Analytical framework for examining the origination and implementation of the SSC concept.

3 Literature Review

3.1 The Concept of 'Sustainability'

The notion of sustainability grew out of the realization that the predominant paradigm of social and economic development was oblivious to the environmental crises caused by anthropogenic activities and to escalating social inequalities and injustices. Specifically, the increasing rate and intensity of development threated to surpass critical thresholds and disrupt key earth systems such as (1) global nitrogen, sulphur and carbon cycles; (2) the availability of resources like fresh water, rich cropland, and high-quality energy; and (3) the rising complexity and interconnectivity of global social-ecological systems, such as the world's financial, trade, food, and resource-extraction systems, all of which imperilled the future of human-wellbeing (Westley, et al., 2011).

By 1972, growing concern over humanity's impact on the environment sparked a global environmental movement that culminated in international United Nations Conference on the Human Environment in Stockholm, Sweden. However, the Stockholm Conference was at first met with much opposition from represented developing countries, who questioned the legitimacy of environmental issues as a global priority (Najam, 2005). Exemplifying this mind-set was the famous statement from Ivory Coast, which announced that it would prefer more pollution problems [in comparison to poverty problems], "in so far as they are evidence of industrialization" (Rowland, 1978 p. 50). The result of the Stockholm Conference was thus to identify the trade-offs between the environmental priorities of developed nations and the human development priorities of developing nations to promote harmonious linkages between the two. Most notably, the Stockholm Conference led to the creation of the United Nations Environmental Program (UNEP) in Nairobi, Kenya which has played a catalytic role in promoting the adoption of international agreements that address environmental issues such as ocean dumping, pollution from ships, and the endangered species trade.

Global environmental debates are still very much a legacy of developed vs. developing politics that first gained prominence in Stockholm (Najam, 2005). In the global environmental conferences following Stockholm, the political debate has shifted away from a primary emphasis on environmental issues to a shared focus on environmental, social and economic development, now recognized as the concept of sustainable development (Prizzia, 2007). Official credit for present day use of sustainable development as a policy term is given to the World Commission on the Environment and Development's (WCED) 1987 report 'Our Common Future', also known as the Brundtland Report after the Commission's chairwoman. The Brundtland Report defines sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WECD, 1987). Since its introduction on the world stage, the concept of sustainable development has experienced widespread dissemination, and has arguably become the predominant discourse promoting the environment in its many spheres, including science and innovation, technology, economy, urban planning and policy (Bibri & Krogstie, 2017b).

The concepts of 'sustainable development' and 'sustainability' can be easily confused with each other. Therefore, it is worth clarifying that sustainability refers to a long-term goal or desired end-state that can be maintained over time, whereas sustainable development entails the initiatives and processes undertaken to achieve the goal of sustainability (Höjer &

Wangel, 2015). The United Nations Educational, Scientific and Cultural Organization (UNESCO) has defined sustainability as "a paradigm for thinking about the future in which environmental, societal, economic and cultural considerations are balanced in the pursuit of an improved quality of life" (UNESCO, 2016).

Despite, or perhaps because of, its popularity, sustainability has eluded a widely agreed-upon definition (Davidson, 2010). It is most commonly described as a balance of its three dimensions (economic, social and environmental) and is also referred to as the triple bottom line perspective of people, planet and prosperity (Elkington, 1997). However, the philosophical and multifaceted nature of sustainability, along with the complexity of the socio–ecological systems to which sustainability is applied, make it a difficult concept to define accurately (e.g. McManus, 1996). The Brundtland Report's classic definition of sustainable development has generated more than a few critiques, and as a result, sustainable development has become highly contested, and oftentimes contradictory and oxymoronic (e.g. Jacobs, 1999). The universal definitions of sustainability and sustainable development have given rise to multiple interpretations and continue to be a source of conflict in academia and environmental policy-making (Najam, 2005).

Given its many interpretations, some scholars have even differentiated between 'weak' and 'strong' forms of sustainability (Pearce, 1993). Beckerman (1994) argues that strong sustainability requires preserving the environment in all its forms. From this perspective, gains in human welfare at the expense of the 'natural' environment are unacceptable. Such a stance is unreservedly 'ecocentric'; that is, based on a green theory of value (Goodin, 1992) which states that nature has a value in and of itself—an integrity which is not compatible in any way with the goals of development as modernization under capitalism. However, this viewpoint tends to be viewed as radical or extreme (e.g. Pearce, 1993), and Dobson (1996) argues that any concept of sustainability must be fundamentally anthropocentric. Currently, the most prominent school of thinking within European sustainability logic is 'ecological modernization', a concept introduced by the EU's Fourth Environmental Action Program (Baker et al., 1997). Essentially, ecological modernization describes a perspective where sustainability goals are set within the economic framework of capitalism and industrialization (Pepper, 1998).

Ecological modernization advocates for the replacement of a manufacturing-based economy (associated with high GHG emission levels) with a 'cleaner' service-oriented economy, and views the productive use of natural resources and ecosystems as a sustainable source of future growth and development. This includes improvement in energy and resource efficiency as well as product and process innovations, such as sustainable supply chain management, clean technologies, benign substitution of hazardous substances and environmental product design. Proponents of ecological modernization theorize that radical innovations in these fields can reduce the rate of resource turnover and the magnitude of energy use, and decouple resource use from economic growth (Hajer, 1996). 'Regenerative development' takes the ideas of ecological modernization even further, suggesting that green economic growth not only preserves environmental stocks but restores and regenerates them from previous losses. According to its advocates, regenerative development is possible due to the potential of recent scientific-technological advances, which can help overcome the lingering trade-offs between environmental and socio-economic development associated with previous sustainable development efforts (Robinson & Cole, 2015).

In the 21st century, the work of climate scientists and particularly the Intergovernmental Panel on Climate Change (IPCC) has helped sustain the relevance and attention given to the environmental aspects of sustainability on the global stage. The strong warnings issued by the IPCC and scientific community against 'business as usual' implications for anthropocentric climate change have created an international call for a 'sustainability transition' or the scientific, technological, societal, economic and political transformations necessary to create a low carbon or green economy (IPCC, 2014). Sustainability has thus become an end goal in the face of complex 'wicked problems' (Rittel & Webber, 1973) and nexus challenges such as climate change, as exemplified by the United Nations Development Program's (UNDP) Sustainable Development Goals (SDGs). The SDGs were introduced in 2015 as a follow-up to the Millennium Development Goals (2000-2015) and establish a set of seventeen 'global goals' to achieve by 2030, ranging from climate action to ending world hunger (UNDP, 2016)

The complex challenges of sustainability require complex solutions, and the interdisciplinary academic field of sustainability science emerged in the early 2000s to give sustainability research a solid scientific foundation and analytical framework (Clark, 2001). Research in this field stretches across different disciplines, from the natural sciences to applied engineering sciences, and can range from scenario analysis that informs policy-making to technological innovations. Generally speaking, sustainability science examines the complex interactions between social, environmental, and technical systems to understand their behavioral patterns and dynamics within these fields and to develop (preferably upstream) solutions for complex sustainability challenges. Sustainability science can be thought of as neither 'basic' nor 'applied' research but as a field defined by the problems it addresses rather than by the disciplines it employs; it attempts to advance both knowledge and action by creating a dynamic bridge between the two (Clark, 2007).

In this way, sustainability science exemplifies the emergence of 'post-normal' science signaled by Funtowicz and Ravetz (1993), where academic and governance-related problem-solving cannot operate under the assumption that problems can simply be divided into single sectors, disciplines, and city departments. Contemporary problem-solving methodologies should instead be dialogic, democratic, practical, open and experimental (Ney & Verweij, 2015). One key mission of sustainability science is therefore to help cross-discipline collaboration and participatory decision-making as a critical step towards achieving sustainable development goals globally, which has been likened to a form of collaborative governance for sustainability (Termeer & Bruinsma, 2011).

3.2 The Sustainable City

It has long been recognized that sustainability challenges are best addressed at the local level (United Nations, 1992). For example, research on climate change and its related impacts has shown that mitigation and adaptation efforts are most effective at local and regional levels (Evans & Karvonen, 2014). At the Rio Earth Summit in 1992, the United Nations implemented Agenda 21 (21 referring to the 21st century), a voluntary action plan inciting local councils to form their own Local Agenda 21 (LA21), or sustainable development strategy. Agenda 21 recommends that cities and communities identify their own priorities for sustainable development, which required the integration of planning and action across economic, social and environmental spheres for the purposes of target setting, monitoring and reporting (United Nations, 1992). Agenda 21 includes a recommended set of indicators for urban monitoring for sustainability, which as a result became widespread in the 1990s (Marsal-Llacuna et al., 2015).

As the world's population becomes increasingly urban, sustainable development is arguably the single-most important paradigm shaping research and discourse around urban development, giving urban development a high-level global policy recognition (de Jong et al., 2015). The international focus on urban development has continued with the recent SDGs, and goal eleven of the SDGs seeks to "make cities and human settlements inclusive, safe, resilient and sustainable" (UNDP, 2016). However, sustainable urban development has of course been plagued by the same strengths and weaknesses as sustainable development. That is, the absence of a less general and more universal definition has led to multiple interpretations and has consequently triggered an explosion of indicators for sustainability (Tanguay et al., 2010). Despite sustainable urban development seeking to provide an enticing, holistic approach to planning, conflicts among its goals—particularly between balancing between economic development and equity in urban areas with the protection of the urban environment—are challenging and difficult to overcome (Bibri & Krogstie, 2017b). As Campbell (1996) notes, the conflicts of sustainable urban development cannot be easily shaken off; rather than being merely conceptual conflicts between the abstract notions of ecological, economic, and political logic, they cut to the historic core of planning and remain a reoccurring theme in the battles of contemporary cities.

The concept of a sustainable city became widespread in Europe through Charter of European Sustainable Cities and Towns Towards Sustainability, otherwise known as the Aalborg Charter (1994). The Aalborg Charter is an urban sustainability initiative inspired by Local Agenda 21 approved by the participants at the first European Conference on Sustainable Cities & Towns in Aalborg, Denmark. To date the Charter has over 3,000 signatories, making it the single most successful European effort in sustainable urban development. The Aalborg Commitments, written ten years after the Charter in 2004, encompass a list of qualitative objectives organized into ten holistic themes for a sustainable city. The Commitments aim to develop a common understanding of sustainability, and as a consequence, to develop a framework that can be used at the local level to comprehensively implement sustainability initiatives across municipality sectors. Whereas the Aalborg Charter primarily described the characteristics of a sustainable city, the Commitments signified a more structured and integrated approach to sustainable development. At the same time, the holistic nature of the commitments allows decision-makers to adapt them to meet their own local conditions.

Outside of Europe, the Melbourne Principles were drawn up in Australia during a planning session leading up to the 2002 Earth Summit in Johannesburg (UNEP, 2002). The Melbourne principles were developed by representatives of the UNEP and the International Council for Local Environmental Initiatives (ICLEI) and adopted at the Local Government Session of the Earth Summit, or the follow-up session to Local Agenda 21. They consist of ten short statements on how cities can become more sustainable. The Principles are:

1. Provide a long-term vision for cities based on: sustainability; intergenerational, social, economic and political equity; and their individuality;
2. Achieve long-term economic and social security;
3. Recognize the intrinsic value of biodiversity and natural ecosystems, and protect and restore them;
4. Enable communities to minimize their ecological footprint;
5. Build on the characteristics of ecosystems in the development and nurturing of healthy and sustainable cities;
6. Recognize and build on the distinctive characteristics of cities, including their human and cultural values, history and natural systems,
7. Empower people and foster participation;

8. Expand and enable cooperative networks to work towards a common, sustainable future;
9. Promote sustainable production and consumption, through appropriate use of environmentally sound technologies and effective demand management;
10. Enable continual improvement, based on accountability, transparency and good governance (UNEP, 2002).

The Aalborg Commitments and Melbourne principles provided the groundwork for a number of frameworks designed to enable local sustainability. Building on these frameworks, a large number of sustainability assessment tools and frameworks have been created, largely by various environmental, consultancy and research organizations (McManus, 2012). At first, urban sustainability assessment was marketed predominately towards the building and transportation sectors to help city officials ensure that new infrastructure was in line with sustainability goals. Recently, the focus of assessment frameworks has shifted from single buildings to entire neighborhoods and districts, enabling simultaneous consideration of the built environment, public transportation and services, quality of life and other aspects of urban environments (Haapio, 2012).

Definitions for a sustainable city are numerous and varying. Rogers (1998) conceptualizes the sustainable city as a place where higher quality of life is realized in tandem with policies that effectively reduce demand on resources (energy, materials, etc.) outside of the city. As such, the sustainable city becomes a more self-sufficient economic, social and environmental system. Some scholars, such as Meadows (1999) and Brugmann (1997) approach the term from a more environmental angle. Their respective sustainable city models focus on a city's environmental perforce, measuring and reducing pollution and GHG emissions, energy and water consumption and agricultural land loss while improving water quality, recycling rates, green-space ratios and primary forests. Rode and Burdett (2011), on the other hand, adopt a more socio-economic interpretation, where social equity alongside a greener living environment should be considered for the development of sustainable cities. They point out that cities should offer proximity, density and variety which would engender productivity benefits for firms, and help stimulate innovation and new job creation through, for example, high-tech clusters in urban regions, such as Silicon Valley. In general, the broad three-dimension perspective means that sustainable city advocates tend to view ecological sustainability as less in conflict, or even compatible with social and economic considerations (de Jong et al., 2015). Sustainable city advocates recognize that understanding the relationships between people, their activities and the environment is key to sustainability, and that understanding these interactions requires a systematic approach (Ahvenniemi et al., 2017).

Most of the existing sustainability assessment frameworks tend to have a strong environmental focus (Ahvenniemi et al., 2017). For example, the most well known sustainable neighborhood rating schemes, BREEAM, CASBEE and LEED, assign very low weight to direct economic and social measures (on average 3% for business and economy and 5% for well-being) (Beradi, 2013). Beradi (2013) argues that the most widely-used sustainability assessment tools have been developed in a top-down fashion by expert organizations and stresses the need for more localized, citizen-led and participatory approaches. From the perspective of regenerative development, Robinson and Cole (2015) argue that most sustainability frameworks focus only on reducing the rate of harm to the environment rather than restoring ecological systems and functions.

In the context of this research, a sustainable city can be conceptualized in terms of four dimensions: form (or governance), environment, economy and equity, which should all—given their interdependence, synergy, and equal importance—be enhanced with the achievement of sustainable city goals (see Figure 3-1). Furthermore, this research positions the sustainable city concept within ecological modernization thinking, and sees sustainable cities as striving to maximize efficiency of energy and resources; create a zero-waste system; support renewable energy production and consumption; promote carbon-neutrality and reduce pollution; decrease transport needs and encourage walking and cycling; provide efficient and sustainable transport; preserve ecosystems along with their functions and services; improve social equality, stability and safety; and promote livable and attractive communities (Bibri & Krogstie, 2017b). More simply put, a sustainable city has to achieve a dynamic balance among economic, environmental and socio-cultural development goals, framed within a local governance system characterized by heightened citizen involvement and inclusiveness (UN-Habitat, 2016).

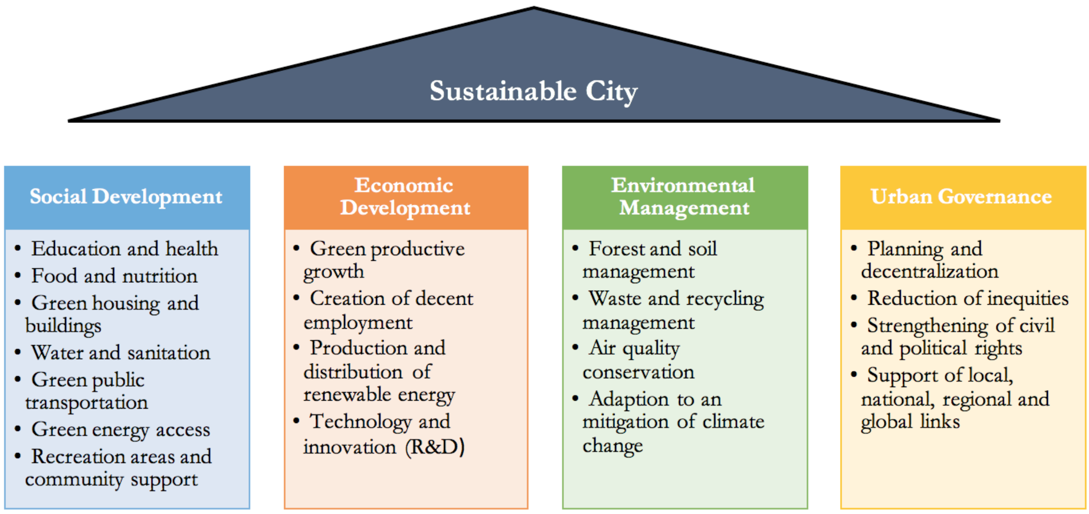

Figure 3-1. Dimensions for of the sustainable city

Source: United Nations, 2013

This holistic vision of a sustainable city entails a creative, local, balance-seeking process that extends into all areas of local decision-making and aims to continuously improve various urban systems in terms of their design and function. The governance dimension is therefore especially key as it requires cooperative effort and collaboration from diverse stakeholders to take a comprehensive approach to solving cities' complex challenges. This has been conceptualized through the 'quadruple helix' model of the Public-Private-People-Partnership (PPPP) in which government (formulating policies), the private sector (developing and marketing innovative products), and academia (providing knowledge and evaluation) work together with the general public to find joint solutions to shared problems (Arnkil et al., 2010).

