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Eco City Development in China and Japan“

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Abstract

The sustainable urbanisation process is considered to be crucial for the achievement of global sustainable development. Such development has been required, because of the threats of climate change, air pollution and resource depletion. The construction of eco cities is a new approach, which promotes the sustainability in the cities. Japan and China have envisioned the creation of eco cities in their sustainable urban development plans. The aim of this thesis is to outline the similarities and the differences between the eco city development programmes in these two countries. The concept of eco city is examined in the literature review and in the theoretical part of this paper. The case study method has been chosen for the analysis. The eco cities of Kitakyushu, Tianjin and Suzhou are compared according to a specific framework, which has been developed by the Ministry of Environmental Protection (MEP) and consists of 19 indicators. The results of this comparison suggest that, although there are a lot of similarities, the eco city development in Japan is superior to the Chinese one. The MEP framework has been considered as the best one in China, nevertheless certain limitations of the framework became evident when it was applied in the case of the Kitakyushu Eco-Town. It is concluded that the eco city development in China could benefit from the adaptation of some features of the Japanese eco-model. This study provides also suggestions for future research.

Zusammenfassung

Der nachhaltige Urbanisierungsprozess gilt als wichtiger Schritt für die Verwirklichung einer weltweiten nachhaltigen Entwicklung. Diese Entwicklung wird wegen der Bedrohung des Klimawandels, der Luftverschmutzung, sowie der Ressourcenverknappung benötigt. Der Bau von Ökostädten ist eine neue Herangehensweise, welche die Nachhaltigkeit in Städten vorantreibt. Japan und China haben die Realisierung von Ökostädten in ihren nachhaltigen Stadtentwicklungsplänen vorgesehen. Das Ziel der vorliegenden Masterarbeit ist, die Gemeinsamkeiten und die Unterschiede zwischen den Programmen der Stadtentwicklungen in diesen beiden Städten aufzuzeigen. Das Konzept einer Ökostadt wird im Literaturüberblick und im theoretischen Teil dieser Arbeit untersucht. Für die Analyse wurde die Fallstudie als Methode herangezogen. Die Ökostädte Kitakyushu, Tianjin und Suzhou werden miteinander nach spezifischen Rahmenbedingungen verglichen, die durch das Ministerium für Umweltschutz (MEP) entwickelt worden sind und aus 19 Indikatoren bestehen. Die Ergebnisse des Vergleichs weisen darauf hin, dass trotz vieler Gemeinsamkeiten die Entwicklung der Ökostädte in Japan der in China überlegen ist. Die MEP Rahmenbedingungen gelten als die besten in China. Nichtsdestotrotz gab es einige Einschränkungen der Rahmenbedingungen, als diese im Fall der Kitakyushu Ökostadt angewendet wurden. Es wird geschlussfolgert, dass die Entwicklung von Ökostädten in China von der Adaptierung einiger Kriterien des japanischen Ökomodells profitieren könnte. Diese Masterarbeit gibt auch einen Ausblick für weitere Forschungsarbeiten.

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Abbreviations

AIA American Institute of Architects

BOD5 Biochemical Oxygen Demand

BREEAM Building Research Establishment Environmental Assessment Method

CASBEE Comprehensive Assessment System Building for Building Environmental

CFC Chlorofluorocarbon

COD Chemical Oxygen Demand

CPA Cleaner Production Audit

ECAC Eco City Administrative Committee Efficiency

EPM Environmental Protection Ministry

ETDAs Economic and Technological Development Areas

GBES Green Building Evaluation Standard

GDP Gross Domestic Product

GHEM Green Home Evaluation Manual

HTPs High-Tech Parks

IAV Industrial Added Value

INDCs Intended Nationally Developed Contributions

IPCC Inter-governmental Panel on Climate Change

MEP Ministry of Environmental Protection

METI Ministry of International Trade and Industry

MHURD The Ministry of Housing and Urban-Rural Development

MoE Ministry of Environment

Mtce Metric Tons Carbon Equivalent

NDRC National Development and Reform Committee

NEA Singapore's National Environment Agency

NH₃-N Ammonia Nitrogen

OECD Organisation for Economic Co-operation and Development

RECP Resource Efficient and Cleaner Production

RMB Rural Net Income Per Capita

SEPA State Environmental Protection Administration of China

SO₂ Sulfur Dioxide

SSTEC Sino-Singapore Tianjin Eco-City

TBNA Tianjin Binhai New Area

TEDA Tianjin's Economic-Technological Development Area

UNEP United Nations Environment Programme

UNFCCC United Nations Framework Convention on Climate Change

WMO World Meteorological Organisation

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Chapter 1

Introduction

1.1 Overview

The creation of sustainable urban development regulations, measures and strategies is an issue, which requires careful consideration by the policymakers. There have been different approaches in regard to the achievement of sustainable urbanisation. The policies that have been taken into account in the sustainable urbanisation process are related to the creation of: “‘sustainable cities’; ‘liveable cities’; ‘green cities’; ‘digital cities’; ‘smart cities’; ‘intelligent cities’; ‘information cities’; ‘knowledge cities’; ‘resilient cities’; ‘eco cities’; ‘low carbon cities’; ‘liveable cities’” (de Jong et al., 2015, p.1). I am personally interested in the development of eco cities because the eco-city design envisions plenty of green areas and a healthy living environment.

This Master Thesis represents a research project in the area of sustainable urban development. The aim of this research is to outline the similarities and differences of the eco-city model in China and Japan. The objective is to analyse the eco-city development model, which has been applied in the countries. This analysis will be based on three case studies. A framework developed by the Ministry of Environmental Protection of the People’s Republic of China will be applied in the analysis of the eco-cities. The case studies, which have been chosen for examination, are the eco-city projects in Kitakyushu, Suzhou and Tianjin. The urban planning context will be also analysed, in order to clarify the objectives and the process of the eco-city development. A general hypothesis has been developed and it suggests that the Chinese and the Japanese eco cities differentiate and that the Japanese eco cities are more ecological. The target audience of the master thesis is the new Master students.

1.2 Why is the Sustainable Eco-City Development Relevant?

1.2.1 Global Issues

There are numerous reasons behind the need for creation of eco-city development programmes. Examples of such are the threats of climate change, loss of biodiversity, water scarcity, deforestation, desertification, air pollution and water pollution. These environmental issues could also have a negative impact on the economic development (Hammer et al., 2011, pp. 12-13).

Global warming is an issue of international magnitude and is becoming one of the main obstacles for the realisation of the sustainable development goals set by the United Nations. According to numerous scientists, Global warming is real and ongoing and leads to changes in the climate patterns and to natural catastrophes. The threats to the environment, which global warming poses, are connected to the emergence of threats to the human settlements. Since the Industrial Revolution, the mean temperature has risen by 0.5 degrees Celsius. There are various measures that could reduce the threats of global warming. Sustainable development plans envision such measures and need to be promoted simultaneously in all countries around the world. The urban population of the industrialised countries has immensely contributed to the increase of waste gases. In particular, an increase occurred by the waste gases: carbon dioxide, nitrous oxides, methane and chlorofluorocarbon (CFC). These waste gases trap the solar radiation in the atmosphere, which leads to the increase of the global temperature. It has

been estimated that the levels of carbon dioxide have increased by 25 percent over the last century (Girardet, 1996, p.112). The registered in 2015 global carbon emissions amounted to 32.1 billion tonnes. The two countries, which were producing the greatest amount of carbon emissions on the planet in the year 2015, were China and the United States of America (International Energy Agency, 2016). The six regions/countries, which have the highest rate of carbon emissions on the planet, are China, the United States of America, the European Union, India, the Russian Federation and Japan. In 2014 the carbon emissions in China amounted to 30 percent of the total number of emissions on the planet. The amount of carbon emissions produced in the United States was during the same year half of the one produced in China. The European Union produced 9.6 percent and India produced 6.6 percent of the total number. The share of carbon emissions in the Russian Federation amounted to 5 percent and the one in Japan was 3.6 percent. Altogether these six regions were responsible for about 70 percent of the carbon emissions production in 2014 (Olivier et al., 2015, p.12). Climate change has majorly affected the urban areas. It has caused a destruction of the urban infrastructure. The increase in the number of storms, droughts, floods, smog and sea levels along with other threats to the natural environment and the wellbeing of the people emerged due to the greenhouse effect (Stockholm Environment Institute, 2015, p.1). The Intergovernmental Panel on Climate Change (IPCC) has reported that in the period from 1995 to 2006 the highest temperature since 1850 was recorded. A rise in the global average sea level was also measured due to the fact that in 1960 the average rate per annum was 1.8mm and after 1993 it became 3.1 mm per annum. The sea level increase could have a huge negative impact in the years ahead and particularly for the security and sustainability of the island countries. According to the information given by the Environment Agency in 2005, the main reason behind the climate change is the increased amount of greenhouse gas emissions (Low, Liu & Wu, 2009, p. 369). An estimation, which has been made by the United Nations Environment Programme (UNEP) in 2008, suggested that the air pollution in the cities is responsible for about 1 million early deaths per annum. The expenses related to this represent 2 percent of the gross domestic product in the developed states and 5 percent of the gross domestic product in the developing states (Liang Fook & Gang, 2010, p.2).

Goal 11 of the United Nations Sustainable Development Goals “Make cities and human settlements inclusive, safe, resilient and sustainable” is since 2015 part of the plan of United Nations to achieve sustainable development. Different countries around the world are facing similar issues concerned with the urban development. Examples of such issues are accessibility, efficient and sustainable transportation, waste management, the creation of green areas, uneven income distribution among the urban residents, accommodation and public services. In the East Asian region, these issues are especially serious as the rate of urbanisation is rapidly increasing. It has been predicted that by 2018 over 50 percent of the population in East Asia will be urban (Economic and Social Commission for Asia and the Pacific, 2016). The urbanisation process has a great impact on the worldwide development and especially on the one in the developing countries in the Asia-Pacific region. It has been also suggested that by 2050 the urban population in the Asia-Pacific region will represent about 3.3 out of the 6.2 billion urban citizens in the world. Therefore, the governments need to respond adequately to the urbanisation challenges. A suggested approach is the promotion of sustainable cities. This is needed so that the world could successfully respond to climate change along with further challenges connected to the establishment of sustainable development worldwide. The urbanisation process has also an influence on the levels of air pollution, energy consumption and economic growth. It has been estimated that 80 percent of the global gross domestic product has been determined by the cities. In such way, cities play an important role in the economic development around the world. Cities also demand high-energy supplies. In 2012 67% of the energy use in the world was consumed by cities and they produced 71% of the global greenhouse gas emissions. Eco-efficient urban planning and

smart green cities are out of fundamental importance for the developing countries. By making the urban infrastructure more sustainable the countries in the Asia-Pacific region would have the chance to develop their economies and to grow in a more sustainable way. An important part of this economic growth is the investment in the construction and development of buildings, bridges, factories, homes, railways, roads and public facilities. Buildings are responsible for 40 % of the carbon emissions in the cities. If such sustainable planning is not imposed in the earlier stages of the city planning and construction it will be much harder to make the cities environmentally friendly and sustainable. United Nations Secretary-General Ban Ki-Moon has made the statement that sustainable development can only be achieved if the urban development is conducted in an ecological and sustainable manner. This point of view supports the idea that eco cities are essential for the establishment of sustainable development in a given country and possibly worldwide (Lehmann, 2015, pp. xxxi-xxxii).

It has been suggested that there are more migrants to the urban areas than available housing. Therefore, a rise in the construction process is expected to occur in the next years. There are three main reasons behind the increase in energy use in the buildings, namely: “socio-cultural changes, design of building and equipment” (Mohanty, 2012, p.2). The global resources, which have been used in the building process, represent about 35%. It has been also estimated that 12% of the fresh water has been consumed in the buildings. The buildings are also producing 40% of the waste in the world (Mohanty, 2012, p.5). The energy consumption, which occurs in the buildings, represents about 40 percent of the energy consumption in the world. If buildings are constructed in a sustainable way it has been predicted that the energy consumption during the lifecycle of a building can be reduced by 30 to 80 percent. The green building construction will decrease the amounts of carbon emissions along with the energy use and costs in the developing and the developed countries. Therefore, there are going to be both economic and social benefits (United Nations Environment Programme, 2009, p.9). When the urban development is conducted in an efficient and ecological way the role of the city in the overall sustainable development process becomes more beneficial and supportive. Cities could contribute by creating more work opportunities, increasing the standards of living and economic growth, improving the social life of its citizens and promoting environmentally friendly businesses and industries. The sustainable urban development can also improve the ecosystems in the cities and decrease the levels of poverty along with the levels of pollution (Sustainable Development Solution Network, 2013, p.2).

The United Nations has estimated that by 2050 the urban population will increase sharply and that more of the half of the population in the world will be urban. As a result of this urbanisation rate, the demand for energy and natural resources will also rise. The sustainable urbanisation in the cities has been pointed out as a possible answer to this increase. The innovation process has been promoted in many cities. This, in turn, provides greener alternatives to the energy and natural resources consumption. The urban areas are becoming more environmentally friendly. This can be seen in the emergence of more sustainable transportation, waste management and spatial development strategies. In order for cities to become more ecological, the development of a scientific urban design and management are required. One of the main priorities of the governments should be to promote the urban sustainable development so that the future generations could benefit from the appropriate agglomeration conditions. Therefore, considerable attention should be also given to the eco-city development. The eco-city initiatives, which were introduced by many governments, support the sustainable urbanisation within a social, economic, environmental and demographic context (Tsolakis & Anthopoulos, 2015, p.1).

1.2.2 Japan and China

The government policies and regulations in regard to the urbanisation process in China and Japan are important and are defining the urban development in the East Asian region. This is due to the fact that China and Japan are the two countries with the biggest territory, covered by urban areas in East Asia. There were 869 urban areas in East Asia in 2015. Out of this number 600 cities were in China and 59 in Japan. 15 Chinese cities and 3 Japanese rank among the 25 biggest cities in this area. China and Japan are also the two of the three countries with the biggest proportion of the total urban population in East Asia, namely 61.4 percent (China) and 9.9 percent (Japan) in 2010 (World Bank Group, 2015, pp. 15-20).

Japan is one of the two countries, which has been chosen for the analysis purposes of this research. The main reasons behind this choice are based on the environmental policies and regulations, the need for sustainable urban development measures and the international acknowledgment of the Japanese eco-city projects.

In the East Asian region, Japan was the first country to undergo an industrialisation of the economy. This industrialisation process occurred in the second half of the 19th century. As a result of the high level of the industrialisation process, the urban development experienced a rise from 37.5 percent in 1950 to 90.7 percent in 2010. Therefore, Japan is nowadays known for the high density of population in the urban areas. Due to numerous environmental problems in the 1950s and in the 1960s, the Japanese government introduced various policies, which had the purpose to protect the nature in the country. Pollution control technology has been promoted since that period in Japan and the country became a world leader in regard to its measures to overcome pollution and other environmental issues. In 1989 the government developed the idea of an “ecopolis” and this marked the beginning of the sustainable urbanisation policies in the country and led to the creation of the “Eco-Town” programme in 1997, which had the aim to establish a circular economy. The Kitakyushu Eco-Town has been considered as the best example of the eco-city development programme in Japan and has been also internationally recognized (Li & Qiu, 2015, pp. 58-59). The Japanese government is faced with issues such as the scarcity of landfill area and a limited number of raw materials. The eco-town programme is offering solutions to these issues as it is supporting the establishment of a stable material-cycle society (Hashi, 2005, p.2).

The People’s Republic of China is the second country, which will be analysed throughout this research. This choice is based on the urbanisation challenges, the government policy of “ecological civilization” and the worldwide interest in the emerging eco-city projects in the country.

China has contributed to the global warming through several activities and factors: industrial production, population size, consumption and “offshoring” of raw-materials exploitation (Koehn, 2016, p.4). China is facing environmental and resource problems such as desertification, deforestation, carbon emissions, water scarcity, damaged biodiversity, inefficient waste management, acid rain and soil erosion (Geng & Doberstein, 2008, p.232).

The country is the biggest developing country in the world and is characterised by an uneven urbanisation process. There are various environmental problems, which have been caused by the rapid urban growth. For example, the air in the cities is heavily polluted. The urban areas are also faced with issues such as lack of housing and other problems related to the urban infrastructure, healthy environment, education opportunities, water pollution, waste pollution and noise pollution (Li & Qiao, 2015, pp.105-107). The People’s Republic of China has been known as the most populous country in the East Asian region (Asian Development Bank, 2010). The large number of people that live in China has been considered as the reason behind many of the environmental challenges in the country and the inefficient resource management (Hutchison, 2009). Nowadays the country is experiencing rapid economic growth and this is reflected in the expansion of the urban areas. The registered number of urban residents in

China amounted to about 600 million in 2008. The number of urban areas was in the same year 655 and the urbanisation rate amounted to 45.7 percent. These numbers are expected to rise dramatically by 2030. The number of urban residents is expected to increase to more than 1 billion people. Therefore, the development of policies for sustainable urban growth is out of crucial importance. In the second half of the 1980s, the Chinese government considered the introduction of a policy, which promotes the ecological urban development. Nevertheless, such was created and implemented first in 1995 by the State Environmental Planning Agency, which was renamed and is currently called the Ministry of Environmental Protection (MEP). The created policy has the purpose to stimulate the development of eco communities and eco cities. The development of eco communities and eco cities is under the regulation of the Eco-Construction Programme. One of the most distinct eco-city projects, which is currently under development is the Sino-Singapore Tianjin Eco-City (SSTEC). The construction of the Sino-Singapore Tianjin Eco-City officially started in November 2007 and is part of a project based on the cooperation of the governments of Singapore and China (Asian Development Bank, 2010). Another project of the Chinese eco-city development programme represents the Suzhou city and its transformation into an eco-city, which has been considered as one of the most successful ones in the country (Li & Qiu, 2015, p.59).

1.3 Structure of the Thesis

The structure of this paper consists of Chapter 1 Introduction, Chapter 2 Literature review, Chapter 3 Methodology, Chapter 4 Theoretical Framework. Chapter 5 Eco-city Development, Chapter 6 Eco-city cases and Chapter 7 Conclusion. The Abbreviations, Acknowledgements and Abstract parts are presented in the beginning of the thesis and the Bibliography section is shown at the end.

The Introduction part provides an overview of the purpose and relevance of the research topic and presents briefly the aims, objectives and the research question. It also defines the target audience. The literature review is presented in Chapter 2 and will provide an outline of the main authors and research related to the eco-city development and the sustainable urbanisation process. Chapter 3 introduces the methodology, which has been applied in this research. Chapter 4 has the purpose of outlining the theoretical background. General information about the background of the sustainable development process will be provided in this chapter. Various concepts related to the establishment of green growth, industrial ecology and the circular economy will be also discussed. Chapter 4 will outline the important theories, concepts and characteristics for the sustainable urbanisation process and the eco-city development. The concept of eco city and the history of its development will be closely examined. Examples of relevant theories are the five dimensions of sustainable urbanisation and the eco-priority theory. Chapter 5 will provide a general background of the two countries and will outline the significance of the sustainable urban development. In Chapter 5 the policies for sustainable development in China and Japan, which are linked to the eco-city development programmes, in the respective countries, will be reviewed. General information about the eco-city development will be also provided in this chapter. In order that a more detailed comparison of the eco-city development model in China and Japan is delivered, the eco cities of Kitakyushu, Tianjin and Suzhou will be compared. The analysis section in Chapter 6 has the purpose to apply an indicators framework and to outline the similarities and differences between the eco-city model, which has been developed in Suzhou, Tianjin and Kitakyushu. The conclusion will summarise the results and will briefly explain their relevance. It will provide an answer to the research question and will also present the limitations of this study and suggestions for future research. In the conclusion, the relevance of the findings will be also discussed. A reference list will be provided in the bibliography part.

Chapter 2

Literature Review

In the 1970s Lefebvre outlined the importance of the urban development. He claimed that it needs a new definition, which positions the urban development in a central place. The international organisations and the countries around the world need to take into account and prioritise the urban development policies and measures. As a result of that, the urban development is expected to become the episteme of the age. The thorough knowledge of the urbanisation process is important for the accurate analysis of the world economic development and it is also needed for the understanding of various social and political issues. Lefebvre claimed that the role, which the urban development has, is epistemological and out of great importance for the comprehensive characterization of the “society” (Brenner & Schmid, 2015, p. 155). According to Barnett, there is a need for alterations in the urban design. This is required due to the changing nature of the urban spatial structure. Barnett claimed that the urban areas have and will continue to evolve during the decades (Cajot et al., 2015, p. 3367).

There are several pioneering books in the field of sustainable urbanism. One of them is “Eco-City Berkley: Building Cities for a Healthy Future”, which has been written by Richard Register in 1987 (Lehmann, 2015, p.14). Register (1987, p. 3) outlined the term eco city and the predeceasing it signs such as the development of solar technologies, recycling systems and wind turbines. He claimed that the greatest sign for the eco-city development is the public’s inclination to use environmentally friendly means of transportation and to protect the environment. Herbert Girardet also wrote a book, which has been considered as a pioneering book of sustainable urban development in 1992, which is titled “The Gaia Atlas of Cities” (Lehmann, 2015, p.14). Girardet (1996, p. 117) stated that the urban areas are the main habitat of the people and therefore social, economic and environmental sustainability need to be present in the cities. The book of Sir Howard “To-morrow: a Peaceful Path to Urban Reform” is considered as the ground stone of the “eco-city” concept. Sir Ebenezer Howard was the founder of the “Garden City Movement” in England in 1898 and his research has laid the foundations of the eco-city development (Liang Fook, 2014, pp.8-9). He outlined the importance of the creation of an urban design, which is beneficial for the urban community. Howard suggested the separation between the industrial areas and the neighbourhoods and outlined the importance of the governing role of the communities (Joss, 2014, p.36).

Lewis Mumford was a supporter of the construction of garden cities. In the book “The Culture of Cities” he outlined the need for a decentralisation of the population in the urban industrial areas (Mumford, 2014, p.19). Sharifi (2016, p.1) investigated the historical background of the eco-city development. He outlined the panning movements, which were developed since 1900. The purpose of his study was to provide a better perspective on the evolutionary stages in the urban design planning. He studied in detail the studies and research, which has been done in regard to the following 5 movements: “Garden City, Neighbourhood Unit, Modernism, Neo-traditionalism and Eco-urbanism” (Sharifi, 2016, p.1). Sharifi (2016, p.10) deducted that the Eco-urbanism movement is closely related to the concepts of sustainability and urban metabolism. Therefore, the Eco-urbanism movement covers a wider range in comparison to the other four movements.

New Urbanism has been described as a neo-traditional movement, which has the goal to recreate traditional design and form and has been applied from the period from the end of the Second World War to today. It takes practical aspects into consideration and aims to improve the environment in the cities, the standard of living and other social aspects, such as the social communities in the neighbourhoods and the aesthetic architecture. New Urbanists take into

consideration the balance between work environment and nature and support the compact urban design and the allocation of land in a way that provides accessibility, which is within a short and a walking distance (Bahrainy & Bakhtiar, 2016, p.23). Roseland (1997, p. 197) has also explored the history behind the creation of the eco cities and the different definitions, which have been given to this concept. He related the eco-city concept to the concept of urban planning. The roles of the economic development and social democracy in the creation of eco cities have been also taken into account. According to Roseland (1997, p. 201), the other dimensions of the eco-city concept are sustainable urban development, sustainable communities, community economic development, suitable technology, bioregionalism and social ecology. The green movement, which is characterised with its green cities and green communities, has been also connected to the eco-city concept (Roseland, 1997, p. 201). Simon Joss supported the view that the eco cities should contribute to the sustainable development and particularly outlined the need for the establishment of social sustainability in these cities. Joss also outlined the importance of the public engagement in the creation of eco cities (Liang Fook, 2014, p.15). Rapoport and Verney (2014) investigated the social processes involved in the emergence of eco cities. These social processes are related to the introduction of policies and the involvement of various actors. This also explains the difference in the development methods between the eco-city projects.

Premalatha researched the correlation between the realisation of eco-cities initiatives and the participation of the residents of the eco cities. He concluded that the concept of the eco-city could never be fully implemented without consumption limitations and further environmental restrictions, which require public involvement. Premalatha suggested that the public involvement is not just relevant for the eco-cities, but also for other sustainable urban development plans (Premalatha et al., 2013, p.660). Sheryl Arnstein wrote the article “A Ladder of Citizen Participation”, which examined the involvement of the inhabitants in the urban planning process. This article proved to be especially popular and defined the process of public participation (Joss, 2014, p.36). Engewicht outlined the need for a construction of the urban infrastructure, which takes into account the successful human exchange. He published the book “Towards an Eco-city” in 1992 and criticised in it the urban development, which is not compact and doesn’t support the community wellbeing (Roseland, 1997, p. 197).

An important journal article for the sustainable building is: “Sustainable construction-The role of environmental assessment tools”, in which the role of the green building design assessment frameworks for the construction of sustainable buildings is examined (Ding, 2008, p. 451). Nakamura has also investigated the role of sustainable buildings and has stated that the “humans and our extended built environment as well as semi-artificial ecosystems are part of the Earth system and that physical sustainability should be assessed by material and energy flows that drive and comprise the system” (Nakamura, 2012, p. 99).

David Satterthwaite (1997, pp.1669-1685) defined the necessity of an institutional framework for the assessment of the sustainability in the cities. He recognised the role in the creation of such framework of the local and national governments and the international agreements. Joss, Tomozeiu and Cowley (2012, p.109) investigated the sustainable indicator frameworks, due to the emergence of various urban sustainability initiatives like “sustainable city” and “eco city”. They discussed the need for such sustainability indicators for the governance processes. Bayulken and Huisingh (2015, p.152) investigated the eco-city concept and the policy frameworks for eco city development, which have been created in some European and Asian countries. They identified the successful and the ineffective aspects of the eco-city governance process. There are various attempts across the world for the creation of frameworks for sustainable cities development. Examples of such are the “Green City Index” methodology, funded by Siemens and created by the Economist Intelligence Unit (EIU), the Rockefeller Foundation project 100 Resilient Cities and the Environmental Performance indicators, developed by the Universities of Yale and Columbia (Scientific and

Technical Advisory Panel, 2014, p.14). The Organisation for Economic Co-operation and Development (OECD) has developed a programme, which aims to evaluate the sustainable urban development and further policies, related to the green growth and the sustainable development. The OECD Green Cities Programme also uses a set of indicators for the assessment of the green urban growth (Hammer et al., 2011, p. 9). The Bellagio conference report provides a list of the various indicator frameworks, which have been developed for the assessment of the eco-city development. Some examples of the indicator frameworks, which have been listed in the report are: Eco2 Cities (World Bank), Hitachi Smart Cities (Hitachi), International Ecocity Framework and Standards (Ecocity Builders), Living Building Challenge (International Living Future Institute), One Planet Communities (BioRegional), Reference Framework for Sustainable Cities (European Union) and others (Joss, 2012, p.8).