Figure 3-2. The 'quadruple helix' model

Source: SIP-SSC, 2015

Collaborative urban governance has the potential to cut across traditional jurisdictions and routines of organizations, reorganize cross-scale and cross-level interaction and create new synergies between various public, private, and civil society stakeholders (Lubell, 2015). Moreover, it can stimulate learning dynamics, support exchange of resources, and create joint ownership of problems (such as climate change), promoting democratic inclusion and accountability in finding solutions. In brief, collaborative urban governance is seen as fundamental to creating a sustainable city (Kordas et al., 2015); and moreover, collaborative governance for sustainability is shown to be increasingly supported by ICT (Termeer & Bruinsma, 2016).

3.3 The Emergence of 'Smart'

While the sustainable city was traditionally the preferred model for urban sustainability, it has recently been surpassed by smart city model (de Jong et al., 2015). The modern understanding of a smart city is inherently linked to the emergence and increasing use of urban ICT and computing—i.e. mobile broadband, cloud computing, Big Data and the Internet of Things. Computing and ICT are becoming deeply embedded in the very fabric of urban environments while wireless networks are proliferating on a hard-to-imagine scale (Kitchin, 2014). Over the past two decades, the expansion of mobile networks has been particularly explosive, surpassing most predictions (see Figure 3-3).

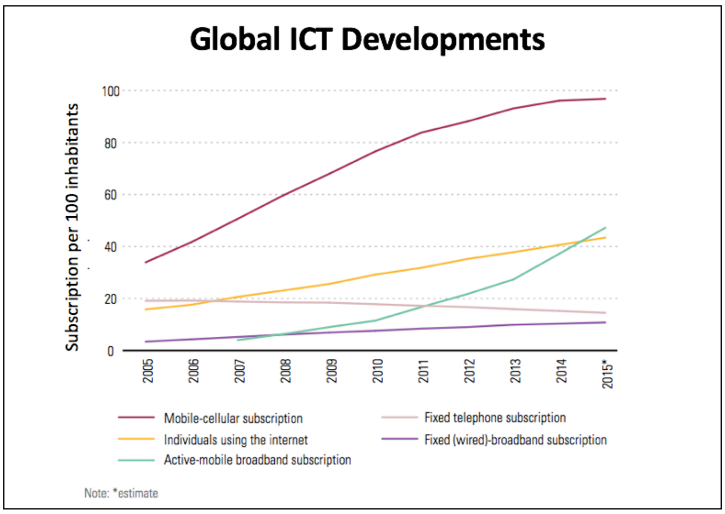

Figure 3-3. Global ICT developments (2005-2015)

Source: UN-Habitat, 2016

In technologically advanced nations, high-quality infrastructure, innovation, investments and efficiencies in energy and budgets are cited as main ICT-driven benefits conferred to cities (Bibri & Krogstie, 2017b). However, the consequences of the wide-scale deployment of ICT are not well understood, and there have been instances of a 'digital divide', whereby the uneven deployment of ICT has been shown to exacerbate inequality, characterized by well-connected affluent neighborhoods and business districts coexisting with under-serviced and under-connected low-income neighborhoods (Robles-Morales et al., 2016). The affluent tend to have greater access to these technologies, and ICT can often serve as a means to extend their reach and control while curbing that of the more socioeconomically marginalized residents.

For the majority of low-income population in developing countries, mobile networks are still likely to be the only channel for connection to the Internet (Turok, 2014). Although an affordable and reliable Internet is not yet a reality for the majority of people in the world, the network, both in terms of infrastructure and content, has grown rapidly since inception and is spurring enormous innovation, diverse network expansion and increased user engagement. According to Turok (2014), the deployment of more ICT in the cities of developing nations has been cited as promoting efficiencies in urban infrastructures, providing lower costs in city services and supporting innovation and poverty eradication. In some cases, such as in Honk Kong and Singapore, urban economies avoid the need to retrofit existing infrastructure by building ICT technologies into infrastructures during their initial construction (UN-Habitat, 2016).

Local governments from all around the world have come under increased pressure to collect and monitor data in connection with governance, infrastructure, urban planning, services, the economy, health, education, safety and the environment (UN-Habitat, 2016). The use of data allows cities to measure their performance in various aspects, from crime prevention to energy efficiency, and to inform investment decisions regarding city infrastructure in order to improve public services (Kitchin, 2014). Performance measurement has become fundamental if policymakers and planners are to make evidence-based decisions. The use of data allows cities to not only measure their own performance but compare and benchmark themselves empirically against other cities internationally; in this case more ICT in cities has been accompanied by deeper connectivity and networking of cities and citizens at both the local and global levels (UN-Habitat, 2016).

Data-driven decision-making has evolved over time due to advancements such as performance indicators, data analytics, machine learning, predictive metrics and geo-spatial measurement (Picciano, 2012). Large data sets (i.e. big data) and predictive analytics can be used to improve evidenced-based urban planning, policymaking and development. Several definitions have been put forth for big data, such as that of de Mauro et al. (2016) who describe it as information assets characterized by such a high volume, velocity and variety that it requires specific technologies and analytical methods for its transformation into value. Predictive analytics is one such method and uses techniques from data mining, statistics, modeling, machine learning, and artificial intelligence to analyze current data in order to make predictions about the future. These techniques can help cities study patterns, identify trends and better manage flows of people and materials. It can also help predict potential stressors, such as natural disasters, and improve urban preparedness and response capabilities. Predictive analysis and knowledge sharing is recognized as crucial to responding to emerging global challenges and the associated demand for sustainability planning, resilience and emergency preparedness (McCarney, 2011).

In order to take full advantage of data sets, comparable high-quality city data and indicators are required to share knowledge and information within city sectors and across cities (ITU, 2015). International standards bodies, such as the International Electrotechnical Commission, the International Organization for Standardization (ISO) and ITU have begun to address to work on standards ranging from smart grids and smart city infrastructure, to international telecommunications and management systems (UN-Habitat, 2016). Additionally, the ISO Technical Committee for the Sustainable Development of Communities is developing a new series of international standards designed for a more integrated approach to sustainable development and resilience. Among these standards is ISO 37120: Sustainable Development of Communities—Indicators for City Services and Quality of Life, which is the first international standard on city indicators (ISO, 2014). UN-Habitat also developed the City Prosperity Index in 2012, which advocates for a broader understanding of prosperity in cities, taking in six criteria: productivity, quality of life, infrastructure, equity, environmental sustainability and governance (UN-Habitat, 2016).

Efficient information sharing requires data accessibility. Although there are concerns in terms of privacy and the proprietary nature of data, international standards bodies such as ITU (2015) strongly promote that data on energy, utilities, transportation and other basic datasets should be made public and presented in a consistent and standardized manner. This supports a widespread Urban Open Data movement that aims to foster the average citizen's participation in urban governance and is commitment to transparency and accountability. Accordingly, Open Data enables public access to information and more direct public involvement in decision-making (Silk & Appleby, 2010).

With ICT developments such as big data and the Internet of Things (IoT), cities are gaining more detailed, real-time picture of what is happening within their city (Kitchin, 2014). The IoT is the inter-networking of physical devices (also referred to as connected devices or smart devices), and other items embedded with electronics, software, sensors and network connectivity which enable these objects to collect and exchange data. The Internet of Things enables the collection of large-scale data sets, or big data, that can be used to analyze and identify patterns and provide a form of intelligence with accurate and objective truths. The Internet of Things is reaching a tipping point, and as more people and new types of information are connected, Internet of Things becomes an Internet of Everything. This trend, which has been described ironically as 'everyware', is creating a network of networks where billions of connections can create unprecedented opportunity in making cities knowable and controllable in new detailed, comprehensive and dynamic ways (Greenfield, 2006).

Notably, the volume of digital data is currently almost doubling every two years (Turner, 2014). The increasing use of Geographical Information Systems (GIS) allows spatially referenced data from diverse sources to be integrated, thus providing a clear picture of what is going on within cities. For example, in the Spanish city Santander, solid waste, parking spaces, air pollution and traffic conditions are monitored through 12,000 sensors installed around the city, providing city officials real-time information on service delivery (Newcombe, 2014). In another example, the city of Los Angeles developed software that processes large volumes of data to address traffic congestion problems. Using magnetic sensors, real-time updates on traffic flow are transmitted, with simultaneous data analysis making second-by-second adjustments to avoid bottlenecks (Wheatley, 2013). To put it simply, IoT and big data in urban systems can help improve the understanding of how cities function and can be managed as complex systems.

At the technical level, urban ICT includes both hardware and software components. The former includes sensors (e.g. GIS), computers and terminals, smartphones, wireless communication networks, telecommunication systems, database systems, internet and cloud computing infrastructure. The later includes all kinds of software applications running on these hardware systems, including big data analytics, database integration and management methods, modeling and simulation methods, visualization methods, real-time operation methods, enterprise integration methods and decision support systems. The applications range from smartphone apps providing citizens with useful contextualized information to navigate cities to supercomputers processing vast quantities of unstructured data and suggesting solutions to more complex problems (Bribie & Krogstie, 2017a).

ICT clearly spans across dozens of urban domains, and is now increasingly integrated into built forms or infrastructures in the city. It is therefore best to speak of urban ICT based on the context or use, such as smart transport, smart energy, smart governance, smart education, smart healthcare and smart environment to name a few (Bibri & Krogstie, 2017b). In theory, ICT in cities can act as a sort of central nervous system which orchestrates all the different interactions between the physical and service infrastructural elements of the urban environment (Kitchin, 2014). The ever-increasing applications of big data and the IoT have the potential to support more collaborations between city governments, citizens, and businesses; and this trend is driving the smart cities phenomenon worldwide (UN-Habitat, 2016).

3.4 The Smart City

The concept of a smart city is relatively new in origin, although it stems from older city typologies such as 'information city', digital city' and 'intelligent city' (de Jong et al., 2015). Its origin can be traced back to the Smart Growth movement of the late 1990s, which advocated for city governments to develop new urban development policies that encouraged increasing urban efficiency regarding energy, transportation, land use, and so forth in reaction to to the the increasing impacts of traffic congestion, air pollution, loss of open places and school overcrowding (Harrison & Donnelly, 2011).

A review of academic literature showed that the use of the term smart city has increased exponentially beginning in 2009, to the extent that it is now the most popular city category describing sustainable urban development (de Jong et al., 2015). The smart city has now become a catchphrase, drawing increased attention among research institutes, universities, governments, policymakers and ICT companies. Across the globe, there has been rapid proliferation and promotion of smart city programs, and there is significant market potential for smart city solutions in both developed and developing countries. China is urbanizing rapidly, and the Chinese government is undergoing a push to modernize its cities with 120 initiatives under various titles, including Eco-Cities, Low-Carbon Cities and Smart Cities (SIP-SSC, 2015). Recently, India announced plans to develop over 100 smart cities in response to the country's growing population and pressure on urban infrastructure (Smart Cities India, 2015).

The global market for smart city solutions is estimated to be in the order of EUR 1.2 trillion by 2019 and is growing by 17% every year (Transparency Market Research, 2014). On the one hand, global ICT companies (such as Ericsson, IBM, Cisco, Microsoft, Intel, Siemens, etc.) are pushing for the adoption of their new technologies and services by cities. The Smart Cities Counsel is a business-led initiative promoting the interests of it members through advocacy and lobbying actions (SIP-SSC, 2015). On the other hand, nation states tend to be seeking deregulation, privatization and more open economies that enable more efficient capital accumulation. For city officials, national governments and supra-national states such as the European Union, smart city projects and initiatives are seen to offer the enticing potential of creating more livable, secure, functional, competitive and sustainable cities and the renewal of urban centers as hubs of innovation and work. National governments are ramping up their efforts to remove barriers that are preventing regional and municipal governments from applying smart city solutions and local businesses from developing and exporting related products and services in order to compete in this lucrative market (Kitchin, 2014; Townsend, 2013).

Despite the rise in popularity of the smart city, the diffusion of initiatives in countries with different needs and contextual conditions (e.g. in either either developed or developing nations) makes it difficult to identify shared definitions and common current trends at the global scale. There is still no precise definition of the term smart city, nor a general consensus on what its describing attributes are (Caragliu et al., 2011; Dameri, 2013; Neirotti et al., 2014; Kitchin, 2014; Albino et al., 2015). For instance, Latin American smart city projects tend to be strongly focused on the improvement of security, local government management and mobility; Asian smart city initiatives tend to emphasize the improvement of infrastructure and mobility; and European smart city projects often concentrate on the improvement of the efficiency of public services, building a more socially inclusive society and improving citizens' well-being (Neirotti et al., 2014).

In an attempt to clarify the smart city concept, more than a handful of researchers have put forward definitions (see Table 3-1 for select definitions; see Albino et al., 2015 for a more complete list). According to Kitchin (2014) part of the term's ambiguity comes from the two distinct understandings as to what exactly makes a city 'smart', which has in turn inspired two separate fields of research.

Table 3-1. Smart city definitions

Definition	**Source**
A smart city is a high-tech intensive and advanced city that connects people, information and city elements using new technologies in order to create a sustainable, greener city, competitive and innovative commerce and an increased life quality.	Bakici et al. (2012)
A city is smart when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance.	Caragliu et al. (2011)
Smart cities should embody two main ideas: 1) Smart cities are all about networks of sensors, smart device, real-time data and ICT integration in every aspect of human life and 2) Smart cities should do everything related to governance and economy using new thinking paradigms.	Cretu (2012)
A smart city is a well-defined geographical area, in which advanced technologies such as ICT, logistic, energy production, and so on, cooperate to create benefits for citizens in terms of well-being, inclusion and participation, environmental quality, intelligent development; it is governed by a well-defined pool of subjects, able to state the rules and policies for the city government and steer development.	Dameri (2013)
A smart city performs in a forward-looking way in terms of its economy, people, governance, mobility, environment and living, and is built on a combination of endowments and the activities of self-decisive, independent, and aware citizens.	Giffinger et al. (2007)

A smart city is one that monitors and integrates the conditions of all of its critical infrastructures, including roads, bridges, tunnels, rails, subways, airports, seaports, communications, water, power and major buildings to better optimize its resources, plan its preventative maintenance activities, and monitor security aspects while maximizing services to its citizens.	Hall (2000)
A smart city connects its physical infrastructure, ICT infrastructure, social infrastructure and business infrastructure to leverage the collective intelligence of the city.	Harrison et al. (2010)
Smart cities use data, information and information technologies to provide more efficient services to citizens, to monitor and optimize existing infrastructure, to increase collaboration among different economic actors, and to encourage innovative business models in both the private and public sectors.	Marsal-Llacuna et al. (2015)
A smart city infuses information into its physical infrastructure to improve conveniences, facilitate mobility, add efficiencies, conserve energy, improve the quality of air and water, identify problems and fix them quickly, recover rapidly from disasters, collect data to make better decisions, deploy resources effectively, and share data to enable collaboration across entities and domains.	Nam and Pardo (2011)
Smart cities use smart computing technologies to make the critical infrastructure components and services of a city—which include city administration, education, healthcare, public safety, real estate, transportation, and utilities—more intelligent, interconnected, and efficient.	Washburn et al. (2010)

On the one hand, the term smart city has emerged out of the increasing use of ICT, big data and ubiquitous computing in cities. According to Caragliu et al. (2011), the smart city was introduced as a strategic device to encompass modern urban production factors in a common framework and, in particular, to highlight the importance ICT for enhancing the competitive profile of a city. Researchers have theorized that the smart city can ultimately become a sophisticated system that can itself 'sense and act' and through which a great volume of real-time information is processed and integrated across multiple process, systems, organizations and value chains to optimize public services and inform authorities on incipient problems (Hall, 2000). Proponents of the smart city generally portrayed its technologies and initiatives as technical, pragmatic and non-ideological—that is, as rational innovations designed to improve social, economic, and governance systems (Kitchin, 2015b). Within this 'techno-centric' approach to the smart city, there is a vast amount of literature promoting and reinforcing the ways in which ICT can be used to enhance various urban systems, ranging from applications in energy grids and transportation to healthcare (see Neirotti et al., 2014 for literature classified on the various domains of a smart city).

The second area of research emphasizes that the validity of any claim to be smart ought to be centered upon something more than the use of ICT alone (Hollands, 2008; Allwinkle & Cruickshank, 2011; Townsend, 2013). In a widely cited article, Hollands (2008, p. 305) argues that the smart city concept originated as a form of urban labeling used for city's self-promotional purposes, calling it "a high-tech variation of urban entrepreneurialism." Hollands (2008) continues that a 'real' smart city must use ICT to enhance democratic debates and policies regarding city development and citizenship. The second, 'people-centric', understanding of the smart city focuses on how ICT can serve as a platform for innovation and creativity and facilitate more social, environmental, economic and cultural development (Allwinkle & Cruickshank, 2011). For example, one particular focus of smart city literature is examining the ways in which ICT is encouraging more openness, transparency, collaboration and participation in urban governance (Gabrys, 2014; Termeer & Bruinsma, 2016).

The diversity of interpretations around the smart city has (much like the sustainable city) have led to an increasing amount of frameworks and indicators that allow for analysis and comparison of these cities. According to The Climate Group (2011), a smart city is one that uses ICT strategically in its administration to provide efficient services to citizens, monitor policy outcomes, manage and optimize existing infrastructure, employ cross-sector collaboration and enable new business models. Similarly, Schaffers et al. (2011) see the three key domains of potential smart city applications to be the innovation economy, city infrastructure and utilities and governance. They also argue that in order to become smart, a city needs to (1) create a rich environment of broadband networks that support digital applications and (2) initiate large-scale participatory innovation processes for the creation of applications.

The European Smart Cities initiative established six key characteristics in their 2007 report (Giffinger et al., 2007). These six characteristics include: smart governance, smart people, smart mobility, smart economy, smart environment and smart living. These characteristics have since been used by a number of studies (e.g. Batty et al., 2012; Lazaroiu & Roscia, 2012) to develop indicators and more elaborate frameworks and strategies, such as the Smart Cities Wheel (Cohen, 2012).

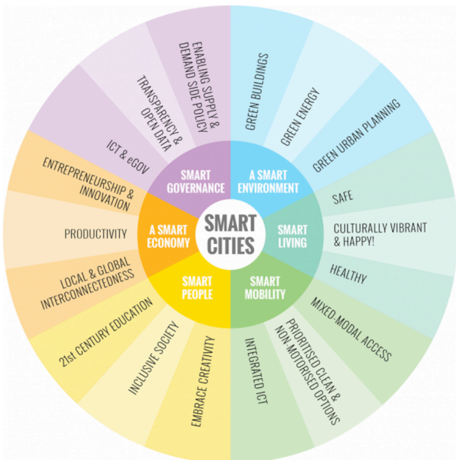

Figure 3-4. Smart cities wheel

Source: Cohen, 2012

It is noteworthy that other than in the European Smart Cities initiative, issues of ecological sustainability are not an integral part of the majority of smart city definitions or frameworks; instead social and economic aspects prevail. As Kramers et al. (2014) conclude, the concept of a smart city says little about the environmental performance of cities.

4 Findings and Analysis

4.1 The Smart-Sustainable City

The explicit use of 'smart-sustainable city' in urban development only emerged around 2015 (ITU, 2015; Höjer & Wangel, 2015; Bibri & Krogstie 2017b). As of this writing, although there is seemingly endless academic discourse surrounding smart and sustainable cities, published studies specific to smart-sustainable cities are overall limited in academic journals and are mostly the result of research in Scandinavian countries, specifically Sweden (Höjer & Wangel, 2015; Kramers et al., 2016) and Norway (Bribie & Krogstie 2017b). The most topical studies have focused on developing definitions and refining the concept, such as Bibri and Krogstie (2017b) who recently published a comprehensive literature review on the SSC field. Researchers Höjer and Wangel (2015), visualize the SSC as an aggregate concept, arguing that all three components need to be present to qualify a SSC.

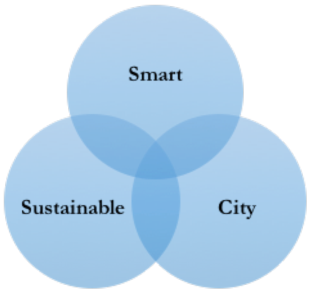

Figure 4-1. The SSC as an aggregate concept

Source: Höjer & Wangle, 2015

The aggregate concept emphasizes that cities can be sustainable without the use of smart technologies, and smart technologies can be used in cities without contributing to sustainable development. Smart technologies can also be used for sustainable development in applications outside of urban systems and services. The SSC concept is only applicable when all of these aspects are combined, essentially when smart technologies are used for making cities more sustainable (Höjer & Wangle, 2015).

4.2 The Smart-Sustainable City as an Urban Vision

In 2013, the ITU's Telecommunication Standardization Sector (ITU-T) formed a Focus Group on Smart-Sustainable Cities (FG-SSC) to help define and disseminate the concept of a SSC. Specifically, the FG-SSC was established as an open platform for various stakeholders to exchange knowledge in order to help identify the standardized frameworks needed to support the integration of ICT services in cities for sustainability purposes. The FG-SSC concluded its two-year study in 2015, releasing twenty-one technical reports and specifications in their publication 'Shaping smarter and more sustainable cities: Striving for sustainable development goals' (ITU, 2015). This publication analyzes 166 existing definitions of smart cities from a variety of sources in order to develop a UN-corroborated definition for an SSC:

> A smart-sustainable city (SSC) is an innovative city that uses information and information and communication technology (ICT) and other means to improve quality of life, efficiency of urban operations and services, and competiveness, while

ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects (ITU, 2015).

In addition, ITU (2015) qualifies a number of characteristics that are emblematic of an SSC. Within the Swedish context, while the SIP-SCC (2015) does not give a formal definition, but instead gives a list of qualitative characteristics it envisions in an SSC. Based on these two authoritative reports, the following characteristics can be used to portray the urban vision promised through the SSC concept.

- **Prosperity and Equity**: An SSC should provide *all* different kinds of citizens with the capacity to fulfil their own needs and strive to improve their quality of life.
- **Sustainability and Sensitivity**: An SSC should pursue environmental, social and economic sustainability through innovative systems and services. Moreover, an SSC should consider the impact of its activities beyond the physical boundaries of the municipality, taking a regional and global perspective of its production and consumption footprint and constantly evaluating and improving the sustainability of the city.
- **Collaboration and Co-Creation**: An SSC should be an open innovative area where co-creation delivers sustainable services to citizens. To this end, an SSC should possess platforms that enable local governments, industries, academia and citizens to improve city life.
- **Efficiency and Adaptability**: An SSC should have efficient, streamlined physical infrastructure-based services, including those related to the transportation (mobility), water, utilities (energy), telecommunications, and manufacturing sectors. An SSC should also exhibit adaptability and and the ability to adjust to rapid dynamic changes in demands on infrastructure and market demands, as well as future technological breakthroughs.
- **Security and Resilience**: An SSC should reinforce resilience capacities and handling functionality for natural and man-made disasters, including the ability to address the impacts of climate change, and should include green and blue infrastructure.

At the core of the vision of an SSC is ICT. However, many researchers acknowledge that smart technologies also need the right societal and institutional conditions to further sustainable urban development (e.g. incentives, ad hoc organizational bodies, etc.) (Neirotti et al., 2014). Within ITU (2015), the FG-SSC also classified SSC services into a number of categories, namely smart energy, smart transportation, smart water management, smart waste management, smart healthcare, smart education, smart security and smart buildings. Based on these studies and other smart city literature, the following sectors were identified as the most prevalent in visions for an SSC:

Smart energy: Smart energy systems use ICT such as sensors, advanced meters and digital controls to automate, monitor and optimize grid operations and enable information exchange about consumption between providers and users. These systems aim to reduce costs and increase the efficiency, reliability and transparency of the energy supply

Smart transportation: Smart transportation systems use ICT to optimize logistics and transportation in urban areas by collecting information about the mobility patterns of both people and goods. These systems provide users with dynamic and multi-modal information for traffic and transport efficiency and assure sustainable public transportation by means of environmentally-friendly fuels and innovative propulsion systems.

Smart water management: Smart water management systems promote sustainable management of water (water supply and distribution, water and wastewater treatment, drainage services, etc.) using ICT to coordinate and improve water management.

Smart waste management: Smart waste management systems apply ICT and innovations to monitor the movements of different kinds of waste and to optimize waste collection, disposal, recycling and recovery. These upgrades will help to convert waste into a resource and create closed loop economies, fostering more sustainable and productive uses of waste.

Smart buildings: Smart building systems use sustainable techniques and technologies to create living and working environments with reduced resources. Smart buildings use ICT to optimize energy and water, all without affecting occupants' satisfaction. Existing buildings can also be modified or retrofitted with ICT to gain energy and water efficiency.

Smart environment: A smart urban environment uses ICT to better protect and manage environmental resources, optimize ecosystem services and control pollution levels.

Smart healthcare: Smart healthcare systems use ICT and remote assistance to prevent and diagnose diseases and provide all citizens with access to healthcare services. Smart healthcare systems can also convert health related data into clinical and business insights and improve the productivity and quality of service provided to citizens.

Smart security: Smart security systems use ICT to feed real-time information to fire and police departments. ICT can also be used to more effectively resolve incidents and provide criminal identification, as well as conducting predictive analysis to identify criminal patterns and improve citizens' safety. It should be noted that new ICT infrastructure also needs to be protected from security threats.

Smart education and culture: Smart education systems use ICT to provide students with a personalized learning environment (e.g. tailored to their progression levels, interests, learning styles), as well as by providing educators with new tools to design learning activities or open new communication channels with students, parents and community members. At the city level, ICT can be used to promote cultural events and motivate participation as well as manage entertainment, tourism and hospitality services.

Smart governance: A smart urban government promotes a digitalized public administration, e-ballots and ICT-based transparency of government activities in order to enhance citizens' empowerment and involvement in public management.

4.3 The Smart-Sustainable City as a Techno-political Agenda

In Europe, most smart city initiatives match the aggregate concept of the SSC. The European Innovation Partnership for Smart Cities and Communities (EIP-SCC), the EU's official platform for smart cities, provides the following definition:

> Smart cities should be regarded as systems of people interacting with and using flows of energy, materials, services and financing to catalyze sustainable economic development, resilience, and high quality of life; these flows and interactions become smart through making strategic use of information and communication infrastructure and services in a process of transparent urban planning and management that is responsive to the social and economic needs of society (European Commission, 2013).

Although the focus on the economic dimension of sustainability is clear, this thesis views all smart city programs and initiatives within the EU as SSC programs and initiatives. In looking into defining the SSC concept and its implications, it is important to understand it not only as a framework for urban development but as a techno-political agenda. Therefore, several policy documents relevant to SSCs were reviewed at both the EU-level and the national level in Sweden.

In Europe the smart cities trend can be traced back to the prolific promotion of the 'smartness' agenda through the Europe 2020 strategy (Haarstad, 2016). Europe 2020, a ten-year strategy proposed by the European Commission in 2010 for the advancement of the EU's economy, aims at smart, sustainable, inclusive growth where Europe's economy is based on knowledge and innovation and is more resource efficient, greener and economically competitive. Under Europe 2020, the EU is supporting the concept of smart cities through a number of projects, programs, partnerships and platforms, including the ICT Policy Support Program (focusing on the infrastructure required for smart cities), the European Innovation Partnership on Smart Cities and Communities (EIP-SCC) (connecting 3000 stakeholders including local authorities, companies, NGOs, academia and citizens across Europe) and the European Commission's Smart Cities Stakeholder Platform (European Commission, 2012). A recent European Parliament study found that more than half of European cities with over 100,000 inhabitants had implemented or proposed smart city initiatives (European Parliament, 2014).

Research in the SSC field in Europe is flourishing. One of Europe 2020's main targets stipulates that 3% of the EU's GDP to be invested towards general research and development, and many research calls fit within the broad context of the SSC field. Strong funding for smart cities initiatives and research began under the Seventh Framework Program for Research and Technological Development (FP7), which ran from 2007 to 2013 and has continued in the more recent Horizon 2020 program (2013–2020). In Sweden, Stockholm was selected as one of Horizon 2020's first 'Lighthouse' cities and granted EUR 25 million to demonstrate smart-sustainable urban energy and transport solutions and to create new jobs in the smart city sector (SIP-SSC, 2015).

Several initiatives have already revealed a significant potential for ICT to help cities reach their climate targets by lowering energy use and GHG emissions from other sectors, including the proposals such as dematerialization and demobilization, as well as comprehensive solutions for smart logistics (GeSI, 2012). Hilty et al. (2011) suggest that ICT can be seen as an enabling technology for improving or substituting processes in other sectors. In these respects, ICT can be used to optimize the design, production, use and end-of-life treatment of other products. On an SSC scale, ICT-enabled solutions offer the estimated potential to reduce GHG emissions by 16.5% create 29.5 million jobs and yield EUR 1.7 trillion in savings (GeSI, 2012). European countries with strong environmental ambitions, such as Sweden, have been investigating how best to use ICT as an enabler for reducing energy use and to better understand what types of ICT investments provide the best benefits for environment and society (Kramers et al., 2014).

Haarstad (2016) proposes three drivers behind the SSC concept's current popularity in the European policymaking community: the appeal of technological solutions, governance innovations and political opportunities. First, part of what makes the SSC discourse so appealing is that it alludes seductively to a future where technology can solve societal challenges (Hollands, 2008; Luque-Ayala & Marvin, 2015). For resource-strapped cities and local governments, transferring responsibility for societal challenges to technologies and the companies that offer them makes for an attractive solution. For large engineering firms and ICT companies, SSC projects offer concrete innovation and investment opportunities for urban infrastructure development (de Jong et al. 2015).

Most of SSC criticism has been focused in this area, and some researchers who view the emergence of smart-sustainable development as a technocentric approach to creating sustainable cities and question or outright reject the transformative claims made within its rhetoric (Kitchin, 2015a). The core argument is that SSC rhetoric is a form of green-washing or "corporate storytelling" (Söderström et al., 2010) which outsources urban governance and infrastructure to global ICT corporations (Viitanen & Kingston, 2014). This reflects the view of Fran Sengers, a researcher working on comparing smart city programs in the Netherlands with China. Sengers sees SSC concept primarily as an economic growth agenda that uses sustainability awareness to gain legitimacy:

> Much about smart cities is that it's a modernist agenda that cements a coalition of big companies and government agencies together behind the goal of a smart city. Especially in the wake of the 2008 financial crisis, big ICT companies see the city as a market for their urban solutions or urban operating system type of products. For city governments, the proposition to use technologies to manage cities in a better way is quite seductive, and city governments are always really keen to stimulate economic growth and to attract a creative class of people, essentially those working in technology and ICT sectors. So for me the smart city is an economic growth agenda and in order to legitimize it, sustainability might be something that is added on. Much of the smart city is about optimizing existing systems, which prevents thinking that we need to radically depart from that. For example, in terms of mobility there is a lot going on in terms of smart mobility, but it is centered around electric vehicles or self-driving cars. This is optimizing the current systems, here the private car, rather than pushing for alternatives like cycling…I believe a lot of the smart city agenda is about maintaining vested interests and optimizing existing systems rather than radically departing from that and going towards more truly sustainable types of socio-technical systems (Interview, 19 May 2017).

The second driver behind the SSC agenda fits well with what some scholars refer to as the 'post-political condition' in urban planning (Haarstad, 2016). The post-political condition posits that politics based on contestation and conflict has been superseded by consensus-based politics, under the assumption that there is now broad agreement about the nature of society's challenges (Allmendinger & Haughton, 2011). Concepts such as smart and sustainable get part of their appeal from their conveyance as ideas that no one really opposes; they cater to a general societal agreement as desirable goals. It is therefore politically difficult to be against a smart city project. However, in reality the SSC agenda might harbor particular objectives and priorities that remain obscured, such as the technocentric and neoliberal approach to urban development (Viitanen & Kingston, 2014).

The third driver behind the SSC agenda is its promise of opening up new modes of cross-sectorial collaboration, new forms of problem-solving and new governance models through smart technologies. In the push to address complex sustainability problems and nexus challenges, there is a push to overcome artificial institutional barriers, to engage in flexible institutional arrangements and to develop integrated and holistic solutions to urban challenges (Haarstad, 2016). One example of this is the urban living lab concept, in which practical applications to solve urban problems are developed and studied *in situ*, to generate empirical data that can support practical planning (Evans & Karvonen, 2014). Living labs are key ingredients in many SSC projects, and the SSC agenda argues that smart technologies can be used to create more collaboration and reconcile conflicts in urban policy-making by directing attention toward practical, mutually recognized problems that require different actors and stakeholders to address. 'Smartness', according to Herrschel (2013, p. 2337), is "essentially about finding a formula to bridge institutional and territorial separateness."