Liang Fook and Gang (2010, p.58) outlined the importance of the eco-city building for the achievement of sustainable development and examined more specifically the eco-city projects in Asia. Low (2013, p.7) provided a historical background of the eco-city development in Japan. He also analysed the eco-city strategy, which has been adopted by the city of Kitakyushu since 1997. Low, Liu and Wu (2009, p. 368) conducted a research, which had the focus on the Sino-Singapore Tianjin Eco-city Project. Additionally, they examined the institutional and legal frameworks for achieving sustainable development in China and Singapore. This research suggested that there was a need for the Chinese government to adopt some of the laws for environmental protection, which exist in Singapore. Caprotti (2014, p.15) turned attention to the community building process in the eco cities. The role of social resilience in the eco-city projects has been also discussed. He also analysed the eco-city development in the case of Tianjin Eco city. Qin Tianbao also investigated the Sino-Singapore Tianjin Eco-City and concluded that the international knowledge transfer holds great importance for the success of the eco-city development. He outlined the need for greater public engagement in the project (Liang Fook, 2014, p.16). Hu, Wu and Shih (2015, p5) discussed the driving forces for the construction of the Sino-Singapore Tianjin Eco-City. They suggested that the transition theory has certain contributions for the eco-city development in China. Hu, Wadin, Lo and Huang (2016, p.86) explored the Asian eco-city development models and the connections between the different governmental and non-governmental actors in the eco-city building process. According to Joss (2015b, p.836), the concept of governance needs to be taken into account by the sustainable urbanisation and the development of eco cities. In the book “Sustainable Cities: Governing for Urban Innovation” Simon Joss discussed the governance and innovation aspects of the construction of sustainable cities (Joss, 2015a, p. x). Harriet Bulkeley and Simon Marvin have also outlined the crucial role for the eco-city development of the concept of governance. They have investigated the different stakeholders and implementation process of the eco-city projects (Liang Fook, 2014, p.15). The policy implementation challenges in China have been analysed by de Jong et al. (2016, p.31) and it has been concluded that local businesses and the local governments have to cooperate closely in the eco-city development process. The importance of policy networking was also outlined in the findings. Ghiglione and Larbi (2015, pp.103-104) investigated the relationship between the Chinese government and the sustainable development goals and have determined that the implementation of various urban projects in China represents a complex administrative process and only the top-down approach in regard to the development of eco-city projects is applied. In the paper “How Eco are China’s Eco Cities? An International Perspective” Zou and Li (2014, p.18) compared the Chinese national framework for eco city development with the frameworks, which were developed in Japan and Germany. Li and Qiu (2015, p.57) have made a similar comparison between the eco cities Kitakyushu and Suzhou. This research had the purpose of assessing the standards of eco-city development in China. They have also investigated the MEP framework. Based on the comparative analysis suggestions for the improvement of the framework were provided.

Chapter 3

Methodology

The methods, which have been often used for research purposes, are the case study method, the comparative method, the experimental method and the statistical method (Collier, 1993, p.107). The case study method and a mixed research design have been chosen as a methodological approach in this master thesis. The mixed research design included electronic database search, and careful reading and consideration of numerous resources such as reports, journals, research publications, government policies, project reports and the official websites of various organizations.

Scientists, who examine the urban areas, use qualitative or quantitative approaches or a combination of both (LeGates, 2007, p.9). The mixed-method research design is a combination of qualitative and quantitative research approaches. The mixed research design is “well established in the case studies, but nonetheless, the differing quality standards-regarding truth, applicability, consistency, and neutrality in qualitative and quantitative research are difficult to codify” (Johansson, 2003, p.11). A further definition has been suggested and it describes the case study method as a “triangulation, the combination on different levels of techniques, methods, strategies, or theories” (Johansson, 2003, p.11). The choice of the case study research methodology is based on previous urban development studies. The type and availability of resources, which were required for this study, were also taken into account. The following clarification of the study method states that:

Case study is a qualitative method that is best suited to the study of unstructured and ill-defined phenomena, focusing on understanding critical elements and their evolution over time. Furthermore, a multiple-case design supports the use of replication logic to compare or confirm the insights that are gained from each case (Hu, Wadin, Lo & Huang, 2016, p.79).

The case study method is regarded as beneficial for the research in spheres, which are new. It is considered to be an advantageous method when the number of resources and studies, which have been conducted in the area of interest, is limited. However, the case study method is considered as not very efficient in regard to building theories (Collier, 1993, p.107). The case study method is, according to David Collier (1993, p.106), “providing a framework in which a scholar with modest time and resources can generate what may potentially be useful data on a particular case”.

The eco-city development has been considered as a new phenomena and the research, which has been done in regard to the assessment of the eco-city model in China and Japan is limited. Therefore, the case study method was found suitable for the conduction of this study. The case studies that are going to be investigated represent three eco cities from China and Japan. The collected data for this research is a secondary one. The research question is: ‘What are the differences and the similarities between the eco-city development in China and Japan?’ The aim of this research is to present an enhanced view of the eco-city development in China and Japan and to provide an answer to the research question. In order to do that a brief history of the eco-city development programs in these two countries will be presented. The urbanisation context will be also taken into account and various environmental protection policies and regulations will be considered. The objective of this study is to outline the similarities and differences between the eco-city models in China and Japan. This will be achieved by comparing different eco cities. The eco-city development in China differentiates from one eco

city to another and therefore this research will compare two Chinese eco cities. In such way a better clarification of the eco-city development programme in China will be provided. In the case of Japan the eco-city development follows a similar pattern and the eco-city model, which has been developed in different Japanese eco cities is quite similar. Therefore, only one city, which has been considered as the most advanced eco city in the country, will be analysed and used for comparison. The selected city for comparison is the Kitakyushu Eco-Town. The Chinese eco cities, which have been chosen for comparison, are Suzhou Eco City and Tianjin Eco City. The case study selection is based on the different approaches for eco-city development, which have been applied in each of the eco cities. In the case of Suzhou Eco City, a transformation of a city, which has been already inhabited and developed into an eco-city, can be observed. In the city of Suzhou an example of an eco-industrial park can be also observed. What makes this eco-industrial park important and intriguing is the fact that the eco-industrial park in Suzhou is evolving into an eco-city. This has been considered to be a result of the increased migration to the area. The model of eco city development in Tianjin eco city presents another type of eco-city development method. The Tianjin eco city has been projected out of scratch as an eco-city. Both Tianjin and Suzhou eco city have been considered as examples of the best-developed eco-cities in China. The Kitakyushu eco city is known as an outstanding model of the eco-city development project in Japan and has been internationally acknowledged. The Kitakyushu Eco-town is part of the Eco-Town Project in Japan and is known as one of the first three cities to take part in this project. The Kitakyushu Eco-Town case represents the transformation of a highly industrialized and polluted city into an environmentally friendly, clean and resource efficient city (Li & Qiu, 2015, p. 60).

A hypothesis has been developed, which states that there are more differences than similarities between the two programs and that the Japanese eco-city model proves to be more environmentally friendly and successful than the Chinese eco-city model. The hypothesis will be tested with the help of a comparison between the three case studies. The analysis will be based on an indicator framework for eco-city assessment.

The choice of the indicator framework, which will be applied in this study, has been based on the access to information in regard to the indicators. Considering, that the case studies represent two Chinese and one Japanese eco city a framework for the eco-city assessment, which has been developed in China, has been regarded as more fitting and applicable. The framework, which will be used for the comparison of the eco cities in China and Japan is the national Chinese eco-city framework and has been developed by the Ministry of Environmental Protection (MEP). The three characteristics of sustainable development “economic development”, “environmental protection” and “social progress” are part of this framework (Li & Qiu, 2015, p.58). The 19 indicators are:

rural net income per capita (RMB), percentage share of tertiary industry, energy consumption per unit GDP, corporation qualified in cleaner production audit (CPA), fresh water consumption per capita industrial added value (IAV), forest coverage, proportion of protected area, air quality, water quality, COD&SO₂ emission intensity, drinking water quality, ratio of urban sewage treatment, noise level, disposal rate of solid waste, urban green area per capita, investment ratio for environment, urbanisation level, coverage of centralized heat supply and public satisfaction rate to environment (Global Green Growth Institute, 2016).

Chapter 4

Theoretical Part

4.1 Overview

The theoretical part represents the core of this study. The purpose of this chapter is to outline the key features of the eco-city development and to provide a background of the eco-city concept and the relevant theories. The various theories and international factors, which are associated to the sustainable development, will be also discussed. Chapter 4 will present the context and the various concepts of sustainable urban development. This chapter will also outline the reasons behind the eco-city development and will examine the principles, which are specific for the eco-city development in China and Japan.

4.2 Sustainable Development

The history behind the creation of the concept of ‘sustainability’ dates back to the beginning of the 1970s. It was created due to the rising concern in regard to the environmental issues. ‘Sustainability’ has the goal to preserve the nature and to encourage the people to contribute to the sustainable development. The reason behind the creation of the concept of ‘sustainability’ is reckoned to be the damaging human attitude to the environment. The first international discussion in this area occurred in 1972 at the United Nations Stockholm Conference on the Human Development. The outcome of this conference was the creation of a declaration, which was related to the preservation of the environment and had the purpose to of promoting international cooperation in this area. The World Conservation Strategy was created in 1980 by the International Union for the Conservation of Nature and Natural Resources. It had the goal to achieve sustainability of the natural resource use. The World Commission on Environment and Development further stimulated the sustainable natural resource consumption in 1983 (Yigitcanlar & Dizdaroglu, 2015, p.162).

The concept of ‘sustainable development’ emerged first in October 1987 in a report of the World Commission on Environment and Development. This report is also referred to as the Brundtland report. There is no clearly set definition of the term ‘sustainable development’. Therefore, various definitions have emerged, but the common thing between them is that they all stress the importance of the social, economic and environmental criteria (Sharifi, 2016, p.2). The Brundtland report has been initially called: “Our Common Future”. The major issues, which have been outlined in the report, are the international importance of sustainable development and environmental protection. The sustainable development was given the following definition in the Brundtland report: “development that meets the needs of the present generation without comprising the needs of future generations” (Yigitcanlar & Dizdaroglu, 2015, p.163). The United Nations Conference on the Environment and Development in Rio de Janeiro took place in 1992. This conference was out of international importance and the negotiations, which took place at the conference led to the signing of the Rio Declaration on Environment and Development. In the Rio Declaration on Environment and Development, the principles of Agenda 21 were defined. The Agenda 21 tackled various sustainable development issues and outlined the importance of harmonized living between nature and people for achieving such (Yigitcanlar & Dizdaroglu, 2015, p. 162). Agenda 21 is

related to the successful realisation of the sustainable development goals. This agenda has the aim to outline the importance of the three elements that are defining the sustainable development, namely: “to conserve the basic needs of life, to enable all people to achieve economic prosperity, and to strive towards social justice” (Wellmer & Becker-Platen, 2001, p.185). The sustainable development goals amount to 17 (United Nations Development Programme, 2015, p.15):

- “Goal 1 End poverty in all its forms everywhere”
- “Goal 2 End hunger, achieve food security and improved nutrition and promote sustainable architecture”
- “Goal 3 Ensure health lives and promote well-being for all at all ages”
- “Goal 4 Ensure inclusive and equitable quality education and promote lifetime learning opportunities for all”
- “Goal 5 Achieve gender equality and empower woman and girls”
- “Goal 6 Ensure availability and sustainable management of water and sanitation for all”
- “Goal 7 Ensure access to affordable, reliable sustainable and modern energy for all”
- “Goal 8 Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all”
- “Goal 9 Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation”
- “Goal 10 Reduce inequality within and among countries”
- “Goal 11 Make cities and human settlements inclusive, safe, resilient and sustainable”
- “Goal 12 Ensure sustainable consumption and production patterns”
- “Goal 13 Take urgent action to combat climate change and its impacts”
- “Goal 14 Conserve and sustainably use the oceans, seas and marine resources for sustainable development”
- “Goal 15 Protect, restore and promote sustainable use of terrestrial ecosystems, sustainable manage forests, combat desertification and halt and reverse land degradation and halt biodiversity loss”
- “Goal 16 Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels”
- “Goal 17 Strengthen the means of implementation and revitalize the global partnership for sustainable development”

The UN-HABITAT II conference took place in Istanbul in 1996. At this conference, 171 nations approved the Habitat Agenda. The Habitat Agenda has the purpose to promote the environmental sustainability and the green growth (Yigitcanlar & Dizdaroglu, 2015, p.162).

The Convention on Long-Range Transboundary Air Pollution took place in 1979 and has set specific requirements for the reduction of sulphur dioxide and nitrogen oxide (Fitzmaurice, 1999, p.11). The World Meteorological Organisation (WMO) and the United Nations Environment Programme (UNEP) created the Intergovernmental Panel on Climate Change (IPCC) in 1988. The IPCC expressed in its First Assessment Report in 1990 a great concern that human action could have had a negative effect on the environment and is leading to a change in the climate. It has been suggested that the greenhouse gas emissions, which have been produced by the people, are responsible for the occurring global warming. Following the results of this report, the UN General Assembly created in 1992 the United Nations

Framework Convention on Climate Change (UNFCCC). UNFCCC is acknowledging the negative effects of climate change. IPCC produced a second report in 1995, which further promoted the international negotiations in regard to the reduction of greenhouse gas emissions. This resulted in the creation of the Kyoto Protocol in 1997 at the UN Framework Convention on Climate Change in Kyoto (Henderson-Sellers, 2001, p.80). This agreement sets specific targets for the reduction of the carbon emissions produced in the developed countries. The developed countries are also legally obliged under the Kyoto Protocol to follow their commitments. The World Summit on Sustainable Development took place in Johannesburg in 2002. Various topics in regard to environmental protection and resource preservation were discussed there, which led to the creation of the Johannesburg declaration. After the World Summit on Sustainable Development, the matter of sustainable urbanisation became more important for the promotion of sustainable development on an international level (Yigitcanlar & Dizdaroglu, 2015, p.162). The Copenhagen Climate Change Summit in 2009 has outlined the importance of the reduction of the greenhouse gas emissions and has acknowledged the importance of keeping the global mean temperature at a level, which doesn't exceed 2 grades Celsius (Nejat et al., 2015, p 848). The Paris Climate Summit in 2016 has marked a new stage in the international cooperation on climate change issues. The goal of a 2 grades Celsius of a global maximum level of increase in the temperature in the 21st century has been confirmed. A further target was set, which was connected to the implementation of a carbon budget of maximum 1 trillion tonnes of carbon dioxide emissions during this century. At this summit 150 countries officially stated their Intended Nationally Developed Contributions (INDCs) in regard to a decrease in the emissions of carbon dioxide. This led to the signing of the Paris Agreement. What makes the Paris Agreement distinctive is that unlike the Kyoto protocol, where only the developed countries were required to limit their carbon emissions, it sets specific targets for the decrease in carbon emissions for developed and developing countries (International Emissions Trading Association, 2016, p.10).

The concept of green growth has interested many governments across the world as it promotes sustainable and environmentally friendly economic growth. Various definitions of the concept of green growth exist. The concept has been defined by the Organisation for Economic Co-operation and Development (OECD) as a growth of the economy, which ensures that the natural resources and the environment are preserved and used in a sustainable way. It promotes the innovation and the investments in green development. Green growth is a similar concept to the one of sustainable development. The only difference is that it is concerned with two of the four dimensions of sustainable development, namely economic and environmental sustainability (Organisation for Economic Co-operation and Development, 2013a, pp.14-15).

The theory of ecological modernisation is closely related to the green growth concept. It states that a future development, which is simultaneously beneficial for the environment and for the economy can be achieved. The theory suggests that: "sustainable futures can be attained under conditions of a continuously growing capitalist economy by making use of negotiated, problem-specific settlements among different and divergent policy actors" (Liang Fook & Gang, 2010, p.93). When this theory is applied in the case of the urban areas it is promoting the idea that a good urban standard of living can be only provided in the future if this theory is taken into account. This is a result of the rapid growth in the number of urban residents. The ecological modernisation has been divided into two categories. The first one is referred to as the weak ecological modernisation. It has been defined as: "economic, technological, instrumental, technocratic, neo-corporatist, closed and national" (Liang Fook & Gang, 2010, p.94). The second category is the strong ecological modernisation, which has been described as: "ecological, institutional, systematic, communicative, deliberative, democratic, diverse, open and international" (Liang Fook & Gang, 2010, p.94). There are certain similarities between the theory of ecological modernisation and the eco-city concept.

One similarity is “the emphasis on open international orientated policies aimed at systematic change in the ecological performances of places” (Liang Fook & Gang, 2010, p.94).

The establishment of a low-carbon economy has been out of international concern since the recent years. It has been considered as an approach, which could resolve many climate change issues. The research in regard to a low-carbon economy hasn't been very extensive and there have been many aspects, which need further clarification, such as the definition, the focus of analysis and the methodology. The concept of a low-carbon economy was developed in 2003 by the government of the UK in its Energy White Paper. It has gained international importance after the fifteenth session of the Conference of the Parties in 2009. There are 8 features of the low-carbon economy: “low-carbon production, low-carbon energy, low-carbon technology, low-carbon transportation, low-carbon consumption and standard of living, low-carbon housing and building, low-carbon farming and low-carbon city” (Jinjun, 2014, pp.4-7).

Another concept, which is related to the low-carbon development, is the zero-emissions concept. The zero-emissions concept was created in 1994. It originated from the United Nations University and nowadays many companies and urban areas are aimed at achieving it. The goals of the concept of zero-emissions are: decreasing the amount of waste at almost 0, reducing the environmental pollution and greenhouse gases and promoting measures that are decreasing the use of energy. A further goal of the zero-emissions concept is the cooperation between various industries from different areas of operation and the cooperation between the administrations of numerous urban areas. Initially Eco-Towns in Japan were created in order to support the realization of the zero-emissions concept. The zero-emissions concept, when incorporated in the Eco-Town Projects, is setting goals for many companies in the areas of waste management and environmental protection. It is also promoting the development of various industries (Global Environment Centre, 2005, p.19).

The concept of industrial ecology has been also referred to as an eco-industrial development. This concept has been internationally recognised and has been implemented in the industrialised countries such as Japan and some countries of the European Union. It is also very important for the developing countries, for example for China, as the developing countries are experiencing many environmental and resource use issues (Geng & Doberstein, 2008, pp. 231-232). The concept of industrial ecology suggests that a closed loop material system can be only created if a recycling industry exists. It has the goal to promote the efficient use of energy, resources and budget during the life cycle of a product (Ohnishi et al., 2012, p. 217). As previously mentioned, the eco-industrial development has been associated with the concept of industrial ecology. It is considered to be important for the achievement of sustainable development because it contributes to the harmonized growth of the economy with nature and the social aspects. Examples of projects, which are promoting the eco-industrial development, are the eco-industrial parks and the eco cities (Ohnishi et al., 2016, p.95). The concept of industrial metabolism is also closely related to the concept of industrial ecology. It has been defined as: “the whole integrated collection of physical processes that convert raw materials and energy, plus labour, into finished products and wastes in a (more or less) steady-state condition” (Ayres, 1994, p.3).

The United Nations Industrial Development Organisation (UNIDO) has suggested that the sustainable industrialisation process could be achieved when sustainable measures such as the creation of eco-industrial parks are promoted. The construction of eco-industrial parks has been considered to be especially important for the developing countries. The eco-industrial parks are comprised of different companies, which are service orientated or conduct different types of manufacturing and production. These companies are required to have a Resource Efficient and Cleaner Production (RECP). The main idea behind an eco-industrial park is the reduction of environmental damage that has been caused by the industry. This type of industrial parks is trying to achieve symbiosis with the nature in the design. During the construction stage, such balance is also a requirement. The eco-industrial park has to be

sustainable and environmentally friendly during the operation and management period. The manufacturing process needs to be conducted in a clean and environmentally friendly manner. It is also typical that the produced waste from one firm in the eco-industrial park is transformed into a resource for another firm. The features, which comprise an eco-industrial park implementation, are: “RECP application at the enterprise level, collective RECP application at the park level; environmental and energy services companies; spatial planning and zoning of industries and infrastructures; and management and operations of the industrial park” (United Nations Industrial Development Organisation, 2015). Typical for an eco-industrial park is the cooperation between the firms, which conduct their operations in the eco-industrial park, in order to avoid any environmental pollution. The exchange of resource flows between them is therefore encouraged (Yu et al., 2015, p.264).

The concept of circular economy originates from the eco-industrial development concept. It supports the idea that the economic development should take into account the amount of natural resources and the self-sustaining features of the ecosystem. The concept of circular economy is closely related to the theory of ecological modernisation. It has the aim to introduce a closed loop society in the countries and to promote environmental- friendly economic development (Geng & Doberstein, 2008, p. 232). The circular economy promotes the economic development in a sustainable way. It encourages the efficient use of resources and the 3Rs model. The realisation of a circular economy in a given country is followed by a decrease in the amount of emissions and consumption. The circular economy growth pattern is known as a very efficient model of economic development. The decrease in consumption and of the emissions occurs because people begin to reduce the amount of raw materials, which they use. This decrease is an evidence for the reduction activity, which is part of the 3Rs model. Reuse and recycling are also promoted in the 3Rs model and contribute to the attainment of a circular economy. The reuse process is happening when the costumers continue to use purchased items without replacing them immediately. The process of recycling is beneficial for the reduction of emissions and is contributing to the raw materials production, which is converting waste into usable materials (Sun, Liu & Wang, 2016, p.91).

The main aim of the 3Rs concept is the creation of sustainability in regard to consumption and production patterns. Networking and cooperation on a local level are required for the efficient application of the concept. A good access to information along with the establishment of markets is also needed. The role of the regional and national authorities in the creation of the necessary policies and the design of a clear plan for the envisioned development are also important for the application of the 3Rs concept. The conduction of research activities in the development of environmentally friendly technology and the use of innovative approaches and such advanced technologies is necessary. The concept also promotes the commitment by the public and the private actors to sustainable operations and development (Global Environment Centre, 2005, p.1).

The promotion of circular economy in different countries is leading to the creation of a “food chain” and a “food web”. They are occurring in the eco-economic system in a way, which is imitating a natural ecosystem and are enabling a producer-to-consumer-to-decomposer circulation path. The history of the concept circular economy is relatively new. This pattern of economic development is considered to be newly developed and is mainly created because of the need for a prompt response to the resource, economic and environmental issues, which are emerging in most of the countries around the world. Important for the conduction of a circular economy is the balance between industrial, urban and ecological development (Sun, Liu & Wang, 2016, pp. 91-92).

Important for the development of policies and regulations in regard to the eco-city development is the concept of ecological civilisation. The 18th Congress of the Communist Party of China adopted the concept of ecological civilization in 2012, which symbolises a new path of development in China. This new economic development is taking into account the

environmental issues and the preservation of the nature. The main idea behind the concept of ecological civilisation is the balanced living of the people and the natural environment. This harmonised living has been associated with the Confucian principles. One of them is called “tianrenheyi” and has been described as the unification between heaven and people (Zhuang, 2015, p. 142). The term civilization is related to the positive coexistence of nature and humans. It stresses the way in which people are using and architecting the natural environment in order to meet their necessities. The Chinese Communist Party has defined the term ecological as the state of existence of the natural environment and the term civilization as the state of human development. The concept of ecological civilisation is one of the most important concepts for the sustainable development in China. It encourages the balanced development of ecology, economy, society, culture and politics in the country (Ishwaran, Hong & Yi, 2015, p. 349). Ernst Haeckel has initially introduced the concept of ecology in 1866. His definition was the following: “the entire science of the relations of the organism to the surrounding exterior world, to which relations we can count in the broader sense all the conditions of existence. These are partly of organic, partly of inorganic nature” (Friederichs, 1958, p.154). The origin behind the name ecology is rooted in the Greek language. Oikos has been translated from Greek into English as a house or dwelling. Logos is another Greek word and it means logic or a persuasive argument (Ishwaran, Hong & Yi, 2015, p. 349).

The ecosystem concept has been considered as an evolving concept and since it was officially named it has been studied and defined by numerous researchers. Tansley has originally developed the ecosystem concept in 1935 in his famous paper “The use and abuse of vegetational concepts and terms”. He has defined in this paper the ecosystem as a physical system, which is a combination of an organism and the surrounding environment. According to Tansley, the main factor of the ecosystem is the organism, but the inorganic elements are part of the ecosystem and are also important for its development. The existence of the idea of an ecosystem could be found ages before it was officially termed as an ecosystem. It has been mentioned in the works of Theophrastus, Forbes in 1887, Cowles in 1899, Thienemann in 1918 and Allee in 1934. The same authors attempted to create new definitions of the ecosystem concept (Willis, 1997, p. 268). According to Forrester, there are two types of ecosystems, namely open and closed ecosystems. The open ecosystem is considered as the one that has emerged autonomously and has an access to sufficient natural resources, which are needed for the sustenance of the ecosystem. The closed ecosystem, on the other hand, is artificially made and is dependent on the natural resources that were provided and taken into account in advance by the people involved in its creation. An important difference between the two ecosystems is that the open ecosystem has no self-adjusting mechanism (Young, 1974, pp. 76-78).

Urban ecology has been considered as a subdiscipline of ecology and its influence has been growing over the last decade. It has been also referred to as an urban ecosystem and numerous disciplines are related to it. Examples of such disciplines are political science, sociology, environmental science, economics, engineering, history, hydrology, architecture/planning, climatology, geography, human ecology, health sciences, landscape ecology, ecology and forestry. A clear definition of urban ecology is hard to be provided, as the concept is dependent on numerous other disciplines related not only to the biological, physical sciences but also of social sciences and therefore it is constantly evolving. Wu has provided a definition in 2014:

the study of spatiotemporal patterns, environmental impacts, and sustainability of urbanisation with emphasis on biodiversity, ecosystem processes, and ecosystem services. Socioeconomic processes and urban planning practices profoundly influence urbanisation patterns, and thus contribute to, but cannot alone constitute, the scientific core of urban ecology (McDonnell, 2015, p.2).

4.3 Sustainable Urbanisation

The urbanisation process has been considered as a socio-economic phenomenon, which holds a massive importance in the 21st century. It has been described as a shift from urban to rural society and leads to alterations in the patterns of manufacturing and consumption. It also represents the relationship between people and the natural environment. The sustainable development of the urban areas has been considered, since recent years, as a crucial step in the achievement of sustainable development. In the 1990s the concept of sustainable cities became more widely spread and was taken into account by the policymakers in numerous countries (Allen, 2009). There are 14 categories of issues in regard to the urbanisation process:

extent, speed, and intensity of world urbanisation; primate cities and their effects; rural depopulation and effects on hinterlands; poverty and labour issues, including problems of women and children; urban lifestyles and economy; physical infrastructure, such as roads, schools, health, water, power, and sewage; housing; pollution; land use and values; crime; stress and psychological problems; ethnic conflict; inequality and class issues; and social patterns and family instability (Nadarajah & Yamamoto, 2007, p.6).

Along with these issues there are further problems, related to the urbanisation process, such as: “declining infrastructure, deteriorating urban environment, growing unemployment, fraying social cohesion, and institutional weakness” (Nadarajah & Yamamoto, 2007, pp. 6-7). The sustainable urban development has been defined as:

a process of synergetic integration and co-evolution among great subsystems making up a city (economic, social, physical and environmental), which guarantees the local population a non-decreasing level of well-being in the long term, without compromising the possibilities of development of surrounding areas and contributing by this towards the harmful effects of development on the biosphere (McCormick et al., 2013, p.4).

The main reasons behind the emergence of the urbanisation process are the increase in the number of population and the migration from the rural to the urban areas. The migration from the rural areas is stimulated by the better work opportunities and standards of living, which the city provides. It has been suggested that the urbanisation process needs to be conducted in a more sustainable manner (Hawley, 2014).

The sustainable urban development represents the harmonised existence of the economy, society and nature. This existence is assumed to simultaneously provide to the residents economic opportunities and preserve the environment. The results of this harmonised existence are expected to be the reduction of the negative impacts from the urbanisation process and the establishment of a healthy environment in the urban areas (McCormick et al., 2013, p.4). Adriana Allen defined the five dimensions of sustainable urbanisation. She claimed that the political sustainability is crucial for the sustainable urban development. The other four dimensions, which she reckoned to be significant, are social sustainability, economic sustainability, ecological sustainability and physical sustainability (Allen, 2009).