According to James Evans, above all the promotion of the SSC reflects a practical political drive:

> Just in the last five years or so, the idea that smart technology can make cities more sustainable has gained a lot of traction, and there are practical reasons for this as well as some academic reasons. The practical reasons are that we've had targets for sustainable cities for twenty years or longer now that we've struggled to achieve. We've also had huge amounts of effort invested into smart cities, which to a large degree have failed to deliver the benefits that were promised. So there is some realpolitik on behalf of the European Commission. We've got these two problems, these two things we want to happen to cities, let's try to tie them together and use 'smart' to become 'sustainable' (Interview, 15 May 2017).

Clearly, there many reasons as to why the EU is strongly pushing an SSC agenda. The question of how the EU is promoting and framing the SSC requires closer investigation of the EU 2020 strategy and its relevant initiatives. One of the Europe 2020 core strategies is 'smart growth', which according to Russo et al. (2016, p. 1716) intends to "challenge current planning theories, stimulating their innovation." This challenge comes through both European Technology Platforms (ETPs) and European Innovation Partnerships (EIPs). ETPs are industry-led stakeholder forums that are tasked with defining medium to long-term research and technological objectives, or industry-driven roadmaps for relevant sectors (European Commission, 2013). EIPs are a new 'demand-driven' approach to research and innovation which aims to bring together public and private stakeholders, "to accelerate the deployment of major innovations by committing them to undertaking supply and demand side measures (funding, regulation, standards, procurements, etc.) in and across their respective sectors" (European Commission, 2013 p. 3).

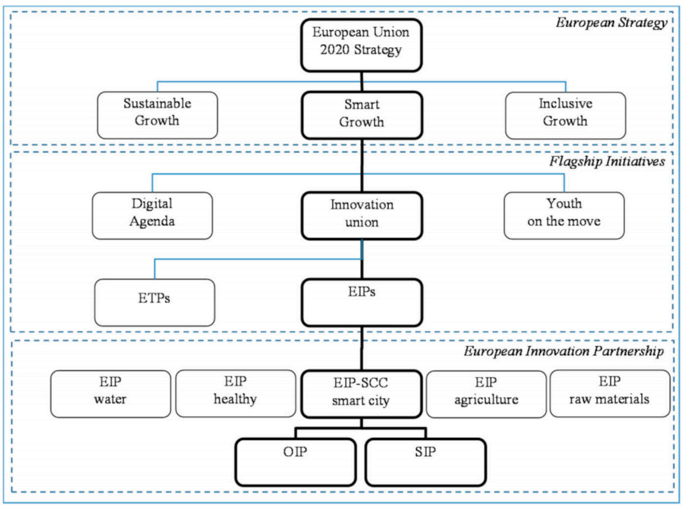

Figure 4-2. The smart city European process

Source: Russo et al., 2016

The focus then of the EIP-SCC is to encourage public-private partnerships in urban development to improve quality of life through more sustainable integrated solutions, or in other words promoting deregulation and privatization in urban planning and development. This is in line with the SSC agenda's underlying emphasis on business-led, or neoliberal urban development (Hollands, 2008; Caragliu et al., 2011). The EIP-SCC has produced both the 'Strategic Implementation Plan (SIP)' adopted in 2013 (European Commission, 2013) and the 'Operational Implementation Plan (OIP)' drafted in 2014 (European Commission, 2014). These implementation plans are neither a new funding program nor an instrument nor a legal entity, but rather European 'guidelines' directed at SSC developments (Russo et al., 2016). Figure 4-3 shows the guiding framework presented in both the SIP and OIP.

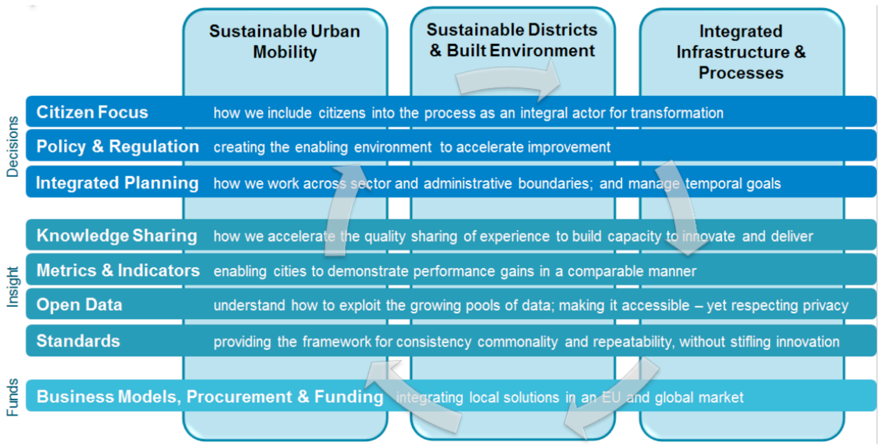

Figure 4-3. The guiding framework of the SIP and OIP

Source: European Commission, 2013

According to Russo et al. (2016), this guiding framework can be considered an attempt to find an equilibrium in order to both pursue sustainability and to increase the quality of life in cities through urban development. However, this 'equilibrium' has been disputed. In an analysis of the EU's SSC agenda, Haarstad (2016, p. 7) concludes that it "is bound up with the European Commission's agenda of fostering innovation and competiveness in the knowledge based economy" arguing that "environmental sustainability does not play a lead role" and further more that "sustainability is largely an assumed result of more efficient, cost-effective urban systems and greater availability of data."

Haarstad's (2016) conclusions are supported by other researchers working to differentiate between smart and sustainable city frameworks. A recent study by Ahvenniemi et al. (2017) used sixteen existing smart city and sustainable city assessment frameworks (eight related to sustainable cities and eight related to smart cities) in order to compare and contrast the frameworks associated with each. Frameworks were compared according to their respective indicators, which were categorized by the authors into ten sectors (natural environment; built environment; water and waste management; transport; energy; economy; education, culture science and innovation; well-being; health and safety; governance and citizen engagement; and ICT) and three impact categories according to the three dimensions of sustainability (environmental, economic and social sustainability). The authors found that smart city frameworks had a high number of indicators related to ICT and economic and social sustainability and lacked environmental indicators compared to sustainable city frameworks.

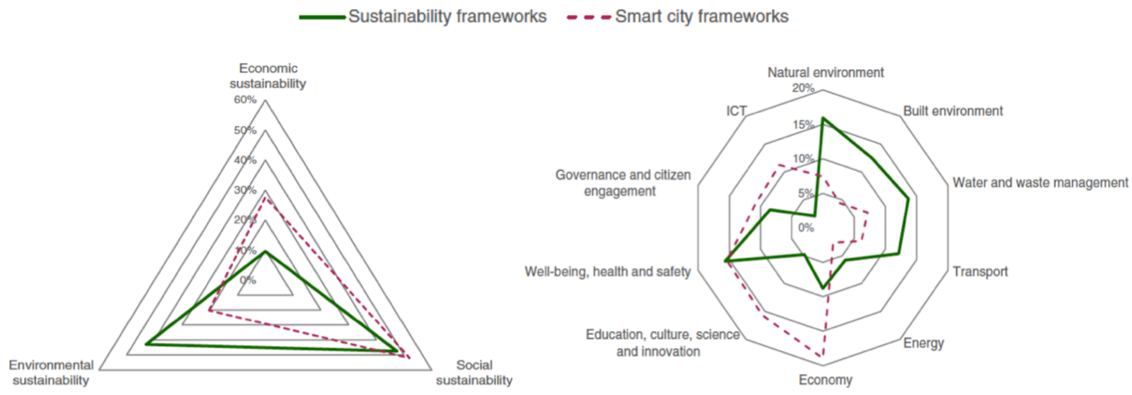

Figure 4-4. Division of the number of indicators for both smart city and sustainable city frameworks under the three dimensions of sustainability and ten sector categories

Source: Ahvenniemi et al., 2017

The work of Ahvenniemi et al. (2017) clearly shows the disconnect between smart cities and sustainable cities and argues for the explicit use of 'smart-sustainable cities' to more accurately reflect that the primary role of smart technologies should be in enabling sustainable development. This was also the view of the Swedish government when coming up with a national agenda for smart cities, which they accordingly called the Strategic Innovation Program for Smart Sustainable Cities (SIP-SCC).

4.4 The Smart-Sustainable City as a National Agenda

In 2015, the Swedish government announced a national agenda for smart-sustainable cities. According to its application, the SIP-SSC represents the "shared vision of a prominent and strong multi-stakeholder consortium and serves as a research and innovation based roadmap towards a zero-emission society" whose primary purpose is "to support Swedish and European energy and climate commitments by facilitating the transition to smart and sustainable cities" (Kordas et al., 2015 p. 1). The foundations of the SSC-SIP are described as follows:

- Sweden's climate and energy commitments with the aim of zero net emissions of greenhouse gases by 2045, 100% renewable energy production by 2040 and new goals for energy efficiency defined by 2017;
- The sustainable transformation of cities as a vital condition for a turn-around to a zero-emission society; and
- ICT as an enabler for such a turn-around (Kordas et al., 2015).

Generally, the SIP-SSC structures a comprehensive roadmap or framework to drive both incremental and radical changes in cities towards sustainability using a 'system innovation' approach. This approach has evolved out of the field of sustainability transition studies (Bulkeley et al., 2010). Sustainability transitions research draws on work in evolutionary economics and social constructivist accounts of technology management, the history of technology and technology assessment (for an overview, see Markard & Truffer, 2008). Sustainability transition scholars have developed detailed frameworks for the formation of new, more sustainable socio-technical configurations, as well as frameworks for analyzing prevailing socio-technical structures that either support or hinder the emergence of radically new modes of production and consumption (Truffer & Coenen, 2012).

Lately, these frameworks have received increasing policy attention. For instance, in 2001 the Dutch Ministry for Economic Affairs built a national sustainability policy on the concept of 'transition management', a policy framework with strong roots in sustainability transition research (Kemp & Rotmans, 2009). Similarly, other countries such as the United Kingdom, Finland and Belgium have adapted elements of these approaches to create regional policies with a more sustainability-oriented environment (Truffer & Coenen, 2012). However, a recognized weakness of the system innovation approach is an overemphasis of science and technology as drivers of development (Moulaert & Mehmood, 2010)

In essence, the SIP-SCC outlines Sweden's roadmap for a transition to sustainable urban growth, mainly targeted at energy and climate related challenges. The SIP-SSC represents a slight departure from the EU level work on smart cities in that the SIP-SSC makes sustainability an explicit priority, as evidenced by its name. The specific vision of the agenda is as follows:

> In 2050 Swedish SSC innovations will have successfully delivered new ICT enabled solutions for integrated urban systems that aid cities to achieve their sustainable development goals within the Planetary Boundaries whilst ensuring a good quality of life for its citizens (SIP-SSC, 2015).

It is worth noting here that Swedish government has added its own 'generational goal' to the Brundtland definition of sustainable development in that the overall goal of Swedish environmental policy is to meet the needs of its present and future generations without increasing environmental and health problems outside Sweden's borders, so the vision of the SIP-SSC extends to cities outside of Sweden (Höjer & Wangle, 2015). However, as it stands the vision is rather vague and no specific quantitative targets are set, only suggested examples for research and innovation in its priority areas. That being said, the SIP-SSC is also in the very early stages of its development, yet its main priorities are already clear. The SIP-SSC also revolves around two main principles: 1) a strong focus on environmental sustainability, together with social and economic aspects, through SSC solutions and initiatives; and 2) coordinating efforts for sustainable urban development through the integration and connection of infrastructures and systems, participation and co-creation enabled by ICT (SIP-SCC, 2015).

This emphasis on environmental sustainability is perhaps a reaction to previously mentioned criticisms of smart cities being more focused on economic and social interpretations of sustainability (Kramers et al., 2014; Ahvenniemi et al., 2017). Another explanation is that Sweden is trying to create competitive advantage in the SSC market by building on its recognized reputation in environmentally sustainable development. Regarding the second principle, the SIP-SSC is to serve as a platform, or "national arena", to coordinate smart-sustainable developments. Sweden already has an extensive list of national goals and programs around sustainable development that serves as the basis for planning work in cities and municipalities. According to a study conducted for the SIP-SSC (2015), the National Board of Housing, Building and Planning in Sweden already has more than twenty national policy frameworks and sectors relevant to sustainable development and more than one hundred relevant national goals. Moreover, many of the actors involved in sustainable development are uncoordinated and have entrenched and context-based experiences that are difficult to scale or transfer to other projects. The SIP-SSC states its intention to coordinate these actors by finding ways to integrate sustainability aspects into decision-making processes through measuring progress using key performance indicators (KPIs) (SIP-SSC, 2015). Lena Neij, one of the founding members of the SIP-SSC, stressed in an interview that increased collaboration was just as, if not more important, than ICT in making cities more smart and sustainable (Interview, 17 May 2017).

The SIP-SSC also states that it will take a people-centered approach through empowering citizens and utilizing co-creation to drive the country's energy and climate agenda. As shown in Figure 4-5, the SIP-SSC in many ways mirrors the guiding framework for smart cities at the EU level but differs in that it has made 'empowered citizens' a priority area along with sustainable districts and built environment, sustainable urban mobility, and integrated infrastructure.

Figure 4-5. Priority areas for the SIP-SSC

Source: SIP-SSC, 2015

The emphasis on empowered citizens and co-creation originates from the Scandinavian tradition of participatory design. Participatory design refers to changing the design philosophy to one where technology is designed in partnership, or co-created, with users, thereby eliminating a discrepancy of power imbalance between 'experts' and 'users' (Beck, 2002). In the SSC context, this can include open access to data so that citizens can make use of this empirical resource in their own research pursuits (Batty, 2012). There is also an increasing role for citizen science and civic crowd funding, or the use of crowdfunding on projects that produce community or public assets (Davies, 2015). Within citizen science, the emergence and rapid development of sensor technologies can allow for more citizen sensing, or environmental monitoring through low-cost or DIY digital technologies, a practice that Gabrys (2014; 2016) argues can make citizens more empowered to act on environmental matters of concern from air pollution to the migration of animals.

However, Beck (2002) notes that participatory design has been adopted in situations where there is no real intent for empowerment, but instead to serve the needs of technology manufacturers. As Chris Martin, a researcher in sustainable cities with a background in computer sciences, notes in an interview, there are different understandings of 'participation' within computer science and social science disciplines. Whereas the social sciences see participation as citizen engagement and empowerment, computer sciences tend to see participation primarily as a form of data collection (Interview 17 May, 2017). Much of the data collected in the SSC is generated by citizens (often without their knowledge or informed consent) from sources such as social media, consumer sites, search engines, credit card transactions, etc. and can then be used by private corporations for commercial purposes as well as by governments. Viitanen and Kingston (2014) argue that open data business models are not yet fully established in cities, and that the privatization of the upkeep and maintenance of databases or pubic services may provide contradictory incentives to open data trends; as private companies view see data as a valuable commodity, they might not be willing to provide it to the public (including their competitors) for free. James Evans confirmed that data sharing was the main barrier in implement SSC projects in Manchester (Interview, 15 May 2017).

The ultimate paradox of the SSC is that the same networked technologies that can offer opportunities for empowerment can also be used against civil rights for surveillance or censorship (Viitanen & Kingston, 2014). However, the more common criticism is that SSC solutions are all too often designed or proposed without considering the needs of and usability by citizens (Almirall et al., 2014). Andrew Karvonen, an SSC researcher in Stockholm, notes that the SSC agenda is primarily being driven by technology companies rather than being driven by cities themselves. He argues that this distinction makes the SSC agenda, as it currently exists, more about the marketing of technology products than about increasing livability in cities. SSC technologies therefore need to be driven by the context-specific needs of cities and rather than technology being the driver itself, and that the real potential of the smart agenda is in urban grassroots initiatives, such as community gardens or sharing style networks, being able to use ICT in creative ways (Interview 17 May, 2017).

In a similar vein, Calzada (2017) argues that favorable conditions exist for a potential politics of progressive smart city agendas based on urban transformations driven by social innovation and experimentation. Moreover, Sweden's longstanding culture of innovation, participatory design and sustainable development all create a positive environment for the beneficial and need-driven use of smart technologies in an SSC context. However, examining real-life examples of urban developments in Sweden can reveal more about what the implications of the Swedish SSC agenda. This thesis looks at past and ongoing developments in the city of Malmö, Sweden's third largest city.

4.5 The Smart-Sustainable City in Development: The Case of Malmö

Malmö is the capital and largest city in the southern Swedish region of Skåne with a population of over 300,000. The modern history of Malmö is primarily one of a once prosperous shipbuilding town that has since struggled with an economic crisis in the wake of post-industrialization.

Figure 4-6. Locating Malmö on the map

Source: Encyclopedia Britannica, 2017

Referencing the essential strategies of a SSC advanced by Caragliu et al. (2011), Malmö has employed several of these strategies in its journey to reinvent itself as a leader in sustainable development. Overall, the city exhibits an emphasis on strategies: (2) a business-oriented urban development; (4) acknowledgement of the role of high-tech and creative industries in its long-term growth; and (6) including social and environmental sustainability as major priorities for urban development. Researchers Holgersen and Malm (2015) argue that Malmö's business-strategy for urban development was to market itself as a sustainable city, or as they call it a 'green fix', similar to the 'sustainability fix' of While et al. (2004).

The concept of a 'green fix' is derived from eco-modernization thinking. Eco-modernization argues that economic growth and sustainability are compatible in that growth can be a potential instrument for the furthering of sustainability (Hajer, 1996). The green fix gives this idea a slight twist and argues that sustainability can actually be a mechanism for growth. The logic of the urban green fix is to attract capital investments, particularly investment in urban infrastructure, to the city through the production of a green image (Holgersen & Malm, 2015). The green fix is based on Harvey's (1989) 'spatial fix' to the crisis-tendencies inherent in capital accumulation. Harvey (1989) argued that a vibrant and dynamic private sector should be the principle actor in urban governance, driving economic growth and enhancing a city's competitiveness in a globalized economic system. On-going economic growth is assumed to deliver quality of life benefits to the population, and the public sector's work should be to enable the private sector and manage the social and environmental challenges created by on-going economic growth.

In many ways the green fix is an archetypal strategy of the SSC. Cities are increasingly interested in attracting private investments and turning towards these 'entrepreneurial' or neoliberal forms of governance, and in doing so backing away from the Keynesian Welfare State (Cochrane, 2007). This is in line with the neoliberal restructuring of the state and escalating inter-urban competition (Harvey, 1989). To attract international investment, cities attempt to create a positive image—cultural vibrancy, entertainment outlets, sports stadiums, universities and other centers of knowledge and innovation that "cast a seemingly beneficial shadow over the whole metropolitan region" (Harvey 1989, p. 8).

According to Holgersen and Malm (2015) the green fix must, at least initially, be coordinated together by city governments and private investors through policies in planning guidelines, infrastructural development, the adoption of certain environmental values etc., as well as advertised in the public arena as a solution to political problems such as unemployment, under-competitiveness, slow or non-existent economic growth and, of course, environmental degradation. This requires the active participation and close collaboration of policymakers, planners and politicians and their private partners. If successful, the green fixed capital, which could take the form of energy efficient residential areas and developments or new transportation systems, is branded as sustainable and delivers political gains as well as profit.

The green fix concept continues to argue that because of increasing environmental awareness, establishing a sustainable 'brand' for a city as a marketing tool can attract more investments to the city in a positive feedback loop. Harvey's (1989) 'spatial fix' warns that while investments in urban infrastructure are necessary and may temporarily boost an area's profile and create employment, this may not be sustained as investors can always leave to other locations. In this scenario, the city's 'investment' in diverting public (welfare) resources to help lure in mobile global capital does not pay off and ends up creating further social polarization. The green fix, however argues that capital accumulation can be refurbished and rejuvenated *in situ* (Holgersen & Malm, 2015).

Malmö's green fix began in reaction to an economic crisis in the 1970s and 1980s after years of industrial decline and a municipal unemployment rate of 22%. The city's fate changed in 1994 with the election of a new mayor, Ilmar Reepalu, the local leader of the Social Democratic Party and an architect by profession. Reepalu was inspired by the idea of a 'K-society' (K-samhället) presented by Åke Andersson. The K's stand for Kunskap (knowledge), Kommunikationssystem (systems of communication), Kreativa resurser (creative resources), Konst (art) and Kulturellt kapital (cultural capital). Andersson's idea was essentially to build an economically sustainable knowledge society, and stressed that formal knowledge needs to be combined with creative resources, cosmopolitanism and culture alongside systems of communication (Listerborn, 2017).

Reepalu's fixation on the knowledge city shows that Malmö's urban development strategies were not at first focused on environmental sustainability. In urban planning documents from the 1990s, the environment was mentioned as part of city development solely in relation to recreational parks (Holgersen & Malm, 2015). Under Reepalu's leadership, the municipality started to work on a comprehensive new city vision, tasking teams with conceiving alternative futures for the post-industrial city. This laid the foundation for the city's new Comprehensive Plan (Översiktsplan) adopted in 2000, proclaiming that 'after the industrial society comes the knowledge and information society' (City of Malmö, 2000).

4.5.1 Bo01: The City of Tomorrow

According to Holgersen & Malm (2015), Malmö's green fix is inextricably linked to its award-winning sustainable district, Bo01. The Bo01 development began as a project for the European Millennium Housing Exposition in 2001 and was the first phase of a larger revitalization project called Västra Hamnen (Western Harbor), nicknamed the City of Tomorrow and as a mixed-use neighborhood adjacent to the historic center of Malmö. The project title designates its 2001 opening date while "Bo" is the Swedish verb "to dwell" (Austin, 2009).

Figure 4-7. Bo01 in Malmö's Western Harbor today

Source: City of Malmö, 2017a

The development of Bo01 began in 1995 as the result of the comprehensive planning process undertaken by the City of Malmö. The process was prompted by the closing of the Saab factory in 1990 on the original site of Malmö's Kockums shipyard, which freed up 140 hectares of valuable real estate on the Öresund Strait. In addition, construction of a new bridge connected Malmö and Copenhagen over the Öresund Sound, resulting in a thirty-minute transit link to downtown Copenhagen and its international airport. This allowed the moderately-sized town of Malmö to be considered as a potential transnational hub, creating the possibility for new development opportunities. The planning process generated two strategic projects: (1) establishment of the independent Malmö University in the city center and (2) Malmö's application for one of Sweden's housing expositions sponsored by SVEBO (Svenska Bostäder, an organization formed by BOVERKET, the Swedish National Board of Housing, Building and Planning). Sweden has a decades-long tradition of sponsoring housing expositions in order to promote innovation in housing construction over conventional technologies and practices. With the support of SVEBO and Reepalu's leadership, the idea emerged for a "housing exposition as an innovative project with the most farsighted solutions for sustainable building and city development in every respect being applied concertedly for the first time in Sweden" (Persson & Tanner, 2005 p. 9).

After the Bo01 project in Malmö was chosen to be the site of a European Millennium Housing Exposition, the city quickly purchased the site and buildings. Bo01 AB, a temporary public company owned by the City of Malmö, was established to plan and operate the exhibition itself. Revenue generated from ticket sales and other exhibition-related activities were used to finance the company. Bo01's development rights were advertised and sold to a series of private architect-developer teams. In order to purchase development rights, developers were required to participate in an Expo Architect Committee, responsible for collaborating with the City Planning Office to create building guidelines for the site. SVEBO appointed head architect Klas Tham to lead the Expo Architect Committee, and the planning process began with sixteen private developer teams alongside the city who together produced a Quality Program to supplement the city's existing planning regulations. The Quality Program describes the final master plan for the district, including guidelines for the physical development of individual plots (including requirements for sustainability), and clearly delegated development responsibilities amongst the city, the exhibition team and the participating developers. The Quality Program endeavored to "exemplify a holistic approach but also give criteria, detailed objectives and directions for more sustainable solutions, e.g. concerning energy efficiency, source separation of waste, greenery, biodiversity, and also for the more elusive quality of human sustainability" (Persson & Tanner, 2005 p. 9). Because of their participation in the process, private developers were already prepared to meet the more stringent requirements of the Quality Program.

As the primary landowner, the City of Malmö became the 'horizontal developer', responsible for planning and constructing all the public spaces and infrastructures, while the private developers were responsible for construction within their respective plot boundaries. Although basic funding for the housing expo planning was provided SVEBO, additional government funding was sought from Sweden's Local Investment Program (LIP) to cover the added costs of planning and designing the envisioned innovative sustainable systems. The LIP was run by the Swedish Ministry of the Environment as a national funding program to support Local Agenda 21. In 1999, Bo01 received 250 million Swedish kronor (EUR 27 million) from the LIP to help fund sixty-seven projects in the following eight areas: urban planning and form; soil decontamination; energy; eco-cycle; traffic; green and blue infrastructure; building and living; and information and knowledge dissemination. The EU granted an additional EUR 1.5 million to support a concept developed by Sydkraft, the local power utility, to run the district on 100% local renewable energy (Persson & Tanner, 2005).

Bo01's innovative planning and development was strictly driven by top-down government policies and funding initiatives. The district was also highly influenced by SVEBO's high expectations of creating "a national example of sustainable urban development," with closed eco-cycles and 100% local renewable energy. These high expectations created ambitious sustainability goals for the district, from energy and technology to green space, all designed to service a high-quality urban lifestyle. The Quality Program was the steering instrument for achieving Bo01's various sustainability goals, intended as a "single basic standard" for developers. Most of the requirements in the Quality Program were qualitative in order to allow for innovation and creativity on the part of the sixteen developer teams. Even though developers were required to comply with the Quality Program from the outset, there were no sanctions for not achieving its goals, nor were there any incentives for outstanding performance. The signing of the agreement can therefore be seen more as a principled commitment on the part of developers; however, with thousands of expo visitors and the LIP contract to evaluate and report their performance, developers' reputations were clearly at stake (Fraker, 2013).

The inclusion of sustainability goals with emphasis on innovative designs to achieve these goals placed Bo01 at the forefront of sustainable urban development in Sweden and on a global stage. The district's urban form was an important aspect and attempted to recreate and update traditional forms of a European city: a compact high-density environment; complex layering of many different architecture styles and design strategies; mixed-use; the integration of public parks and plazas with quiet residential neighborhoods; and a diverse network of streets, boulevards, promenades, paths and alleyways. The relatively low-rise, high-density block plans are contrasted with a single high-rise tower, the Turning Torso. With fifty-four floors, it is the tallest residential building in Sweden (Fraker, 2013).

Figure 4-8. Blowup plan of the first block and promenade in Bo01

Source: Fraker, 2013

Bo01's sustainable transport strategy revolves around reducing dependence on the private car. The strategy includes providing services and recreational activities within the district (to reduce demand for trips outside the neighborhood), a convenient and clearly marked network of bicycle and pedestrian paths and a comprehensive and reliable bus system that runs on electricity and natural gas with stops that digitally display updated schedules and arrival times. Residents' parking provisions are also limited (1.5 spaces per unit) and are invited to join an on-site car sharing service made up of 'green' vehicles. The transportation strategy has been so successful it has since has become a model for the whole of Malmö (Fraker, 2013).

The effort to integrate green and blue infrastructure in Bo01 took two different approaches. In the first, each building project had to fulfil at least ten of thirty-five options in a green points system (see Table 4-1). In the second approach, each building project was required to satisfy a green space factor requirement of 0.5, calculated per unit surface area as an average of all the factors shown in Table 4-2. For example, built and other non-permeable surfaces were given a rating of 0.0, while green infrastructure was given a factor of 1.0. Considering these to be the only surfaces and that their areas are equal, the calculated green space factor for this area would meet the required average of 0.5. These two approaches required developers to prioritize green infrastructure in their respective projects, but the flexibility of the criteria and factor approaches allowed for innovation and creativity. The overall goal was not only to completely integrate green and blue infrastructure into the district for different purposes (recreation, storm water collection, habitat for urban biodiversity) but also to make it as visible as possible for residents and visitors. No specific goals were established for water management and usage, perhaps not surprising given Malmö humid climate. There is no rainwater capture or reuse, and the storm water systems are treated more as a design feature and channel all water to the open sea. The incorporation of water-conserving fixtures and appliances was left to the discretion of the developers (Fraker, 2013).

Since its introduction in Bo01, the Green Points system and Green Space Factor have continued to be used as a development strategy by the City of Malmö and, created with transferability in mind, has been used in other municipalities such as the London Borough of Sutton and the city of Southampton (Kruuse, 2011). According to Kruuse (2011), the strategy succeeds as a public-private-community partnership because the the developer has some choice of delivery, the municipality can meet its targets and the community benefits from improved green infrastructure and a reduction in the impact of extreme heat and excessive rainfall.

Table 4-1. Green infrastructure criteria in Bo01's Quality Program

Green Points System	
1. A nesting box for every unit. 2. One biotope for specified insects (plant biotopes excluded) per 100 square meters (m2) of courtyard area. 3. Bat boxes inside the plot boundary. 4. No hard surfaces in courtyards—all surfaces permeable to water. 5. All non-hard surfaces in the courtyard have deep soil good enough for growing vegetables. 6. Courtyard includes a traditional cottage garden. 7. Walls covered with climbing plants wherever possible or suitable. 8. A 1 m2 pond for every 5 m2 of hard surface in the courtyard. 9. Courtyard vegetation specially selected to yield nectar for butterflies. 10. No more than five plants of the same species among the courtyard trees and bushes. 11. All courtyard biotopes designed to be fresh and moist. 12. All garden biotopes designed to be dry and lean. 13. Entire courtyard made up of biotopes modeled on biotopes occurring naturally. 14. All storm water captured to run aboveground for at least 10 m before being led off. 15. Green courtyard but no lawns. 16. All rainwater from buildings and courtyard paving collected and used for watering vegetation or for laundry, rinsing, and the like inside the buildings. 17. All plants suitable for domestic use in one way or another. 18. Batrachian biotopes in the courtyard, with hibernation possibilities.	19. In the courtyard or adjoining apartment buildings, at least 5 m2 of orangery and greenhouse space per dwelling unit. 20. Bird food in the courtyard year-round. 21. At least two different traditional cultivated fruit and soft fruit varieties per 100 m2 of courtyard space. 22. Swallow shelves on house fronts. 23. Entire courtyard used for growing vegetables, fruit, and soft fruit. 24. Developer or landscape architect to cooperate with ecological expertise and to shape the overall idea and the detailed solutions together with the ecological associate (choice of associate must be approved by Bo01 or the City of Malmö). 25. Gray water purified in the courtyard and reused. 26. All biodegradable domestic and garden waste composted and the entire compost output used within the property, in the courtyard, or in balcony boxes and the like. 27. All building material used in constructing the courtyard—surfacing, timber, masonry, furniture, equipment—has been used before. 28. At least 2 m2 of permanent growing space on a balcony or in a flower box for every dwelling unit with no patio. 29. At least half the courtyard to be water. 30. Courtyard has a particular color as the theme for its plants, equipment, and material. 31. All trees in the courtyard to be fruit trees and all bushes fruit bushes. 32. Courtyard has topiary plants as its theme. 33. Part of the courtyard is allowed to run wild. 34. Courtyard has at least fifty wild Swedish flowering plants. 35. All roofs on the property are green, that is, clad in vegetation.

Source: City of Malmö, 1999

Table 4-2. Green infrastructure factor in Bo01's Quality Program

Green Space Factor	
Partial Factors for Green Infrastructure	**Partial Factors for Paved Surfaces**
1.0 Greenery on the ground 1.0 Bodies of water in ponds, streams, ditches 0.8 Green roofs 0.8 Plant bed on joists, >800 mm	0.4 Open paved surfaces (grass-reinforced areas, gravel, shingle, sand, etc.) 0.2 Paved areas (stone or slabs) with pointing

deep 0.6 Plant bed on joists, 35 cm (calculated for an area of not more than 25 m2 of planting space per tree) 0.2 Solitary shrubs, multiple-trunk trees more than 3 m high (calculated for an area of not more than 5 m2 of planting space per shrub or tree) 0.2 Climbing plants more than 2 m high (calculated for a wall area with width of 2 m per plant times the height of the plant)	0.0 Non-permeable areas (roofing, asphalt, concrete, etc.) **Partial Factors for Hard Surfaces** 0.2 Collection and retention of storm water (additional factor of sealed or hard surfaces with joints draining into a pond or magazine holding >20 L/m2 of drained area) 0.1 Draining of sealed surfaces (to surrounding greenery on the ground)

Source: City of Malmö, 1999

The novel waste management system designed for Bo01 was called the eco-cycle system and was designed with the goals of first reducing waste, then recycling as much waste as possible and finally recovering resources from the waste flows. Bo01's eco-cycle inspired the three R's strategy—reduce, recycle, renew (Fraker, 2013). In terms of implementation, Bo02 has a comprehensive recycling system for convenient household separation of glass, paper, metal, and plastic. A couple of experiments were conducted for systems to recover and recycle food waste; specifically, a vacuum collection system was established at waste collection points and a food waste disposal system was installed in individual kitchen sinks. The city has continued emphasizing more sustainable food waste systems as introduced in Bo01. Food recycling in Malmö has been mandatory since 2014, and collected food waste is used to produce biogas for the city's buses, garbage trucks and filling stations (City of Malmö, 2017b).

In terms of energy, one of the few quantitative requirements in the Quality Program was energy demand, which set a target on energy consumption for properties to not exceed an average of 105 kWh/m^2/year. By design, lowering the energy demand facilitates meeting the target of deriving 100% of energy from local renewable sources. While the City of Malmö originally wanted a stricter cap on energy demand, the developers' argued for a higher cap considering more realistic cost estimates, and the resulting cap was still significantly lower than the Swedish average for energy consumption at the time, 250 kWh/m^2/year (Fraker, 2013).