With the term ecological sustainability, Adriana Allen is defining an important factor for the development of sustainable urbanisation in the countries. She claimed that ecological sustainability needs to be taken into account in the consumption and production processes, as such processes could prove to have a negative impact on the health and the well-being of the

urban residents and the sustainability of the natural resources in the urban areas and nationwide (Allen, 2009). According to Michael Porter and Claas van der Linde the damaged environment symbolises a lack of efficient resource management. In order that both the economy and the environment develop in a sustainable manner more sustainable production patterns need to be introduced. The competitive advantages can be created when the government invests in innovation. The Porter Hypothesis supports the creation of policies, which are beneficial for the preservation of nature. It finds a correlation between such policies and the level of innovation in the countries. When the government promotes public and private investment in the development of new technologies and the reduction of waste, the environment and the economy benefit simultaneously (Emas, 2015,p.1).

Economic sustainability is a concept, which is promoting economic growth and rise in the levels of production. The concept of economic sustainability takes into account the efficient use of resources, which are located nearby a given community, for the beneficial development of this community. However, the use of natural resources for such economic purposes shouldn't lead to resource depletion. The sustainable economic development should be also conducted in an environmentally friendly manner. Therefore, the whole production cycle needs to be considered. The benefits of the sustainable economic development are reflected in the long-term public prosperity and welfare (Allen, 2009).

The concept of social sustainability supports the idea of equal rights and fair and inclusive development. It also supports the rights of the residents of a given community of adequate housing. This concept grants equal access to the natural assets along with the economic and the physical capital. In such way, the minimum standards of living in a given community are provided and sustained. A further concept, which has been defined by Adriana Allen, is the concept of social sustainability. Social sustainability has the purpose of decreasing to a minimum the social marginalisation and poverty. It encourages and preserves the cultural development and its history (Allen, 2009).

The concept of physical sustainability is also part of the five dimensions of urban sustainability. This concept has been referred to as the sustainability of the built environment and the main idea behind it is related to the increase of the efficient and sustainable life cycle of the buildings, which in turn proves to be out of benefit for the economic development on a local and national level. The sustainability of the built environment is concerned also with the improvement of the living conditions, which are provided and sustained in the buildings (Allen, 2009).

A clear definition of the city/urban area, which has been internationally accepted, has not been created yet. In general, some indicators are accepted that could differentiate between urban and rural areas. These are the size of population, the population density, the types and quantity of services in the area and the job profiles (Hald, 2009, p.10). The cities could differentiate in the numbers of residents. Some cities are inhabited by about 1thousand people, whereas other are inhabited by more than 10 million people. Based on the number of people that live in the urban areas the cities can be defined as large, mega, medium and small. Other differences among the cities can be found in the infrastructure, the spatial form, the economic development, the local resources, prosperity, and the environmental conditions (Department of Economic and Social Affairs, 2013, p. 54). According to Robert Park cities are not just comprised of constructions, transportation, public and private institutions and further social benefits for the residents. He defines the city as a state of mind. In the cities traditions, nature and cultures are converging. The creative power of humanity can be exhibited in cities. Therefore, the city poses a certain livelihood and is not simply a form of a physical mechanism. The cities have not just geographical, cultural and ecological importance for the humanity but also an economic one (Park, Burgess & McKenzie, 1925, pp.1-2). A further definition of cities states that: "a city is a social, ecological, and economic system within a defined geographic territory. It is characterised by a particular human settlement pattern that

associates with its functional or administrative region, a critical mass and density of people, man-made structures and activities” (Rode & Burdett, 2011, p.456).

The idea behind the ‘settlement design’ emerged in Mesopotamia with the creation of the first cities around 5000 B.C. This urban development emerged later in Egypt and India. The concept of organic growth can be related to the formation of these early forms of cities. The organic growth of the urban areas suggests that there are no objectives and reasons behind the development of the urban areas. The concept of organic growth became less relevant to the urban development throughout the centuries and nowadays a planned development of the urban areas occurs and this planned development is supported by various theories (Bahrainy & Bakhtiar, 2016, p.1). For example, green urbanism promotes the creation of cities, which are designed as zero-emission and zero-waste cities and was created in the 1990s. The concept of green urbanism is also envisioning the development of urban areas, which are compact and energy-efficient. The transformation of the urban design, created during the industrialisation period, into a more sustainable one is its main objective. A central role has been given to the redesign of the neighbourhoods, which aims to make them more social and environmentally friendly. The green urbanism concept has been also identified as a concept, which promotes simultaneously the sustainability of the cities and of the natural environment. There are several characteristics of green urbanism in the cities. The first one relates to the idea that the natural environment in the urban areas needs to be protected. Therefore, the residents of the city and the local authorities need to be involved in the process. The public contribution could help diminish the negative impacts on the environment. This characteristic also outlines the relationship and influence, which one urban area could have on another urban area. The second characteristic is promoting the creation of green areas in the cities and urban design and urban metabolism, which resemble the one in nature. The third one promotes the idea of a circular urban metabolism. The fourth one is related to the urban goals, which envision a regional self-sufficiency. Different aspects, such as the promotion of business activities, economic growth, farming, agriculture and energy production within the urban areas are promoted. The fifth characteristic is related to the provision of a healthy way of living to the urban residents and the sixth characteristic is concerned with the creation of good living standards, close-knit communities and the establishment of neighbourhoods, which have high levels of liveability (Nassar, 2013, p. 339).

The sustainable urban transformation is a concept, which suggests that structural transformation processes are important for the achievement of sustainability. It is associated with the processes of modification of the urban design, processes and structure and includes fields such as “governance and planning, innovation and competitiveness, lifestyle and consumptions, resource management and climate mitigation and adaptation, transport and accessibility, building, and the spatial environment and public space” (McCormick et al., 2013, p.1). The concept urban metabolism was created in 1965 by Wolman and is considered to be important for the promotion of sustainability in the urban areas and in the societies. The concept has been defined as: “the sum total of the technical and socio-economic processes that occur in cities, resulting in growth, production of energy and elimination of waste” (Kennedy, Pincetl & Bunje, 2011, p.1965). The urban metabolism is related to the animal metabolism. The animals consume food, liquids and oxygen and through their metabolic system transform them into energy, carbon dioxide and wastes. The urban areas also require various resources in order to successfully operate and respond to the needs of the residents. Cities are dependent on energy, food supplies, water, materials and further resources. These resources are later transformed into various goods, services, waste products, wastewater and emissions. The urban metabolism represents in a way an animal body, as it also needs the cooperation of numerous actors in order to function. Important for the urban metabolism are the urban policies of the local and the national authorities, the well-developed infrastructure and the urban inhabitants (Science for Environment Policy, 2015, p.6).

The greenhouse gas emissions are produced due to natural processes and also human activities. The main human activities that are polluting the air are connected to the use of fossil fuels. The building sector has been also identified as a source of air pollution. According to the American Institute of Architects (AIA), about 50% of all greenhouse gas emissions were in 2007 caused by the construction of buildings and their lifecycle (Low, Liu & Wu, 2009, p.369). The concept of green building was created in the 1880s. Nevertheless, it became widely acknowledged as a mean for the achievement of sustainable development in the 1980s (Low, Liu & Wu, 2009, p.371). Green buildings have been also described as sustainable buildings and are considered as an important factor for the achieving of green urbanism. Buildings are considered to be dependent on energy over their life cycle. Therefore, the green buildings are an opportunity for saving a large amount of energy along with the decrease of greenhouse gas emissions. It has been estimated that 4/5th of energy is used in the building during its life cycle and about 1/5th is used during the process of construction of the building. An example of that could be seen in the transport and production of raw materials and the general building process along with the destruction of buildings. To summarise, there are 5 types of energy that the building could require. The first one is termed as embodied energy and is connected to the production of the needed materials for construction. The second type is called grey energy and is related to the transportation of materials to the site of construction. In the third energy phase induced energy has been required. This energy has been considered necessary, because of the high population density in cities and the need of high-rise constructions. The operation energy is the one the building consumes over its life cycle. This type of energy consumption is immense and amounts in China to the 42 percent of the overall energy use. The final type of energy associated with buildings is the demolition energy. It is used when a building is not anymore operational and needs to be destroyed. An additional aspect of this phase is the construction material of the destroyed building. It has been estimated that it could be reused or recycled at the cost of energy consumption much lower than the amount of money, which is necessary for the production of new materials. It has been concluded that sustainable buildings can contribute immensely to the global greenhouse gas reduction goal. The change of building design and construction along with the use of a zero net life-cycle cost are able to reduce the global carbon emissions by 6 billion tonnes per year. The construction of green buildings proves, therefore to be beneficial not only for the reduction of greenhouse gas emissions but also for the reduction of the expenses associated with the building sector (Mohanty, 2012, pp. 3-4).

Green buildings need to meet certain standards so that they become classified as sustainable. There are several environmental building assessment methods that have been used in different countries for the classification of green buildings. The first certification system was created in 1990 and is called the Building Research Establishment Environmental Assessment Method (BREEAM). BREEAM is the British certification method. Many other countries like Canada, Australia and Hong Kong have adopted this method for green building classification. It has become the most used certification system in the world. Examples of other certification systems in China and Japan are GHEM and CASBEE. The Green Home Evaluation Manual (GHEM) was created in 2001 in China and the Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) was introduced in 2004 in Japan (Ding, 2008, pp. 452-454).

Green cities are cities that are environmentally friendly. Characteristic for a green city is that the increase in the productivity and in the innovation is combined with the reduction of the production costs and the negative impact to the environment. The high density of the urban planning is key for the development of a green city. It is advantageous because it allows businesses to be situated close to each other and in such way stimulates the growth of the economic activities. It also encourages innovation, productivity and the creation of green economy. The proximity in the green cities allows the costs for services to be reduced and

promotes the location of green industries in the central areas of the cities. It is also expected that the green businesses will benefit from high-tech green manufacturing clusters, which will be also located in or nearby the central urban areas (Rode & Burdett, 2011, p. 454).

The concept of compact cities is spreading around the world and is nowadays especially important in Japan and Europe. In general the characteristics of a compact city are:

high residential and employment densities, mixture of land use, fine grain of land uses, increased social and economic interactions, contiguous development, contained urban development, efficient urban infrastructure, multi-modal transportation, high degree of accessibility, high degree of street connectivity, high degree of impervious surface coverage, low open-space ratio, unitary control of planning and of land development and sufficient government fiscal capacity to finance urban facilities and infrastructure (Organisation for Economic Co-operation and Development, 2010, p.131).

There are many definitions related to the low-carbon city development and this is due to the different amounts of carbon emissions, which are present in the cities all around the world. The goal to reduce the carbon emissions in the urban areas shouldn't contradict the main purposes of the city, which is namely to provide good standards of living and business opportunities to its residents. Different cities rely on different type of industries and consequently the starting levels of emissions differentiate. The idea behind the low-carbon city is that despite the initial differences of the levels of carbon emissions in the urban areas, the local authorities want to set new main trajectories in direction reduction of these levels. This needs to be done without causing any threats to the established economic growth and standards of living in the cities because the sustainability of the urban areas could otherwise be damaged. Sustainability holds a great importance along with the creation of a compact urban form and spatial development, energy-efficient industry and buildings, low-carbon transportation and low-carbon waste management. Distinguishing for the low-carbon cities is that they are efficient, liveable and competitive (The World Bank, 2012, pp. xli-xliii). The development of a low-carbon city has been often associated to the one of an eco-city. The two concepts differentiate slightly as the low-carbon city envisions only the creation of a city, which has reduced its carbon emissions production significantly, whereas the eco-city concept envisions further characteristics of the sustainable urban development. The low-carbon city aims to achieve an economic growth in an environmental manner with the main goal of preventing air pollution (Yu et al., 2015, p. 265).

4.4 Eco-city Development

The term “Eco-city” has been considered as a recent one, but the idea behind it has a long history. In 1850 the city of Paris experienced a reconstruction process. Haussmann has been known as the urban planner who has planned this reconstruction process, which, in turn, has sufficiently increased the green zones in the city. During these years the green zones in cities were mainly used for leisure purposes. After the 19th century, however, industrial processes began to have a negative impact on the environment. The urban areas were affected by the increased amount of traffic and shortages of water. The air in the cities was also considerably polluted. Throughout the years the eco-city concept has been defined in different ways but the definition, which is nowadays widely accepted as the final one, was created in California. It included the notion of the restructuring of the urban areas in a way, in which a balanced development of the urban infrastructure with the nature could be achieved (Hu et al., 2016,

p.78). The year 1979 has been considered to be the year, in which the eco-city term was created. This was the work of the fellows of the Arcology Circle. The concept garden city was introduced earlier in 1898 and has been considered to be very similar to the term eco-city. The philosopher Richard Register is known as the person, who invented the term eco city. The terms garden city and eco city share many common characteristics with the term sustainable city. The idea behind the eco-city concept is the creation of a city, which could provide a satisfactory life in an environmentally friendly manner to all people, who inhabit it. Important for the eco-city development are 10 characteristics (Premalatha et al., 2013, p.661). The eco cities:

(1) should have land-use priorities such that it creates compact, diverse, green, and safe mixed-use communities around public transportation facilities; (2) should have transportation priorities such that it will discourage driving and emphasize “access by proximity”; (3) should restore damaged urban environments; (4) should create affordable, safe, convenient, and economically mixed housing; (5) should nurture social justice and create improved opportunities for the underprivileged; (6) should support local agriculture, urban greening, and community gardening; (7) should promote recycling and resource conservation while reducing pollution and hazardous waste; (8) should support ecologically sound economic activities while discouraging hazardous and polluting ones; (9) should promote simple lifestyles and discourage excessive consumption of material goods; (10) should increase public awareness of the local environment and bioregion through educational and outreach activities; (Premalatha et al., 2013, p.661).

According to Register (1987, p.3), an ideal eco city has not yet been created. He claimed that certain cities around the world have some characteristics of an eco-city, for example in regard to some neighbourhoods and areas but are not entirely ecological. In his view, eco healthy urban settlements existed in the past. He gave examples such as the old European cities and towns and the settlements, which were built by the Indians in America. These settlements were compact and energy efficient. The materials that were used for the construction of these settlements were collected from the local areas and the constructions were designed and built in a way to fit the natural surroundings. Yanitsky has provided a definition of an eco-city in 1981. He described the eco-city as a city that has a positive relationship with the environment, which in turn allows for the merge of technological and environmental aspects. The residents of such cities should be provided with plenty of opportunities, which will allow them to be creative and productive. The eco-city development plans should ensure that the people, who are living in this type of cities, are given the necessary medical care and are provided with the opportunity to lead a healthy way of living. The environmental protection in the eco-city should be promoted. Yanitsky also claimed that one of the most important characteristics of the eco cities is their capability to be resource efficient (Su et al., 2013, p.5). Eco cities are responsible for the provision of good living conditions to their citizens. These types of cities are also benefiting from sustainable urban planning and various management methods, concerned with the reduction of waste and greenhouse gas emissions (Tsolakis & Anthopoulos, 2015, p.1). For an eco-city, the balance between nature and economy is crucial along with the achievement of their sustainability. The local governments need to manage the urban resources in an efficient manner and at the same time reduce the levels of pollution in the cities to a minimum. Waste recycling has been considered as a key element for the creation of an eco-city environment. In such way, the standard of living of the citizens and the competitiveness in the business markets is expected to increase. Eco cities are key for the realisation of a long-term sustainability. Sustainable urbanisation could also contribute to the

improvement of the standard of living of the poor citizens. The eco cities are very important, particularly for the developing countries. They provide economic security to the citizens and attract investments that are essential for the prosperity of the city (Suzuki et al., 2010, p. xviii). Eco cities are regarded as a form of environmental sustainable cities and have been also considered as the predecessors of the so-called Gaia cities. Characteristic for the eco cities is that they are synthesising several subsystems. The proper management of these subsystems is very important for the creation and the efficient sustainment of an eco-city. The environmental pollution subsystem water is concerned with the water pollution, sewage per capita, industry sewage disposed and water by non-traditional sources. The services' subsystem deals with the value of the services sector. The service industry labor population and the service industry labor productivity. The business subsystem determines the research and development expenditure ratio. A further example of a subsystem is the population subsystem. It is concerned with the number of total population, net population increase, population density and workforce. Under the environmental pollution subsystem the emissions, which have been allocated are the carbon dioxide emissions, the total population emission and the total business emissions. The solid waste subsystem is concerned with the solid waste amount, solid waste producers and recycling factors. The industry subsystem is dealing with categories such as the value of the industrial sector, the industry labor population and the industry labor productivity. The final subsystem is the energy consumption subsystem. Under this subsystem are considered the total energy consumption, the electric energy consumption per capita, the industry energy consumption and the renewable energy factor. There are five eco city management levels, which can guarantee the standard of living, employment, and services to the eco-city citizens. These levels are sustainable urban growth, urban transport, greenhouse gas emissions, waste management and energy consumption (Tsolakis & Anthopoulos, 2015, pp. 2-3).

The EU research programme has been also involved in the development of eco cities and has envisioned the eco-city as a city that has a sustainable community and provides: accessibility for everyone, public space for everyday life, green areas, bioclimatic comfort, balance with nature, minimised demand for land, reduction, re-use and recycling of waste. The EU research programme envisioned the eco-city as a city for pedestrians, cyclist and a city, which offers public transport. The development of eco cities should contribute to the close water cycles and should offer balanced mixed use. Characteristic for the eco-city are the short distances and the compact urban form. Further characteristics of an eco-city are: the new balance of concentration and decentralisation, network of urban quarters, power station of renewable energies, health, safety and well-being, sustainable lifestyle, qualified density, human scale and urbanity, strong local economy, built and managed with the inhabitants, development concentrated at suitable sites, integration into the surrounding region, minimised energy consumption, integration into global communication networks, cultural identity and social diversity (Energy, Environment and Sustainable Development, 2005, p.5).

According to Simon Joss, the eco-city projects are divided into three main types. The first type is the new development of eco cities. The second type represents an expansion of the cities and the third type of development of eco cities is adopting the eco-city characteristics through retrofitting. He also suggested that the development of eco cities should be supported by the government and implemented on a larger scale (Rapoport & Verney, 2014). The "Three Harmonies" and the "Three Abilities" are two concepts, which are important for the eco-city development. The concept of the "Three Harmonies" has been defined in three ways. The first definition is related to the achievement of social harmony. This definition represents the harmonised living of people and their positive relationship towards each other. The second definition is connected to the economic sustainability and growth. It supports the balanced relationship between the people and the businesses. The third definition refers to the positive and harmonised existence between the nature and the people. A connection to the

achievement of environmental sustainability has been also promoted according to the third definition. The “Three Abilities” is a concept, which defines the main qualities of an eco-city. The eco-city is expected, according to this concept, to be practicable, scalable and replicable. The practicable aspect relates to the technologies, which have been incorporated in the eco-city. It suggests that they shouldn’t be very expensive and have to be competitive on the market. The replicable aspect represents the idea that a given eco city plan of development could be replicated. This replication could be conducted in different eco-city projects in the country and abroad. The scalable aspect refers to the transferability to other fields of development of the models and measures, which are applied in the eco-city project (Ghiglione & Larbi, 2015, p.106). The development of eco cities has been considered by many Asian governments as an opportunity to introduce a new path of ecological development and to encourage green energy consumption in the respective countries. The idea behind the eco-city development is relatively new and the introduction of policies and measures, related to this idea represents a complex process for the different governments. The successful development of eco cities is connected to the speed of formation and the quality of planning. The existence of circular economy in the countries, where the eco-city is developed, is important for their construction. The efficient cooperation between governmental and non-governmental institutions is also crucial for the creation of eco cities (Hu et al., 2015, p.77).

In order that the sustainable cities could be established, various challenges have to be overcome. The challenges are deriving from different fields and include issues such as the lack of universal access to public services, the lack of the necessary budget and the lack of sufficient national and international governance in the urban development process. Investment in green buildings, renewable energy and sustainable social development is also necessary for the achievement of sustainable urbanisation. The use of electrical power and water resources are also key issues for the development of eco cities. The quantity of parks and green fields needs to be increased and the existing buildings have to be renovated so that certain green building standards are met. The public transportation in the eco cities has to meet certain requirements and to be fast, cheap and environmentally friendly. Another point that has a considerable importance for the creation of eco cities is the introduction or improvement of the waste and recycling system in the cities. International knowledge transfer is important for the projects, which are related to the sustainable urban development and in order that a transfer in the area of environmentally friendly technology occurs, financing needs to be granted. In order that sustainable cities are created, four conditions need to be met. These are the provision of social development, economic development, environmental management and urban governance. The challenges, which the developed and the developing countries are facing in the process of eco city building, differentiate. They are divided into social, economic and environmental sections (Department of Economic and Social Affairs, 2013, p.64).

The use of frameworks in the sustainable urban planning process is considered to be necessary. These frameworks are comprised of a number of standards and requirements. Various principles have been also taken into account by the creation of such frameworks. The use of indicators has been considered as a necessity in the frameworks for sustainable cities (Zou & Li, 2014, p. 20). The sustainable planning is a concept, which is important for the achievement of sustainable urbanisation. The UN-Habitat suggested that the provision of a clear definition of sustainable planning is almost impossible due to the changes in the planning process, which could arise over time (Cajot et al., 2015, p.3368). However, various definitions have been created with the purpose to attempt to clarify the process of sustainable urban planning. An example of such is the following definition:

Urban planning is used loosely to refer to international interventions in the urban development process, usually by local government. The term “planning” thus subsumes a variety of mechanisms that are in fact quite distinct: regulation, collective choice, organisational design, market correction, citizen participation, and public sector action (Cajot et al., 2015, p.3368).

The eco-priority theory has the purpose to direct the eco-city planning. This theory takes into account a number of factors and promotes the environment-friendly construction process. It also supports the efficient use of resources and the mutual benefits for the economy and for the natural environment. The main concepts related to the eco-priority theory are: “ecological culture”, “ecological efficiency”, “ecological economy”, “ecological behaviour”, “ecological allocation” and “ecological accounting” (Su et al., 2013, pp.6-7).

For the creation of sustainability in the urban areas, the use of indicators has been taken into account. It has been suggested that the process of creation and selection of indicators is challenging and problematic. Issues, which are related to that process might include:

1) the poor availability of standardized, open and comparable data 2) the lack of strong data collection institutions at the city scale to support monitoring for the USDG and 3) “localization”- the uptake and context specific application of the goal by diverse actors in widely different cities (Klopp & Petretta, 2017, p. 92).

The use of indicators has scientific, conceptual and political functions. The scientific function is related to the increase in the awareness of the urban areas. The conceptual function is expressed in the public interest through debates and discussions. The creation of new policies or alteration of such is also influenced by the indicators, which also represents their political function. There are no standards or internationally accepted model for the creation of indicators. This is due to the fact that the indicators are often used for different means and are influenced by political factors. Nevertheless, the urban indicators are generally required to be relevant. The need for the indicators to be acceptable and practicable has been also internationally recognised (Klopp & Petretta, 2017, p. 95). The planning indicators for the creation of eco cities have the role to measure the realisation level of the eco-projects. Due to the differences in ecosystems and other aspects of the urban areas of the eco-projects, different standards of the indicator systems have emerged. The mutual aspects between the eco-city frameworks are the three categories: economy, society and nature (Su et al., 2013, p. 10). For example, the MEP framework consists of 19 indicators, which have been divided among these three categories (The World Bank, 2012, pp.37-38).

The MEP framework has been especially designed for the assessment of the eco-city construction in China. The approach, which has been taken, is based on an index system, which has been developed on a percentile scoring system. The aim of the assessment is to investigate the gap, which has occurred between the registered score and the determined level of standards. A further feature of the system is the basic condition. This condition suggests that the evaluation index, which has been developed in regard to the quality of the eco cities and their environmentally friendly development pattern, has to be one of the best in the region. The structure of the indicators is also important and is expected to meet the economic, social and environmental targets (Zhou, He & Williams, 2012, p.11).

The MEP framework for eco-city development exists since 2003. It was developed in China and was originally comprised of 28 indicators. After an alteration in 2007 it consists of 19 indicators. This was done with the aim of improving the framework and making it more feasible (Li & Qiu, 2015, p. 58). The indicators, which were removed after 2007 are “per capita GDP”, “per capita fiscal revenues”, “per capita disposable income of urban residents”, “restoration rate of degraded land”, “tourist area environmental qualified rate”, “urban lifeline

system intactness index”, “urban gas penetration rate”, “Engel’s coefficient”, “Gini Coefficient, “higher education enrolment rate” and “environmental education penetration rate”(Li & Qiu, 2015, p. 59). The indicators, which are nowadays envisioned for the assessment of eco cities in the MEP framework, are according to Zou and Li (2014, pp.22-27):

- 1 “Annual net income of farmers”
- 2 “ Tertiary industry share in GDP”
- 3 “ Energy consumption per unit of GDP”
- 4 “ Water consumption per unit of industrial added value”/ “ Water efficiency of agricultural irrigation”
- 5 “ Compliance rate of enterprises should carry out Cleaner production”
- 6 “ Forest coverage”/ “ Percentage of the forestry and grass coverage in alpine area and grasslands”
- 7 “ Proportion of protected area in total land area”
- 8 “ Ambient Air Quality”
- 9 “Water quality”/ “ Coastal Water Quality”
- 10 “ Emissions density of key pollutants”
- 11 “ Water quality compliance rate of centralized drinking water source”
- 12 “ Centralized municipal waste water treatment”/ “ Industrial water reuse rate”
- 13 “ Environmental quality of noise”
- 14 “Waste”
- 15 “ Urban public green area per capita”
- 16 “ Environmental protection investment share in GDP”
- 17 “ Urbanization rate”
- 18 “ Centralized heating supply rate in heating region”
- 19 “Public satisfaction rate on the environment”

The MEP framework for eco-city development requires the fulfilment of all standards and requirements in regard to the indicators in order for the eco-city title to be granted. The framework envisions no further steps and period inspections. Once a city is approved to be an eco-city, it will remain like that for an unlimited period of time (Li & Qiu, 2015, p.62).

The eco-city development provides several advantages: efficient land use, preservation and restoration, efficient transportation management, resource use efficiency, water efficiency, energy efficiency, better standards of living and profits for the private sector. The urban design is out of particular importance for the eco-city construction and needs to be taken into account so that the environment and the natural resources are preserved. In order that the land is used in an efficient manner the construction of compact cities with high urban density is encouraged. When it comes to the construction process of an eco-city the renewal and preservation of the nature and the biodiversity is required. Nowadays, the urban areas are experiencing traffic jams and many workers are travelling long hours, in order to reach their workplace. The air pollution along with the high levels of noise present a further issue for the wellbeing of the urban residents. In the eco cities, such problems are diminished, as they provide efficient transportation systems. Along with that, there are several transport strategies, which are implemented in the eco cities and are beneficial for the environment. Examples of such are cycling, walking and an increase in the use of the public transport. The consumption of energy and water along with the waste production are rising as the cities grow, therefore a proper management in these areas is necessary for the efficient urban development. The efficient use of water is especially important, therefore measures such as the reducing, recycling and reusing approaches need to be applied. The efficient use of energy is also another very important matter for the eco-city construction. Energy use can be reduced by the

use of efficient infrastructure facilities. The streetlights, which are preserving energy, are an example of such infrastructure facilities. The production in the eco cities of renewable energy and the use of other environmentally friendly fuels also increases the energy efficiency. The creation of liveable cities is the main goal of the eco-city development. This is beneficial for the residents in many ways. It has been recognised that the urban residents begin to perform better in their workplace when the living standards are improved. The use of renewable energy and the decrease in cars use are eco strategies that preserve the environment. The compact urban design, which provides many green areas is creating a liveable environment and is also reducing the air and noise pollution. The residents of the eco-cities are also benefiting from the opportunities to keep their health in good condition by cycling, walking and enjoying the fresh air and beautiful nature in the public parks. The people, who have invested in the development of eco cities could also benefit from the construction of green buildings, as it will save a great amount of money in the years ahead. This estimation has been based on the lower operation costs, which occur in the green buildings. The employees, who work in the green buildings, are considered to be healthier and tend to perform better in their jobs. The green building construction advantages, that are recognisable from the start, are the reduced costs on power and water use (Sarkar, 2016, pp.1-2).