The developers were required to model the performance of buildings' technical systems until they could demonstrate that their units would achieve the Quality Program's energy target. Reports from the developers make it clear that designing for an energy demand target was a new experience for many and required paying close attention to a variety of construction details such as insulation in the walls and roof, the orientation of windows, airtightness and thermal bridging, ventilation and heat exchange and the efficiency of the heating system. Ultimately, all of the buildings modeled an energy demand performance equal to or better than 105 kWh/m^2/year target. However, actual energy performances were much higher than expected, with an average observed consumption of 167.6 kWh/m^2/year. This represents a 77% percent increase over calculated estimates and a 60% increase over the original target (Persson & Tanner, 2005).

There has been speculation but no definitive conclusions about the discrepancy between modeled and observed energy consumption. It is clearly the result of a number of factors, but other studies show that a unit's air infiltration rate (number of air changes per hour, caused by cracks from poor construction, opening doors and windows, etc.) has a significant impact on energy consumption. This is also the likely culprit resulting in higher actualized energy consumption in Bo01, especially given the high wind exposure of the site and the observation that properties with the highest energy consumption are located at the western, most-exposed corner of the site. Despite the unexpected increase in demand, Sydkraft, the local power utility, was still able to execute its goal of providing 100% local renewable energy using an innovative system that takes advantage of (1) a two megawatt (MW) wind turbine for generating electricity, (2) an electric-powered heat pump for heating and cooling and (3) solar photovoltaics for electricity (120 m^2) and solar collectors for heating (1,400 m^2) located on buildings (Fraker, 2013).

The system is designed so that the heat pump (heating and cooling system) can use the local groundwater aquifer as a heat sink, providing seasonal storage. The heat pump is designed to extract excess heat from the units in the summer, storing heat in the aquifer until it can be delivered in the winter. The pump works in reverse during the winter months, extracting cool air for delivery in summer. This energy mix does not take advantage of three additional potential sources of renewable energy generated by the neighborhood: combustible waste (delivered to the city's cogeneration plant), food waste, and sludge waste (delivered to the city's digestion plant). Even so, Bo01 has indeed achieved its 100% local renewable energy target, making it a zero emission district in terms of its energy supply (Persson & Tanner, 2005).

Strong leadership from the City of Malmö was essential to Bo01's success, as was the strong financial support from national and EU programs. The district's status as an international housing exposition set high expectations for all stakeholders involved and motivated systems-thinking approaches for creating novel, sustainable systems and integrating them into an attractive city landscape. The collaborative process between the SVEBO-appointed Expo Architect Committee, the City Planning Office and other agencies, the local utility and the involved property developers was crucial for successfully implementing all of the different concepts in the project, and Malmö's role as the horizontal developer was fundamental to coordinating diverse efforts to reach the goals outlined in the Quality Program. The specific targets of 100% local renewable energy supply and 105 kWh/m^2/year energy demand proved to be crucial in shaping the sustainable design process of the buildings and infrastructure. The decision to have Sydkraft own and operate all of the renewable energy systems, even those attached to private property, was also essential as it liberated homeowners from the risks of maintaining new, unfamiliar technologies while simultaneously consolidating responsibility.

The added costs of developing Bo01 have been recovered by the city through the sale of properties to the developers. The goal of making the neighborhood "at least as convenient, attractive and beautiful as the (so-called) unsustainable city" (Persson & Tanner, 2005 p. 14) was a significant success achieved by Bo01 and set a precedent for sustainability strategies that do not come at the expense of urban design and form but instead pointedly enhance the urban environment. Although many of Bo01's sustainability strategies are very much visible—wind protection, solar collectors, open storm-water collection and retention—they are artfully integrated into the architecture and urban landscape of the district, employing sustainability in creating a high-quality urban environment. Beyond the commitment to creating a high-quality urban environment, the approach of Bo01's development was simple: first, reduce demand in areas such as transport and energy, and then meet demand through strategies with lowest environmental impact. Bo01 has also been a financial success for the City of Malmö, although the real estate market for the district has only been accessible to upper-to-middle income residents.

4.5.2 Hyllie: The Climate-Smart District

The success of Bo01 established a reputation for Malmö as an international leader in sustainable urban development (Holgersen & Malm, 2015). The lessons learned from Bo01 have since been carried over to further development of Western Harbor, Flagghusen (Bo02) and Fullriggaren (Bo03), which attempt to mainstream sustainability by incorporating similar environment and energy goals while also focusing on affordability. Along with new developments, the City of Malmö has also been effective in using sustainable urban development projects to revive and improve existing areas, such as Augustenborg. In the case of Augustenborg, a lower-income neighborhood has been transformed into an 'eco-district' with extensive green roofs and green infrastructure, sustainable storm water systems, renewable energy (solar and wind) and a carpool.

Figure 4-9. Visualization of the future Hyllie climate-smart district

Source: City of Malmö, 2015

The district of Hyllie is currently Malmö's largest development area with plans to build about 9,000 homes (and nearly as many workplaces) by 2030. Plans for Hyllie began in the early 2000s when the new connection to Copenhagen through the City Tunnel train station was built in the area. Accessibility is one of Hyllie's key selling points—the center of Malmö is a short five-minute train ride, and a commute to the center of Copenhagen takes only thirty minutes by train. The municipality emphasizes the regional role of the Hyllie project. The goal is for Hyllie to become a meeting place in the Öresund Region with commercial and conference centers, an attractive business environment and high-end residential areas (City of Malmö, 2013a). These goals are visible within Hyllie's urban design. Along with the train station, several large-scale projects have already been completed, including the construction of a shopping center, Malmö arena, an exhibition center (Malmö Mässan), Point Hyllie (which includes offices, shops and apartments) and a hotel. Many of the residential buildings are still under construction.

In order to implement an ambitious sustainability program for Hyllie (similar to Bo01's Quality Program), city planners applied for EU funding. While efforts to secure funding were unsuccessful, the city was motivated to carry on with a sustainability plan without external financial backing. In 2009, ahead of that year's climate summit COP15 in Copenhagen, Malmö introduced a citywide Environmental Program (MEP) outlining strategic plans for the city's sustainable development. One of the MEP's goals was to become "Sweden's most climate-smart city", stating that "the city administration will be climate neutral in 2020 and all of Malmö will be powered by renewable energy by 2030" (City of Malmö, 2009).

The new MEP created additional impetus to turn Hyllie into a "test-bed" where the city could collaborate with the private sector to test the various energy solutions needed to help reach the city's goal of being powered by 100% renewable energy by 2030 (City of Malmö, 2011). In 2010, Major Reepalu also signed the Green Digital Charter, further incentivizing the development of a 'climate-smart' district. The Green Digital Charter adds a sustainability perspective to how ICT is managed and developed in European cities. The charter commits its signatories to working together to achieve the EU's climate objectives and to using ICT as a technical solution and enabler of behavioral change to reduce carbon dioxide emissions, including those from ICT themselves. Under this commitment, Malmö has a goal to reduce emissions from ICT by 30% by 2020 (City of Malmö, 2017c). Malmö's approach to this goal is focused in three areas:

1. **A sustainable ICT platform**: The city plans to 'green' its ICT platform by adding a sustainability perspective to how the city's ICT technologies are managed and developed. The goal is to ensure that procurement, management and operations relating to Malmö's ICT platform will have minimal environmental impact (based on a lifecycle perspective).
2. **ICT as environmental technology**: The city plans to actively use and develop ICT as environmental technology for sustainable development within the city's municipal administrations as well as the Öresund region.
3. **Green digital communications**: The city will communicate its environmental commitments and achievements in an innovative, educational and creative way through a range of ICT solutions (City of Malmö, 2017c).

According to Darcy Parks, a researcher investigating the climate-smart project in Hyllie, the city originally wanted the Hyllie district to be run completely on renewables. However, Eon, the international energy company that owns Malmö's electricity and district heating network, saw the opportunity to demonstrate smart grid technology along with existing energy infrastructure to test new energy solutions and business models (Interview, 22 May 2017). The idea was to create 'systems' solutions for energy, integrating different types of infrastructures to provide electricity, heating, cooling and transportation in innovative ways, for example, using biogas from food waste to power buses. In 2011, the City of Malmö, Eon and VA SYD (the regional water and waste management association) entered into an official public-private partnership through the Hyllie Climate Contract. As the third key stakeholder in the Climate Contract, VA SYD is responsible for implementing sustainable waste management and recycling in the district. Together, the three stakeholders committed to investing in making Hyllie "the Öresund Region's most climate-smart city district" with the goal of "100% renewable or recycled energy by 2020"—a target set ten years ahead of the rest of the city. (City of Malmö et al., 2013a).

The overall budget for the climate-smart project thus far has been EUR 21 million. The City of Malmö, Eon and VA SYD provided the initial investments for the project and the Swedish Energy Agency provided an additional EUR 5.5 million to help Eon fund its smart grid demonstration. The smart grid uses a decentralized energy management system, a technology developed by Siemens, to provide demand response control system for electricity, heating and cooling (cogeneration or combined heat and power). Smart grid systems are designed to improve flexibility in the consumption chain, using control and monitoring to shape energy demand according to energy supply and optimizing renewable energy production (Strengers, 2013).

In 2015, the municipality officially implanted its sustainability plan for the district, the Hyllie Environmental Program (HEP), a voluntary planning program that outlines responsibilities for various stakeholders, such as developers, in achieving the Climate Contract's ambitions (City of Malmö 2015). The HEP is structured as a list of voluntary goals describing how buildings can contribute to the various aspects of the climate-smart city, along with specific actions and measures property developers can take. The HEP could be described as a tool used by the city to both encourage sustainable building practices and to coordinate the efforts of developers and other key actors, such as Eon, in fulfilling its climate ambitions. Table 4-3 shows the twenty goals included within the HEP.

Although the goals of the HEP are only voluntary, they are also structured to help developers comply with national standards and EU-level policies. For example, regarding the first goal of energy efficiency, the HEP specifies that buildings should be constructed at aa standard that "is equivalent to Mini Energy Buildings, Passive House, Zero Energy Building or another established environmental standard with energy requirements stricter than the requirements of the National Board of Housing, Building and Planning" (City of Malmö, 2015 p. 10). The HEP allows developers to choose their own building standard, giving them flexibility in choosing any standard as long as it is stricter than the national requirements. The rationale behind this guideline is that national requirements are likely to become stricter in the near future in order to comply with the EU directive 2010/31/EU which states that only nearly zero energy buildings (NZEBs) are to be built by 2020.

Table 4-3. Hyllie Environmental Program goals (author's translation from Swedish)

Hyllie Environmental Program Goals	
1. Hyllie buildings are energy efficient 2. Hyllie buildings and facilities are connected to the smart grid 3. Hyllie buildings take advantage of smart home technologies 4. A significant proportion of Hyllie energy requirements are met by local renewable production 5. Hyllie is climate resilient 6. Hyllie represents a close collaboration between Malmö and developers 7. Hyllie attracts companies with strong environmental profiles 8. Land allocation process ensures quality developers with strong environmental profiles 9. Malmö supports monitoring and reporting efforts 10. In Hyllie, walking and biking are prioritized over cars	11. Hyllie has a well-developed public transportation system 12. Green car pooling is available for residents 13. Waste sorting begins at the source 14. Hyllie has accessible and convenient waste collection points 15. Citizens are aware and educated about the impacts of their lifestyle and consumption patterns 16. Hyllie has an extensive network of green and blue infrastructure 17. Ecosystem services are utilized and developed in Hyllie 18. Green factor is used to enrich green and blue infrastructures 19. Life-cycle perspective applies to all construction 20. Hyllie has exceptional indoor environments

Source: City of Malmö, 2015

The rest of the HEP embodies very similar goals to those used within the Quality Program of Bo01. The most obvious 'improvement' from the Bo01 is Hyllie's addition of a smart grid, which was tested by Eon in the Smart Grids for Hyllie project between 2011 and 2016 and is now being deployed in the district. The smart grid's technology allows for the control of energy use in buildings through a demand response controller (DRC) and by using buildings as an integrated part of the energy system. Eon's energy management system in Hyllie is able to monitor how energy is being used in connected buildings and can send signals to the building's management system to reduce demand based on forecasts and renewable production (in Hyllie renewable energy comes from regional wind and local solar production).

Through the smart grid project with the Swedish Energy Agency, Hyllie's smart grid was proven to effectively reduce peak demands and optimize the use of renewable energy. For the energy system, this increases the reliability of delivering energy and simultaneously reduces the need to add new capacity when adding customers to existing networks. It also reduces the need for storage and peak production during hours of high demand. For the building, signals to reduce demand require that energy use is moved, either to hours with the lowest energy price, or hours where the system's GHG emissions are lowest. The Hyllie project showed that this optimization can create both environmental and economic benefits for the property owner, the grid owner and the energy producer. Further deployment of the smart grid is intended to to enable property owners, households and businesses to become more active in the energy market through such measures as selling the surplus from their independent energy production, for example excess energy generated by privately owned solar panels (City of Malmö, 2013a)

The developments in Hyllie and Bo01 are in many ways similar; they are both high-end developments designed to attract international attention and investments by showcasing innovative solutions for sustainability. In Bo01, however, it was the international expectations and attention built up by the housing exhibition that inspired developers to comply with or even exceed the goals stated within the Quality Program. Moreover, many of the innovative solutions showcased in the Bo01 district would not have been possible without substantial amounts of external funding. The case of Hyllie shows that the City of Malmö is able to use its own collaborative networks and expertise to realize ambitious sustainability projects. This is evident both in the partnership with Eon and in goals seven and eight of the HEP. Goal eight states that the city is only willing to work with "actors who have a high environmental ambition, and will take this into account in the evaluation of developers during the land allocation process" (City of Malmö, 2015 p.18). Overall the Hyllie climate-smart district supports the green fix scenario of Holgersen and Malm (2015); that Malmö now effectively uses its sustainability vision and reputation to attract companies and developers who share similar values and green business models, especially in high-profile projects such as Hyllie.

4.5.3 Malmö: An Attractive and Sustainable City

The case of Malmö is perhaps unexceptional. In studying the low carbon transition of cities in the UK, Hodson, McFarland and Bulkeley (2013) observe that cities, namely London and Manchester, when pressured to transform their energy systems but lacking the authority to do so due to earlier liberalization and privatization, created sustainability visions around which they could build networks and solicit commitments from important actors. Sustainability has been at the core Malmö's urban vision since 2005, when its Comprehensive Plan announced the city's vision to becoming an 'attractive and sustainable city' (Holgersen & Malm, 2015). This vision still prevails in Malmö's most recent Comprehensive Plan, adopted in 2014, which is intended to serve as the city's long-term development through the 2030s. A summary of the plan reads:

> Malmö's Comprehensive Plan looks two decades into the future. The overarching aim is that Malmö will be an attractive and sustainable city socially, environmentally and economically. The city should able to continue to grow and there will be a need for more housing, work places and service. The aim is to create a robust and long-term sustainable urban structure for an increased population, green growth and a continued development of Malmö's attractiveness.
>
> When Malmö is complimented with new development there is an opportunity to improve the existing qualities of the city. Malmö has the ambition to be a world leader in sustainable urban development which provides a range of challenges, for example regarding environmental issues. Achieving a socially balanced city where everyone can enjoy good conditions for life is a decisive challenge for Malmö. A prioritized target is therefore to strengthen the economic base for the livelihood of Malmö's citizens.
>
> Malmö should be a neighborly, compact and mixed-use city—a green city with a transport system that puts people in focus. Malmö, together with Copenhagen, will function as an engine in the Öresund region to strengthen competitiveness (City of Malmö, 2014).

The Comprehensive Plan shows that Malmö's vision corresponds with the concept of a SSC, especially in that it seeks to balance objectives of green growth and competitiveness with social and environmental sustainability. The city also places an equal amount of emphasis on being 'attractive' as it does 'sustainable' (see Figure 4-10). Attractive here can be interpreted in the aesthetic sense but also in the economic and entrepreneurial sense as the city strives to attract the right kinds of investments and businesses to strengthen its economic base and, of course, its own image and reputation. This duality also comes across in the Comprehensive Plans overall objectives:

- An appealing city that is socially, environmentally and economically sustainable
- Social balance and good living conditions
- Economic dynamism and sustainability
- Resource efficient society and environmental robustness

Figure 4-10. Malmö's 2014 Comprehensive Plan illustrates its priority to become an 'Attractive and Sustainable City'
Source: City of Malmö, 2014

In order to reach these overarching objectives, the Comprehensive Plan details a principled development strategy, with three priorities: 1) to be to be a mixed-function dense, green and close city; 2) a regional generator of green growth and employment; and 3) a cultural and democratic arena. The plan goes on to detail specific strategies for various sectors (see complete list of sectors and strategies in Appendix III). While working with holistic visions makes for impressive promotional and communications material, it can also create conflicts between different priorities. Conflict can happen both within the municipality's own priorities regarding sustainable development. In instances when the municipality elects to work with other actors and form partnerships, this inherently creates divergent perspectives, priorities and interests which can lead to challenges (Hodson & Marvin, 2010).