The development of eco cities needs to take into account several conditions, which are related to the urban design. There are: “ecological security”, “ecological sanitation”, “ecological industrial metabolism”, “ecological-landscape integrity” and “ecological awareness”. The condition of “ecological security” takes into account the provision of: “clean air, safe and reliable water supplies, food, healthy housing and workplaces, municipal services and protection against disasters for people” (Amakpah & Liu, 2015, p.327). The “ecological sanitation” advocates the existence of: “efficient, cost-effective eco-engineering for treating and recycling human excreta, grey water, and all wastes” (Amakpah & Liu, 2015, p.327). A further requirement is the “ecological-landscape integrity”, which promotes the creation of “built structures, open spaces (parks and plazas), connectors (streets and bridges), and natural features (waterways and ridgelines)” (Amakpah & Liu, 2015, p.327). This has been required in order that the accessibility in the urban areas is increased as far as possible and the biodiversity is preserved. The achievement of this two aspects needs to be realised in an efficient manner and should help to preserve energy and natural resources. The goal is the prevention of “automobile accidents, air pollution, hydrological deterioration, heat island effects and global warming” (Amakpah & Liu, 2015, p.327). A further condition of the eco-city development is the “ecological awareness”. It suggests that the people should get a better perspective of how they can live in a harmony with nature. It is important that the residents of the urban areas get awareness of the urban “cultural identity and responsibility for the environment” (Amakpah & Liu, 2015, p.327). A change in the pattern of consumption is also required. The public involvement in the preservation and improvement of the urban ecosystem needs to be encouraged and present in order that the eco-city project would be successfully supported (Amakpah & Liu, 2015, p.327).

The eco-city development projects are managed and created in different ways and by various actors in the countries around the world. Even when different eco-city projects are developed in one country, it could be also possible that their development is conducted in different ways. There are two actors, which are always existent in the eco-city development. A great influence in the eco-city development is given to the central government. The regional authorities also have a significant political power in the creation of eco-city projects. The cooperation between the national and regional authorities along with the private business and social initiatives is necessary for the efficient implantation of this model for the achievement of sustainable urbanisation (Hu et al., 2015, p.86). In this governance process public and private actors are taking part. The structure of the governance is “vertical” when it comes to the connection with various types of organisations and “horizontal” when it comes to the

international cooperation and knowledge transfer. The governance needs to outline the importance of the urban infrastructure networks and to use the urban socio-technical systems (Bulkeley & Marvin, 2014, pp.32-33).

International knowledge transfer is out of importance when it comes to the promotion of the innovation connected to urban sustainability. It has been especially needed in the development of eco cities. The eco-city development has benefited from the international knowledge transfer and more precisely from the research organisations, governmental and non-governmental organisations, consultancy firms related to the construction and the technology sector, and international governmental organisations (Joss, Cowley & Tomozeiu, 2013, pp. 62-63).

Chapter 5

Eco-city Development

5.1 Overview

In this chapter, the development of eco cities in China and Japan will be reviewed. The relevance of the sustainable urban development and the eco-city construction for the achievement of green growth will be outlined and the eco-city development in China and Japan will be examined in detail. A background of the two countries and the environmental challenges, which they are facing, will be also provided.

5.2 Eco-city Development in Japan

5.2.1 Japan

The total area of Japan is 377 835 square kilometres and its coastline is 29 751 kilometres (Tatara & Okamoto, 2009, p.1). Japan is ranked as the second largest in the East Asian Region in regard to the urbanised area. In 2010 the urbanised area in Japan was slightly more than 16,200 square kilometres. The rate of urbanisation in the country is not very high and it amounted, according to the data in 2010 to about 0.4 percent annually, which represented the slowest rate of urbanisation in this region. The urban population of Japan was in 2010 the third largest in East Asia and its number reached 77 million (World Bank Group, 2015, p.88). However, there is a predicted decrease in the Japanese population, due to the fall in birth rates since the 1990s. The Japanese society became an ageing society, which has been accepted as an alert for the Japanese government for the need for a fast implementation of a sustainable development strategy in the country (Yang & Heng Siam-Heng, 2012, pp.111-112).

The energy resources in Japan are very narrow and could meet annually after 2012 only 10% of the required energy supply. Japan holds the first position in the world in regard to the country imports of liquefied natural gas. It has been also classified among the 4 top countries when it comes to coal imports. The importation of crude oil and oil products has also a huge significance for the energy sector in the country and positions Japan as the third-largest oil net importer in the world. Before 2011 the nuclear energy production in Japan represented 27 percent of the total energy production, this has been nowadays compensated by the import of energy to the country. Therefore, the Japanese government has initiated and is supporting the energy and research development program, which aims to decrease the air pollution and to increase the energy production. The energy consumption from renewable sources has been considered to be significantly lower in comparison to the coal, natural gas and petroleum and other liquids energy consumption in the country and amounted to only 3 percent in 2016 (United States Energy Information Administration, 2017, pp.1-3). The Japanese government has the goal to increase the production of renewable energy and consequently its consumption percentage in Japan. This is evident in the national budget spending. In 2016 renewable energy plans of the Ministry of Environment (MoE) have increased by 62 percent in comparison to the previous year. The reason behind such increase is the commitment of Japan to decrease its carbon emissions by 26 percent in comparison to the carbon footprint in 2013 (DeWit, 2015, p.2). The implementation in 2003 of the “Act on Special Measures Concerning the Use of New Energy by Electricity Companies” has the main goal to promote the use of

biomass energy, geothermal energy and the energy produced by the use of wind turbines and solar cells. It forces the Japanese electricity suppliers to buy a specific percentage of renewable energy per annum (Dong & Schimada, 2017, p. 591).

The green building construction is very important for the sustainable development in Japan. The rating system used mainly in Japan since 2004 is the comprehensive assessment system for building environmental efficiency (CASBEE). It promotes cooperation between the industrial sector and the government. The concept of closed ecosystems has significantly influenced the development of CASBEE. The application of this rating system is used in different aspects of the sustainable construction process and is considering four phases of the construction process: “pre-design”, “new construction”, “existing building” and “renovation” (Ding, 2008, p. 453). The categories of classification in the CASBEE system are: “building environmental loadings” (“indoor environment”, “quality of services”, “outdoor environment on site”) and “building environmental quality and performance” (“energy”, “resources and materials”, “reuse and reusability” and “off-site environment”) (Fowler & Rauch, 2006, p. 12).

The establishment of environmentally sustainable development in Japan is a policy, which has been described as the three pillars of climate change. The three pillars of climate change are connected to the mitigation and adaptation of environmental measures and laws. This policy is also promoting the establishment of a sound material-cycle society and the conservation of biological diversity (Nakamura, 2012, p.98). The Johannesburg Earth Summit in 2002 has been also reckoned to hold importance for the development of environmentally friendly policies in the country. At this summit, the impact of production and consumption patterns on the environment, has been outlined and the goal of establishing their sustainability has been set. A measure, which indicates the sustainable consumption in the countries, is the gross domestic product, which has been generated per unit of material input. The Japanese resource productivity is one of the highest in the world and particularly greater than the one in China (Higuchi & Norton, 2008, pp.224-225). The creation of sustainable cities plays an important role in the promotion of sustainable development in the country. Japan has been known internationally as an outstanding example of how the governments can achieve simultaneously an economic growth and an environmental preservation. The Japanese government has invested in the development of environmental technologies and ecological industries (Holroyd, 2012, pp.16-17).

The emergence of the modern urban environmental policies is connected to the industrialisation process, which occurred after the Second World War. Some West European countries and Japan experienced a sharp growth of the economies and of the urbanisation in the 1960's -1970's. Nevertheless, several issues such as lack of urban accommodation and environmental problems emerged. Therefore, various ecological urban theories and policies have emerged (Feng et al., 2015, p.275).

The history of the urbanisation process in Japan can be divided into four major stages. The first stage began in the late 1950s and lasted till early 1970s. The period after the 1950s has been characterised with a success in regard to the economic development in Japan. This was mainly due to the industrial development. The economy grew sharply and the real gross national product rose by 1.53 times in the 1960s. This trend continued and in the 1970s it experienced an increase, which was 2.95 times larger in comparison to the statistical data from 1955. As a result of this, the urban development in Japan also increased. During 1950 the population in the urban areas amounted to 29 million. This represented 35 percent of the whole Japanese population. In 1960 the urban population rose to 40.8 million and in 1970 it reached 55.5 million, which represented more than the half of the total population in Japan. The main urbanisation process happened in the metropolitan areas of Tokyo, Nagoya and Osaka. The second stage of the urbanisation process in Japan is connected to the period from the mid-1970s to the mid-1980s. During this period the world economy experienced two oil

crises. Nevertheless, the Japanese economy managed to register an economic growth at the rate of 4 percent. The service sector became important for the economic development in the country and the heavy industry was significantly decreased as the industrial structure shifted to processing and assembling. The percentage of residents in the urban areas continued to rise during this stage as well and the registered growth rate was 2.3 percent. The use of vehicles in the country also increased as the population became richer. The level of motorization in the country rose from 358,000 vehicles in 1950 to 2.3 million in 1960. This number increased significantly by 1970 when it reached 18.2 million and it amounted to 37.9 million in 1980. This development resulted in an increased pace of creation of densely inhabited districts. The third stage comprises the period from the mid-1980s to 1990s. The Japanese asset price bubble has significantly influenced this stage. During this time period, the economic growth rate per year represented about 6 percent. The Japanese economy was considered to be highly dependent on the service sector and many corporations and businesses located their headquarters in the city of Tokyo. This was also due to trends of informatisation and internationalisation in Japan, which led to an increase in the prices of property in central Tokyo. After the end of this economic period in Japan, the high concentration of population in the metropolitan zone of Tokyo also decreased along with the prices of property. The fourth stage is characterised by an economic recession and a decrease in the total number of population. After the 1990s due to the inefficient policy decisions, the stock market in Japan collapsed and the economy in the country stagnated. The percentage of elderly people in Japan also started to rise. This rise occurred along with a decrease in the birth rate, which, in turn, created an ageing society in the country. During that period the Japanese urban development gained a central role and the government granted greater power in regard to urban planning to the administrations in the cities. The main goal of these local governments was to achieve sustainable development in the urban regions. After the 2000s the sustainable urban development continued to be promoted on a larger scale. The sustainable urban policies, which were envisioning further regulations and strategies, were passed by the national government. This was due to the fact that climate change became an issue out of international importance and Japan had made international obligations to decrease the amount of carbon emissions. During that period the protection of the environment became essential for the urban development and the local administrations were also encouraging the implementation of various policies and measures for sustainable urban development, such as the creation of compact and low-carbon cities (ALMEC, 2011, pp.5-7).

5.2.2 Eco-city Initiatives

A great role for the development of environmental measures and regulations in Japan plays the Japanese policy in regard to the establishment of environmentally sustainable development. This policy has three main goals, namely: “climate change mitigation and adaptation, sound material-cycle society and biological diversity” (Nakamura, 2012, p. 98). Japan has been considered as the country, which has developed the best low-carbon development policies in the world. The strong economy and the technological advancement in the country have been assisting this development. The government introduced in 2008 a plan for the achievement of “Low-carbon Society”. A target of carbon emissions reduction by 60-80 percent till 2050 has been set. Prime Minister Hatoyama added to this target in 2009 a new plan, which aimed to reduce the carbon emissions by 25 percent till 2020. Both emission reductions are compared to the level of carbon emissions, which was registered in the 1990s (Feng et al., 2015, p.281).

The origin of the eco-city development in Japan has a long history. It has been accepted as a tradition in Japan that the settlements are constructed in a balanced way with the environment. In 1907 the Japanese government promoted the garden city movement. This came as result of

the damaged environment by the industrialisation process after the Second World War and the emergence of a consumer society in the country (Low, 2013, pp. 7-10). In the Asian region, the Japanese Eco-town development has been considered as the most successful one. That has been also internationally acknowledged. The Eco-town project in Japan was created in 1997 and has not only the general Eco-city creation in plan but also specific goals, such as the achievement of economic growth and the decrease of produced waste in the country. The establishment of a sound-material cycle society has been strongly promoted. The use of renewable energy in the Japanese Eco-town programme has been also considered as crucial. The funding of the Eco-town initiative in Japan comes from the National Government, the Ministry of Environment (MoE), the Ministry of Economy, Trade and Industry (METI) and local administrations. Generally, the eco-town development in Japan can be described as an industry driven one (Bayulken & Huisingh, 2015, p.155). The main actors of the Eco-town development project in Japan are the national government, the local government, the industries, the banks, the universities and the residents. The functions of these actors are divided into three main areas: governance, education and technology (Global Environment Centre, 2005, p.84). The Japanese Eco-towns have been described as industrial clusters, which have adopted the recycling cycle. The purpose behind the establishment of the Eco-Town project is the promotion of the recycling industry in the country. There are various other goals behind the development of this project, namely: “to lessen the waste going to landfills (which Japan had a serious shortage of), to revive the local economy, to assist declining industries and to implement the zero-emission concept” (Newman & Matan, 2013 p.149). The Eco-Town project in Japan is structured in a specific way. The central government, represented by the Ministry of Economy, Trade and Industry along with the Ministry of Environment are heading the project. The Eco-Town project is approved by the central government. The local authority has created this project and it has given subsidies to the “Maintenance of Leading Recycling Facilities” and the “Maintenance of Research and Development Bases”. The local authority is conducting the Eco-Town project with the help of dissemination and spreading of information. Local companies are supporting the realisation of the project and are investing in it. In order that the project is successfully conducted, the participation of the eco-town residents is also needed. Up until 2005, the central government was subsidising a Hardware project and until 2006 another software project that was supporting the eco-town development (Fujita, 2006, p.2).