For Malmö, tensions arise between the city's vision and its actual urban conditions (Listerborn, 2017). The city has successfully used its visioning strategy to resolve its economic crisis, and doing so required close collaboration with private capital investments. For the city, it is therefore important to maintain healthy discourse with private partners to continue a working relationship that can lead to future collaborations (Holgersen, 2014). However, Malmö's impressive new sustainable developments, meant to show a break from the city's industrial past and attract the educated 'creative class', have still not resolved the city's issues of unemployment, poverty and segregation. Today, Malmö's population of 318,000 could be characterized as young, relatively poor, with a high unemployment rate, born abroad, and educated when compared to national averages, as shown in Table 4-4.

Table 4-4. Demographic of Malmö compared to the Swedish national average

	Malmö	**National level**
Average age	38.5 years	41.2 years
Average annual income	EUR 21,070	EUR 25,790
Born abroad	32%	16%
Unemployment rate	14.9%	8%
Higher education (university)	48%	41%

Source: SCB, 2015

Although new jobs have been created in in Malmö's post-industrialization transformation, inequality has grown over the last several decades, leading to an increase in socioeconomic polarization (see Figure 4-11) (Salonen, 2012). The current economic disparity in the city has incentivized the City of Malmö to shift its efforts from more environmentally-focused projects to socially-oriented ones, all while maintaining its commitment to building an attractive city for entrepreneurs and businesses (Nylund, 2014). In 2013, the city established a Commission for Socially Sustainable Malmö and published a report, Malmö's Road to Sustainable Future, with policy recommendations. The overall recommendations are:

- A social investment policy that can alleviate the differences in standards of living.
- A social investment policy that can make social systems more equal.
- Transformed processes for socially sustainable development through knowledge alliances and democratized management (City of Malmö, 2013b).

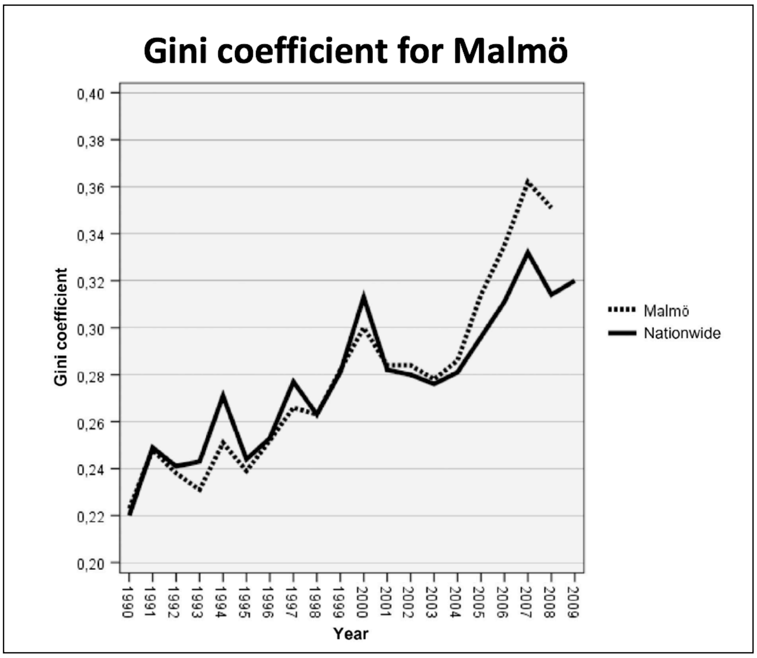

Figure 4-11. Gini coefficient, a standard economic measure of income inequality, has risen in Sweden and especially in Malmö over the past several decades

Source: Salonen, 2012

Carina Listerborn, a researcher at Malmö University observes that "the story of Malmö may appear to be Janus-faced, since the city gains an international reputation for being creative with environmentally conscious planning and cutting-edge architecture and, on the other hand, is infamous for its high levels of poverty, and occasional riots and violence" (Listerborn, 2017 p. 18). Trevor Graham, a sustainability consultant for the city, notices that in Rosengård, a new housing development located in a lower-income neighborhood, there has been a slight "lack of the big picture" from the city's planning perspective:

> Rosengård will be a real game changer from the socio-economic perspective but how ambitious it will be from an environmental performance perspective is still quite unclear. We're battling with a kind of mindset in which there's still a separation in understanding social issues and environmental issues, but you can't just do one or the other. In one meeting, questions were raised if we should really be planting a lot of trees and greenery around the development if our focus is on social sustainability. Planting trees will have virtually no impact from an ecological perspective but it has a huge social impact in creating a higher quality environment for people. In some ways, things like energy efficiency measures are more intangible and it's difficult to see the direct social benefits, but green space is definitely a social issue (Interview, 11 May 2017).

Conflicts in the city's planning priorities show that Campbell's (1996) classic article on the divergent priorities in sustainable urban development and urban planning is still very much relevant. Campbell uses a triangular framework (see Figure 4-12) to understand genuine clashes of interest in urban planning regarding sustainability. He argues that while the current concept of sustainability, though an admirable vision, is vulnerable to the same criticism of vague idealism that was made against comprehensive planning in the 1960s and is in many cases of limited modern applicability. However, when refined and incorporated into a broader understanding of political conflicts in industrial society, sustainability can become a powerful and useful organizing principle for planning if it is used (1) to manage and resolve conflict; and (2) to promote creative technical, architectural, and institutional solutions. In terms of, resolving conflicting economic, environmental, and social interests, Campbell claims that "the more it stirs up conflict and sharpens the debate, the more effective the idea of sustainability will be in the long run" (Campbell, 1996 p. 297).

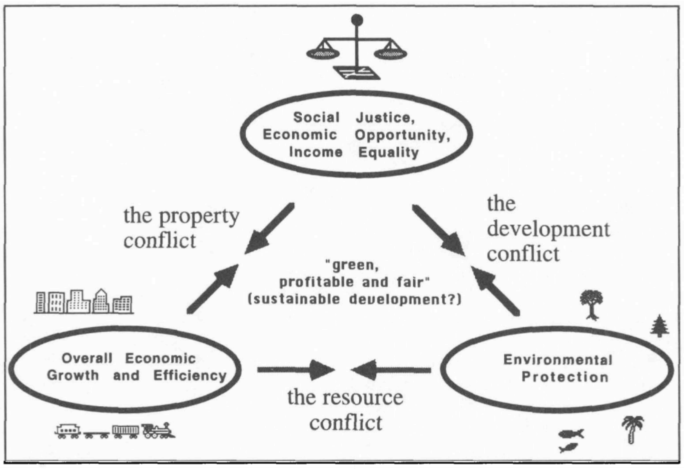

Figure 4-12. Sustainability conflicts in urban planning

Source: Campbell, 1996

For Malmö and for Sweden, it seems that the notion of 'smart development' is more about resolving sustainability conflicts through collaboration and innovative and creative solutions than it is about ICT technology. Roland Zinkernagel, who works within Malmö's Environmental Department, elaborates:

> Within the environmental department, we have been discussing what this idea of 'smart' means for us. And we have taken a wider approach or perspective, smart is trying to break out of this 'siloed thinking' and finding synergies, not necessarily through ICT, but through multi-benefit or multi-purpose solutions. One example is a green roof—it provides building insulation, rainwater management, urban habitat for biodiversity, a recreational area, and a lot of other positive benefits. But the way and processes in which these smart solutions are identified require quite a lot of cooperation and talk between city sectors that historically haven't been communicating (Interview, 15 May 2017).

Similarly, Frans Sengers alleges that a flexible and cooperative governance system in the Netherlands has been a significant factor in Amsterdam's success with a smart city program, stating that in the Netherlands, "public and private actors can work together in an informal setting productively" and that "working in silos and different departments doing different things is less of a problem" (Interview, 19 May 2017). According to Sengers, the cooperative governance in the Netherlands also comes from its unique history in which the Dutch people have historically had to set differences aside in order to work together towards a common goal—managing water and maintaining reclaimed land. However, Sengers also concedes that cooperative governance, and the compromises it entails, reduces the speed of policymaking and can make it difficult to achieve more ambitious goals. In other words, collaborative governance is a system geared more towards incremental than radical change (Interview, 19 May 2017).

In the City of Malmö, the Malmö Innovation Arena (MIA), encourages more collaborative efforts in urban development and between the city administration, private businesses, the non-profit sector and academia working to promote innovations that can contribute to the refurbishment and development of the existing housing stock in Malmö. An important part of the MIA is the Sustainable City Accelerator—a meeting place where different actors can collaborate in developing new solutions for sustainable urban development in cooperation with the real estate industry. According to Trevor Graham, who is involved in the MIA, a lot of the work in the innovation process is about finding conflicts in different levels of policy that are hampering innovations, such as disconnected legislative frameworks or administrative barriers (Interview, 11 May 2017).

While there may still be administrative barriers, the innovation mentality already appears to be flourishing in Malmö and the city an impressive list of ongoing projects currently oriented at the intersection of smart and sustainable development. Table 4-5 contains a list of smart-sustainable development projects on-going at the time of writing. Although this list is surely not comprehensive, as Trevor Graham put it, "our [Malmö's] perspective is, is that if you know everything that's going on, then there's not enough going on, or at least you're controlling it too much. There's an upside to the creative chaos" (Interview 11 May, 2017).

Table 4-5. Ongoing SSC projects in Malmö

SSC Projects	**Objective**	**SSC Sectors**	**Funding**	**Stakeholders**
BiodiverCity	To develop products, services and processes that promote and increase the city's biodiversity with the vision of a greener, more attractive and healthy city. Examples include green facades, walls and roofs.	Environment Buildings Water management Waste management	Grants from Vinnova and the European Regional Development Fund	City of Malmö Skåne Region Business Academia NGOs
BuildSmart	To demonstrate mainstream cost effective techniques and methods for constructing very low energy buildings in various European climates. The solutions implemented will be ready for the market.	Energy Buildings	Co-funded by the EC under the 7th FP	City of Malmö Dublin Basque Region Business Academia
Citadel	To make it easier for citizens and application developers alike from across Europe to use Open Data to create the type of innovative mobile applications that they want and need.	ICT	Co-funded by the EC under the CIP Program	City of Malmö (along with numerous other European cities) ICT companies Business Academia
Cleantech Testbed for Public Procurement	To increase applied research and innovation-oriented activity in ÖKS area with focus on sustainability. This will be achieved through intelligent procurement of municipalities in the region.	Waste management	Co-funded by Interreg ÖKS	City of Malmö (along with other local municipalities Skåne Region Business Academia
Hållbarheten	To test and experiment with energy-smart solutions in order to achieve a self-sufficient energy system for a	Energy Transport	Co-funded by Eon	City of Malmö Business Academia

	building and get consumption down below 65 kWh/m²			
Lighting Metropolis	To strengthen the significant role lighting can play in supporting safety, accessibility, identity, health, and education for people in cities.	Energy	Co-funded by Interreg ÖKS	City of Malmö (along with several other cities in Sweden and Denmark) Region Skåne ICT companies Business Academia
Malmö Innovation Arena	To promote innovations that can contribute to the refurbishment and development of the existing housing stock in Malmö. An important part of the project is the Sustainable City Accelerator - a meeting place where innovators from different sectors may aid in developing new solutions for sustainable urban development in cooperation with the real estate industry.	Buildings	Co-funded by Vinnova	City of Malmö Business Academia NGOs
NICE (Networking Intelligent Cities for Energy Efficiency)	To create a partnership of cities on ICT and energy efficiency.	ICT Energy	Co-funded through the EC's FP7	97 Eurocities members Business Academia
Peripheria	A 'Neighborhood' lab that works in the lower income multi-ethnic suburbs of Rosengård and Fosie and focuses on urban development, collaborative services and social media, exploring the potential of new media for co-creation and social innovation.	Energy Education	Co-funded by the EC's CIP Program	Project consortium led by Alfamicro (PT) and made up of 12 partners from 5 EU Member States
Smart Cities Accelerator	To make the Öresund region attractive to other parts of the world so as to come here and study how we have been working on smart cities and how we have engaged citizens. To create concrete examples of what we have tested and demonstrate how we have reduced energy use by specific percentages.	Energy	Co funded by Interreg ÖKS	City of Malmö (along with other local municipalities) Private enterprises Academia
Stapeln Open Maker-Space (STPLN)	Meeting platform that connects different user groups, resources Facilitates co-production Organizes workshops and courses for capacity building Develops skills in repairing, renovating, design, etc.	Education Waste management	Membership fees and funding from the Malmö Municipality	City of Malmö Private enterprises NGOs Academia
ZenN: Nearly Zero Energy Neighborhood	To identify promising financial solutions for installing energy efficiency renovations in existing buildings	Energy	Co-funded by the EC's 7th FP	City of Malmö Private enterprises NGOs

				Academia
Zero noise, zero emission	Testing solutions where heavy transports are eliminated within a neighborhood and distribution of goods is run by bicycle	Transport Energy	Co-funded by ERDF	City of Malmö

Not everyone has a positive outlook on Malmö's developments however. According to Baeten (2012), the Hyllie project can be interpreted as the 'normalization' or 'institutionalization' of neoliberal, depoliticized planning in Malmö and Sweden. His perspective is that while the Western Harbor was a straightforward attempt to attract elites to the city center with fashionable architecture and high-class amenities, its planning methods were experimental and initially triggered debate and resistance. With climate-smart development in Hyllie, contestation and political debate has all but vanished, showing that the elites of Malmö have institutionalized the Western Harbor experimental planning and design techniques to continue the momentum behind developing future high-profile development projects in Malmö. Baeten (2012) further argues that these plans are not designed to meet the needs of the city's general population but rather to attract a new class of people (the creative class described by Florida, 2002) and in that way change the social demography of the city. This is evident through contracts with high-profile architects, high-profile architectural competitions organized by the city, and the allocation of land to major developers without more democratic consultations—all development strategies that were pioneered in Western Harbor but have become common practice in Hyllie (Baeten, 2012).
Indeed, these criticisms are not limited to Malmö alone but are common critiques of the neoliberal 'entrepreneurial' city. The direction the city has taken to assuage its critiques and better serve its people has been to focus on more social aspects of sustainability in its development projects. This comes across most prominently in one of the city's ongoing urban renovation projects and even its some of Malmö's new developments, such as Sege Park, where a 'sharing economy' style development is being built at the site of an old mental hospital. The focus of Sege Park is to further push the boundaries of innovative planning in order to create a high-quality sustainable neighborhood that is also affordable. Sege Park has its own Environmental Program similar to that of Hyllie and Bo01 that is, in some ways, even more progressive. For instance, some of the sewage collected from units will be used to fertilize agricultural land in the area. Sege Park will have greenhouses and a public fruit orchard in addition to green carpools. Most importantly, developments at Sege Park will focus on optimizing communal resources (such as kitchens, saunas, etc.), allowing individual units to be smaller and more affordable. According to Juliet Leonette-Lidgren, the Sege Park lead at the Environmental Department, "the sharing style of Sege Park's developments is aimed at creating both a high-quality urban environment and an enjoyable sense of community at a low price tag" (Interview, 23 May, 2017).

Sege Park is a telling example that the city shows not only a willingness to continue making strides in low carbon development but to do so in experimental and innovative ways that builds off its previous projects and address its most pressing problems, in this case inequality and a serious housing shortage. While the City of Malmö clearly still has a long way to go in terms of ameliorating its social sustainability disparities, the city's attempts to balance both long (environmental sustainability) and short-term goals and perspectives (equity and economic growth) into its planning and developments is perhaps above all what should qualify it as a smart city.

5 Reflections and Conclusion

5.1 Key Findings

This thesis investigated several aspects of the multi-faceted concept of a SSC. Specifically, it looked at: the origination and meanings of the SSC concept; its approach to sustainable urban development as defined by EU policies and programs; and the ways in which the SSC concept is reflected in the City of Malmö's ongoing urban development projects and planning strategies. First, in order to engage with the origins of the SSC concept, the respective concepts of a sustainable city and smart city were explored and analyzed. This research found that there are glaring differences between the two concepts, both in terms of their founding assumptions and how they rose to prominence in urban development discourses. As de Jong et al. (2015) note in a study on city categories for urban sustainability, labels such as 'smart' and 'sustainable', each harbor particular conceptual perspectives that render them distinctive, pointing to significant differences in how urban development is understood and what related approaches, innovations and solutions each perspective offers for urban sustainability.

The first major difference is the way in which these terms came to dominate urban development discourses. The sustainable city was essentially born out of global environmental discourses, specifically that of sustainable development. It can be argued then, that the sustainable city began as a *principled* approach to urban development; it was systematically advanced as a political agenda by international environmental and development organizations such as the United Nations in order to promote sustainability dogma relating to social equity and ecological integrity and to address issues such as climate change. The spread of urban monitoring, along with the devolution and localization of environmental governance with Local Agenda 21, has since given the sustainable city a more *scientific and strategic* approach to urban development in monitoring various urban systems and measuring progress in reaching both local and global sustainability goals, for example around climate change.

Conversely, the smart city first emerged first out of the increasing use of ICT in cities and as a framework to 'enhance the competitive profile of the city' (Caragliu et al., 2011). In this way the smart city began as a *technical and strategic* approach to urban development. In response, later researchers such as Hollands (2008) argued that the smart city approach to urban development needed to be founded on principles such as citizen empowerment and sustainability to be legitimate. In terms of urban sustainability, arguably both smart city and sustainable city advocates do not emphasize conflict but rather synergies between the three dimensions of society, economy and environment. However, the work of Ahvenniemi et al. (2017) and various other scholars shows that the smart city places its primary emphasis on the economic dimension, while the sustainable city is predominately concerned with the environmental perspective. In general, sustainable and smart city concepts are difficult to accurately define. A large number of definitions and frameworks have been given to each term by various organizations, governments and cities themselves, creating an understanding of a smart or sustainable city in a top down fashion. However, there are also many more grassroots trends happening in cities that create more of a defacto understanding of these terms. For example, widespread citizen sensing for environmental monitoring arguably makes a city more 'smart' than a self-ascribed urban label.

The implications for the marriage of these two terms come from the many contradictions and synergies between the sustainable and smart cities concepts. Chris Martin believes the conflicts are more prevalent than the synergies and that combining the two perspectives of sustainable and smart city represents a further dilution of sustainable development goals, a perspective he elaborates on in a forthcoming article (Interview 17, May 2017). For Martin, one of these contradictions is in the different types of infrastructures and urban forms encouraged by sustainable versus smart development. The sustainable city includes physical form as its fourth key dimension (in addition to the three dimensions of sustainability) and encourages more resilient forms of urban infrastructure, especially in terms of green and blue infrastructure and ecosystem services. Green and blue infrastructure creates environmental benefits (creating urban habitat and adaption for climate change), social benefits (higher quality living environment) and even economic impacts (cost-effective water management). The smart city, however, pushes for more digital infrastructure, in particular integrating digital infrastructure into the physical forms of the city for more effective sensing and monitoring. The smart city then pushes for more efficient urban infrastructure. However, as Andrew Karvonen pointed out, efficiency in terms of urban systems means integrating them all into integrated infrastructure, or urban system. This focus on efficiency, however, makes smart city infrastructure vulnerable, especially in terms of technological failures or cyber-attacks. Resilience, on the other hand, is dependent on having many systems as a form of infrastructural redundancy (Interview, 17 May 2017). The SSC then needs to find a better balance between resilience and efficiency. An example of one solution, as proposed by the SIP-SSC, is to have more urban sensors based within green and blue infrastructures for both a digital and ecosystem service approach to managing storm water.

The second main contrast is that the sustainable city is focused more on finding equilibrium between its dimensions, or taking a triple bottom line perspective between prosperity, people and planet. The smart sustainable city, however, is more oriented towards growth, specifically economic growth driven by technological innovation. The eco-modernization version of a sustainable city predominant in Europe argues that green economic growth can be compatible with ecological integrity and social equity. This claim rests on the perceived ability of digital technologies to drive the dematerialization of the economy, by shifting from resource-intensive to knowledge-intensive forms of economic activity. However, others argue that eco-modernization is already a 'weak' interpretation of sustainability (Pearce, 2013), disputing the ideas around dematerialization and arguing that ongoing economic growth contradicts finite planetary limits. Thus, other versions of a sustainable city have been advanced with the idea of creating environmental sustainability through a stable state economy or even a degrowth economy. The smart city, however, reinforces the neoliberal interpretation of the sustainable city, and arguably makes it even more radical by claiming technological innovation as primary means of green growth, which will then allegedly create more sustainable urban environments. The SSC concept should therefore be hyperaware this internalized contradiction and be especially sensitive to the environmental and social impacts of its activities, on both a global and local scale.

Another contradiction arises from the sustainable city's focus on equity, which contradicts the neoliberal notion that wealth is supposed to 'trickle down' from higher to lower income classes. The economic ideology of trickle-down effects stresses that innovation and creativity will reinforce growth and secure welfare for all; new jobs in the service sector will be created, and tax income will increase, thus income and welfare will be distributed equitably to most people in the area. However, the idea of trickle-down economics has been widely contested, and contradicts studies showing a digital divide linking increasing urban ICT to increasing inequalities in cities. As Andrew Karvonen puts it, "smart mainly refers to a popular version of sustainable development, that of green growth and ecological modernization, but it doesn't talk a lot about social equity, or about justice or about the people that live in cities" (Interview, 17 May 2017).

One challenge for the SSC is therefore balancing both growth and prosperity with equity. This is perhaps one of the most pressing challenges in the information age. Digital technologies and innovations can of course create more jobs, both in terms of creative and technical jobs but also in terms of more informal 'gig economy' jobs, where platforms such as Uber provide more employment opportunities with flexible working schedules. However, the digitalization and automation of traditional industries such as manufacturing also contributes to unemployment. A digital economy however is argued to have the potential to both efficiently and fairly distribute resources, for example through a universal basic income. A SSC should use strategies such as that of a universal basic income to ensure that digital technologies are addressing, rather than exacerbating, socio-economic issues such as inequality and unemployment.

Finally, the sustainable city is inherently ideological, based on triple bottom line principles. The smart city, however, has been argued to be technical, pragmatic and non-ideological in its endeavors to produce urban value. The smart city uses technical standards because these standards are argued to be more efficient and effective than laws. Proponents of this techno-deterministic view of cities argue that in the era of data, authority will shift from humans to computer algorithms. However, smart cities are inherently politically and ideologically loaded in vision and application, and the term 'techno-politics' illustrates that it is impossible to make clear distinctions between technology and politics. The challenge of the SSC will be to use the efficiencies and innovations afforded by digital technology to not just create more 'value' and 'capital' for the sake of industrial competitiveness but to focus on creating an entrepreneurial ecosystem that generates a diversity of values from natural capital to social and cultural capital.

There are also many inherent synergies between the sustainable and smart city concepts. The case of Malmö provides an example of a city that focuses on these synergies to find multi-purpose solutions to create innovative and experimental urban communities. Malmö has shown that strategies of smart-sustainable development, such as public-private partnerships and a focus on green growth, can fund low carbon infrastructures to substantially reduce environmental impacts and create aesthetic and social urban communities. However, social and economic divides continue to be an issue in Malmö. More citizen participation in the planning process may be a way to lessen criticisms of elitism in developments, although citizen participation in urban planning is not something that Malmö, or Sweden, has traditionally engaged in. Overall it remains to be seen if Malmö's urban planning strategies, such as the 'sharing' style community envisioned at Sege Park, will manage to help Malmö not only be a green city but a fair one as well.

5.2 Reflections on Methodology and Further Research

The methodology used in this research was designed to give a broad and all-encompassing overview of the many different origins, agendas and developments that characterize an SSC. Although the questions initially addressed such as "why, how, for whom and with what consequences" the SSC concept is emerging in Sweden and in Malmö were focused, these questions could not be answered without establishing the broader context of the development of the SSC concept. This broad overview of the concept, complete with its internal contradictions and possibly unrealistic components, paves the way for more specific questions and more focused research regarding SSCs to be answered in the future.

An additional criticism of this research was that it focused primarily on a political perspective, that of the EU, Sweden and Malmö. While analyzing various policies and documents was helpful in terms of framing the SSC as an agenda, it is also useful to remember that with governments are not neutral referees overlooking society but players actively involved in the game. And while data taken from these sources is assumed to be reliable and accurate, there is still a need for source criticism when taking into account the subjective purpose of the information. For a more informed study, a penta-helix framework should be used do capture the widest narrative on how cities carry out smart-sustainable development strategies. The penta-helix model examines not only the role of institutions but that of the public sector, private sector, academia and civic society and social entrepreneurs and/or activists. Calzada (2017), who used this framework to analyze smart city politics in several European cities, argues that the last type of stakeholder, social entrepreneurs and/or activists, represent the initial spark in the ecosystem of urban experimentation. Thus, a research design with the penta-helix model in mind would have included interviews not only with academics and city officials, but also with stakeholders from the private sector, including large corporations like Eon, as well as small-scale social entrepreneurs.

5.3 Conclusion

The SSC is clearly a complex and ongoing phenomenon driven by a variety of factors that is reshaping contemporary cities, not merely a buzzword or urban marketing label. The implications of future sustainable urban developments in cities are of profound importance both for human society and for the planet. As the impacts of climate change becoming increasingly visible, heightened urgency surrounds the need to increase the rate at which society transitions to a low carbon model. Moreover, as globalization and market forces continue to create divides in power and opportunities, there is an even more pressing need to fashion interventions that make societies and economies more just.

Within the concept of the SSC, many powerful global trends that have the potential to either address or reinforce pervasive global issues such as climate change, poverty and inequality are represented. Rising interest in sustainability, the transformative power of urbanization, and the opportunities of technological and digital innovation can all be leveraged to make progress towards these goals and others that have been universally recognized through the UN's SDGs. In the city, digital innovations are reshaping every sector from energy, where technologies such as the smart grid can optimize the integration of renewable energy, to applications in e-governance that make municipal governments more open, transparent and accountable. Perhaps the most powerful trend is a growing generation of social entrepreneurs who use new forms of communication and data accessibility to mobilize the necessary networks and resources around solving local issues.

However, while it often seems that the power of technology is transformative, innovating for more sustainable societies is a long-term strategy rather than a quick fix. This has been illustrated with the case of Malmö, which has been able to use a green fix to reinvent itself after an economic crisis, creating world-renowned developments such as Bo01, but is still struggling with socio-economic issues. While cities are dynamic in many ways, they are rigid and enduring in others. A particular inertia surrounds power structures and all transformative agendas face opposition from vested interests. Within cities, urban infrastructures can endure for decades, therefore creating problems with technological lock-ins. While it is enticing to dream of a green digital revolution, the changes promised by the SSC are more likely to occur subtly and incrementally. However, as long as these move along a trajectory that creates more prosperous and equitable societies, all within ecological and planetary boundaries, then there is reason to consider it progress.

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Appendix I. Personal Communications

Interviews with Researchers and Relevant Stakeholders

1. James Evans – *Senior Lecturer in Geography at the University of Manchester* – May 15, 2017
2. Trevor Graham – *Director at urbanisland | Sustainability consultant for the City of Malmö* – May 11, 2017
3. Andrew Karvonen – *Assistant Professor in Urban and Regional Studies at the KTH Royal Institute of Technology* – May 17, 2017
4. Juliet Leonette-Lidgren – *Sustainability Strategist at the City of Malmö | Project Leader at Sege Park* – May 23, 2017
5. Chris Martin – *Researcher at Durham University* – May 17, 2017
6. Lena Neij – *Director at the IIIEE of Lund University | Member of the SSC-SIP* – May 17, 2017
7. Darcy Parks, *Doctoral student at Linköping University* – May 22, 2017
8. Kerstin Rubenson – *Sustainability Strategist at the City of Malmö | Project Leader of Hyllie Climate-Smart*
9. Frans Sengers, *Researcher at the Copernicus Institute of Utrecht University* – May 19, 2017
10. Nora Smelby, *Postdoctoral fellow* at the *IIIEE of Lund University* – April 27, 2017
11. Roland Zinkernagel, *EU Coordinator and Sustainability Strategist at the City of Malmö* – May 15, 2017
12. Lucie Zvolska*, Doctoral student at the IIIEE of Lund University* – May 10, 2017

Appendix II. Semi-Structured Interview Guide

Guide for Researchers
How do you define a SSC? What specific attributes must it have?

Do you know of any SSC frameworks? What definitive literature informs your understanding of an SSC?

How should policy-makers approach the planning of smart-sustainable cities? (i.e. priorities and strategies) What role do other various stakeholders have to play in the realization of smart-sustainable cities? Specifically, please comment on industry, academia, and civil society.

What do you see as the greatest potentials and opportunities in SSC projects and the concept as a whole? What do you see as the greatest challenges and barriers?

What are the other major issues and debates do you know of surrounding smart-sustainable urbanism?

What do you see as the most impactful area for SSC projects in terms of creating more sustainable cities (e.g. energy, waste, buildings, etc.)?

How should SSC projects be evaluated? What key indicators or metrics do you see as most important to monitor and measure SSC projects?

Smart-sustainable urbanism has faced a lot of criticism from researchers, i.e. that it is too focused on technological advancement, industry and economic development compared to other sustainable city models. What do you find to be critical about the SSC agenda?

Both of the terms 'smart' and 'sustainable' have been referred to as 'empty signifiers' in urban planning - concepts without of any substantive meaning that can be used by various actors and institutions for their own agendas and purposes. What do you see as the actors and driving forces behind the 'smart-sustainable' rhetoric?

What do you see as the major step-chance innovations re-shaping cities (e.g. 100% distributed renewable energy)?

Realistically, what kind of SSC developments will we see in 5 to 10 years? Do you believe these developments will have a real impact in making cities more sustainable?

Guide for city officials
How is Malmo trying to become more sustainable? What aspect of sustainability is it investing in most?

What projects does Malmo have going on right now? What are their respective goals?

What are the kinds of funds or partnerships are used to finance projects?

How is does Malmo foster citizen engagement in its projects?

Appendix III. Malmö Comprehensive Plan Strategies

Regional cooperation

- Map the capacity of the Öresund Bridge and investigate a new rail connection between the city centers of Copenhagen and Malmö.
- Planning and designating land for future businesses and eliminating barriers to cross-border entrepreneurship in the region.
- The Malmö-Lund Region should cooperate around common priorities in infrastructure investment and have joint discussions with national and regional governments.

Business and tourism

- Malmö's attractiveness as both a business location and place of residence should increase.
- Malmö's central areas and areas within walking distance from railway stations and future tramlines should be especially prioritized for business location.
- Current retail districts and thoroughfares should be strengthened, focusing on developing the unique characteristics of each one.

An equal, safe and health promoting city

- More and better public meeting places should be created in Malmö. They should be evenly distributed (relative to population density) throughout the city.
- The different experiences and needs of men, women and children should be made visible and considered in the urban planning.
- The urban planning should contribute to an equal public health by planning and designing health promoting environments in all parts of the city.

A denser city with more mixed-function

- An effective land use should always be strived for. The existing city should be supplemented and densified, especially in proximity to rail stations and along public transport routes.
- Physical and mental barriers should be bridged through building, for example by densifying along certain approach roads, transforming them into city streets.
- All parts of the city should be planned to contain the largest variety of functions possible. Functions such as residences, retail, social services, sports, culture and offices can all exist in one single area.
- Existing industrial areas with low land use and large parking lots and expansion surfaces should be densified to provide more space for other businesses.

A greener city

- Densifying greenery in the inner city could mean adding new parks or using spaces with previous other use, such as parking spaces, for nature or greenery.
- Greenery along streets should be increased with the goal of vastly increasing the number of trees along Malmö's streets and city squares.
- Malmö should have a multitude of large and small parks, nature areas and city squares strategically placed, evenly distributed and connected by a network of green links. An aim is for every residence to have access to a larger park within 1 km.

Traffic and transportation

- The city's traffic solutions should be human-centered. A well functioning traffic system should improve health, safety and social cohesion.
- The transport system should contribute to more people walking, bicycling or using public transport. These means of transport should be prioritized in both local and regional traffic.
- All citizens, regardless of age, gender or physical ability, should safely be able to move around the city by foot. Important destinations such as city squares, parks and stations should be linked together better for pedestrians.
- Bicycling in Malmö should be simple and safe for everyone. The bicycle system should be complemented with strategically identified links, become more easily navigated and safe and be prioritized higher.
- Public transport should form the structural backbone of the urban planning. Public transport, urban development and construction should support each other.
- Malmö's public transport system should become more attractive: faster, more convenient, comfortable and safe and more easily accessible to different social groups.

Sustainable waste management, energy and construction

- Planning of waste sorting facilities in conjunction with housing and businesses should be standard. Larger waste sorting stations should be evenly distributed throughout the city.
- Malmö's advantageous conditions for producing renewable energy, heat and gas through wind, biomass, geoenergy and sun should be used in the best manner.
- Building construction should be characterized by longevity, smart energy solutions and environmentally adapted materials.

Nature and rural landscapes

- Natural resources within the municipality must be used in a way that promotes long-term sustainability.
- The municipality's areal of land with' high natural values' should increase.
- The municipality should be restrictive with urban expansion on its existing rural and agricultural land.

Climate adaptation

- There must be planning and preparedness for the effects of climate change.
- Urban runoff should be handled so safety margins for extreme precipitation are met.

Sea, coast and water

- The urban planning should protect the ecosystem services of the sea and coast while still taking advantage of Malmö's coastal location.
- Malmö and its neighboring municipalities should co-operate to protect the groundwater.
- Urban runoff should be handled in a sustainable and safe way.