The reasons behind the emergence of the Eco-town program in Japan were mainly related to the inefficient waste management in the country. The Japanese government was faced with issues such as the shortage of waste landfill sites and the increase in the production of organic waste. There was also a decline in the number of local industries, which had a negative impact on the local economic development (Fujita, 2011). The Eco-Town program proved to be beneficial for the job market. The citizens of the Eco-towns have received greater opportunities for employment. The eco-town development has improved the quality of the natural environment in the eco-towns. It has strengthened the waste management approach and has encouraged the preservation of air and water (Global Environment Centre, 2005, p.2).

Several laws in regard to environmental preservation and carbon emissions reduction in Japan have been introduced. The “Energy Conservation Law” in Japan (1979) was supplemented in 1998 with the “Top Runner Approach”. The government introduced in 1980 mandatory energy efficiency standards for automobiles and appliances in Japan, nevertheless the implementation process wasn't efficient and the manufactured automobiles and appliances were not energy efficient enough. With the introduction of the Kyoto protocol, the Japanese government was obliged to reach certain greenhouse gas emissions reduction targets. During the period from 2008 to 2012, the required reduction levels were 6 percent more in comparison to the one in 1990. The “Top Runner Approach” is regarded as one of the most important methods, which the Japanese government has taken in its climate policy. It has the

idea to create products, which are expected to be the most energy-efficient ones in the world (Kimura, 2010, p.1).

The establishment of a recycling-based society has been strongly sought by the Japanese government. Therefore, the government introduced in 2002 a legal framework that will aid its development. A number of laws were introduced, in order to support the formation of a recycling-based society in the country. One example of such laws is the “Basic Law for Establishing a Recycling-Based Society”. It has the goal to improve the resource productivity and the recycling process and to decrease the landfills by about 50 per cent. The Japanese government developed further laws in this area. An example of such law is the “Waste Management Law”. It was introduced in 1970 and amended later in 2003. It has the purpose of determining the specific aims of the waste management development and sets roles and duties when it comes to waste prevention and management for waste generators. The waste generators can be commercial, industrial and construction ones. The “Waste Management Law” also determines the prefectures in regard to garbage collection, incineration and the permanent disposal of bulk wastes. A further law was passed in 1991. This is the “Law for Promotion of Effective Utilisation of Resources” and it is determining the key products and industries, which have to save resources. Product specific laws along with recycling goals for the different types of wastes are introduced. These could be reached by various product stewardship plans, levies along with the involvement of the governments, the manufacturers and the customers. In order to support the realisation of these goals, the “Law for Promotion of Sorting, Collection and Recycling of Containers and Packaging” was passed. Other laws related to this area are “Law for Recycling of Specific Kinds of Home Appliances”, “Construction Materials Recycling Act”, “Food Recycling Law” and “Domestic Automobile Recycling Law” (van Berkel et al., 2009, p.1545).

The Japanese waste management development could be divided into 3 main periods. During the first period in Japan in the 1960s, there was a rise in pollution and in the creation of waste. The innovations, which occurred during this period, were in the area of technology and were a reason for an economic growth. Nevertheless, the policies in support of the protection of the environment were almost non-existent. In the 1960s the waste management in Japan experienced several problems among which were environmental damages in the area of air and water pollution. Additionally, there was a sharp rise of the generated waste and a lack of enough landfill sites. Pollution and further threats to the society were caused due to the inappropriate treatment of waste generated from industrial activities. The second period of waste development occurred in the 70s and the 80s. Characteristic of this period were the issues caused by the not-authorised waste disposal. The government introduced a number of laws in support of the establishment of an efficient waste management system. The “Waste Management Law” was one of these laws and was mostly concerned with the waste produced by the industry. It also had a great impact on the regulation of the solid waste treatment. Despite the efforts, which were made by the government, the illegal disposal of waste continued to occur. The conclusion, which occurred, was that a shift in the social structure has to take place. Reforms in the mass production along with mass consumption and the following mass disposal of waste were assumed to be obligatory for the achievement of green growth in Japan. In the period, between 1990 and 2000, the Japanese government had the main goal to attain a stable material-cycle society. The quantity of waste directed to landfills had to also be significantly reduced. In order to achieve these goals, the 3R’s model was taken into account by the government. The 3R’s model represents the reduction, reuse and recycling processes of waste. In the third period the Japanese government altered the direction, which was only prioritising the reduction of the quantity of waste. A new focus was set on the improvement of the quality of the generated waste. Therefore, the government imposed certain requirements on dioxins and the dioxin-like compounds. Along with these requirements, there were also certain limitations regarding the polychlorinated biphenyl waste and other forms of toxins.

Besides the general policy that the Japanese government is leading in the direction the establishment of a sound material-cycle society in the country, there are further measures that are contributing to this development. Examples could be seen in the voluntary contributions by the industrial sector and non-profit organisations. The Eco-town initiative in Japan has been considered to be central for the realisation of a stable material-cycle society (United Nations Environment Programme, 2013a, pp. 22-23).

The reasons behind the development of eco cities in Japan could be summarised in 5 segments. These are “waste management”, “development of recycling industry”, “industry modernisation”, “environmental remediation” and “town planning and community development and engagement” (van Berkel et al., 2009, p.1549).

5.3 Eco-city Development in China

5.3.1 China

The Chinese population is about 1.3 billion and is “spread across 33 provincial regions, 333 prefectures, 2862 country-level regions, and 41, 636 township-level regions” (Hu, Wu & Shih, 2015, p.2). China has been ranked as the third country in the world by the amount of landmass and has been historically known as a farming country. Nevertheless, only 15 percent of its territory is suitable for agricultural purposes. The economic modernization process in China began comparatively later around the year 1842. This was due to the establishment of the Treaty Ports. The Eastern part of China is better economically developed than the Western part and about 94 percent of the Chinese population is concentrated in the Eastern part (monsoon China). Therefore, the density in the Eastern part is 260 people per square kilometre, which is 6 times greater than the number of the population density according to the international standards (Naughton, 2007, pp. 17-19).

After 1992 a market reform in China took place. This economic shift was a response to the public disapproval of the policy of Deng Xiaoping, which led to the Tiananmen Square Massacre in 1989. The economic shift promoted low-wages, export-oriented industrialisation and the creation of special economic zones. These special economic zones had the purpose of attracting foreign investments and were situated along the Pearl River Delta, the Yangzi River Delta and the Bohai Bay Economic Rim. The Bohai Bay Economic Rim is the area where the Tianjin eco city is developed and is close to the Tianjin’s Economic-Technological Development Area (TEDA) (Chang, Leitner & Sheppard, 2016, p.931). There are some trends of economic development, which need to be taken into account by the government. There is a certain relationship between the population, the gross domestic product and the energy demand. An expected growth in the population is projected to lead to an increase in the gross domestic product and in the energy consumption by 2025. A rise in the demand for energy has been also expected (Cooper, 2008, pp. 1-2).

It has been expected from the Chinese government to find solutions to several issues that are out of great concern for the sustainable development in China. One of them is the fast rise in the use of natural resources. The inefficiency of the use of natural resources is also an issue along with the recycling rate in China, which has a considerable low rate. Therefore, the government is expected to take action in this direction as well. A proposed action is the development of circular economy in the country. Nowadays the circular economy in China exists and it is known as the “3+1” pattern of development. It includes small, -medium-, and large- scale circulation. Along with that, the Chinese pattern encourages recycling (Sun, Liu & Wang, 2016, p. 93). In 2002 the Chinese government adopted the new model of economic development, which had the goal to support the establishment of circular economy. The model of circular economy, which was introduced in China, resembles the one in Germany and Japan and has the purpose of establishing a closed loop society in the country (Geng &

Doberstein, 2008, p. 232). It has been supported by the “Circular Economy Promotion Law”, which was introduced in 2009. This law had the purpose to ensure that the environmental standards are met and to support the economic development. The “Circular Economy Promotion Law” has proven to be beneficial for the Chinese society. This is due to the fact that this law, was passed also with the purpose to respond to the social necessities (Newman & Matan, 2013, p. 148).

In 2012 China held the first position in the world based on the industrial production in the country. The Chinese government established in 1998 the development of the High-Tech Parks (HTPs) and this played a substantial role in the increase of industrial output. The High-Tech Parks (HTPs) and the Economic and Technological Development Areas (ETDAs) in 1984 were crucial elements of the economic development in China. Nowadays the Eco-industrial Parks Development in China has the purpose of creating a circular economy (Shi & Yu, 2014, p.6325). As China is transforming its economy towards a market-oriented one, the Chinese urban areas are also undergoing a process of transformation. The restructuring of the already established relationship between products, resources, budget, residents, and urban planning is leading to the creation of a mixed-use economy. The urbanisation process is proving to be polluting the nature and the Chinese government is faced with the issue of how to preserve its natural resources and environment (Hald, 2009, p.1). The fast urban growth also creates further problems such as urban sprawl, poor living conditions, bad sanitation and inequality among the society. The Chinese cities are encountering more and more often traffic jams and housing below the standards (Li & Qiu, 2015, p. 57). The use of fossil fuel for the production of energy and the production of cement for the industrial sector are the two main causes behind the emission of carbon in China. Due to them, its quantity reached 8.50 Gt carbon emissions during 2012 and as a result, the country was ranked as the first one by the amount of emitted carbon emissions in the world. The total number of carbon emissions produced in China responded to $\frac{1}{4}$ of the carbon emissions on the planet (Liu, 2015, p.1).

One of the greatest issues, which have occurred in regard to the preservation approaches of the natural environment in China, is the inefficient resource management. For example, the water resources in the country are limited and the water distribution is unequal. The rise of energy consumption in China is also damaging the environment. In 2014 there were 620 coal plants in the country that were producing electrical power. It has been predicted that by 2020 the use of coal will rise by 30 %. The coal plants also create water and air pollution, as loads of them don't operate with the necessary filters to contain dangerous emissions. In 2012 the vehicle use in China considerably increased and the country sold the most cars in comparison to all other countries around the world. The use of cars pollutes the air as it produces sulphur and nitrogen dioxide emissions (Bhatnagar, 2014).

A further issue of great importance for the economic development in the country is the rise in energy demand. The urbanisation process in China has led to a rapid economic growth. The quality of living has also been considerably improved. Nevertheless, the energy demand has been rising since the 1990s. Reasons for this increase were the industrial development and the increase in population. The national energy supply couldn't meet the energy demand needs in China. This made the country dependent on imports of energy supply and in 2010 the oil demand rose to about 59 percent. The production of crude oil in China had a number in the same year of 203.01 million tons coal equivalent (Mtce). The importation of crude oil was 294.37 Mtce. It has been predicted that by 2020 the importation of oil in China will reach 60 percent (Wang, 2014, p.332). The Chinese energy consumption is one of the greatest on the planet. It has been estimated that about 40 percent of the whole energy consumption in the country occurs during the building's lifecycle. The dominant use of coal and other types of fossil fuels with energy purposes suggests that these resources will become insufficient in the near future. In order to achieve sustainable development, the Chinese government has to take this into account and to introduce measures, which encourage not only the creation of

renewable energy but are also the decrease of energy consumption. The green building construction would prove to be beneficial for the reduction of carbon emissions and energy use. Therefore, the Chinese Ministry of Housing and Urban-Rural Development envisioned in 2005 an increase in the creation of green buildings in the country. In order to achieve that goal, several policies and rating systems for the evaluation of the sustainability of these buildings have been created (Yunna & Ruhang, 2013, p. 211). Typical for the Chinese rating system is that it is managed by the government administration. The Ministry of Housing and Urban-Rural Development (MHURD) is playing a central role in this process and more specifically its Building Energy Efficiency and Technology Division. In 2006 the Green Building Evaluation Standard was introduced in the country. One year after that the Green Building Energy Label (GBEL) was also launched. The Green Building Energy Label has 6 rating categories. These are Operational Management, Land Efficiency, Energy Efficiency, Water Efficiency, Resource/Material Efficiency and Indoor Environment Quality. In order that a building is rated as a sustainable, it has to reach a required minimum percentage in all six categories (Khanna et al., 2014, pp. i-ii).

China has been known as a manufacturing country of wind power turbines and it is has achieved quite a satisfactory development in this area. It has become famous internationally for its advances in the production of wind power turbines. The country has been also expected to have by 2020 the largest production of solar cells in the world (de Rambures, 2015, p. 99). The biomass and hydropower renewable energy are nowadays the most used sources of renewable energy in China. There are also other types of renewable energy sources such as solar energy, geothermal energy and wave energy that have been produced in the country. According to estimations if the renewable energy resources in China are used efficiently they could replace about 7.2 billion tons of coal production. Nowadays, the renewable energy is replacing only 0.1 billion tons of the coal production in China (Ma & Oxley, 2012, p.54). The renewable energy sector is out of great importance for the successful development and the efficiency of the energy sector in China. The country is spending the largest amount of money in this area, compared to the expenditure of all the other countries in the world. In 2014 about \$ 89.5 billion were invested by the Chinese government in this sector. In 2014 the development of wind systems (19.8 GW) and solar systems (10.6 GW) was promoted. The country reached a leading position in that year, regarding the investment in wind and solar systems. A very important goal of the Chinese government is that by 2020 the country will use solar installations (100 GW) and wind installations (200 GW). This direction of development has been strongly supported by the government, because that the use of clean energy is becoming crucial for the sustainability of the energy sector. As China is the largest consumer of energy in the world, the need for efficient energy production along with the threat of pollution require great attention from the Communist Party of China. Various policies are in place to assist the renewable energy promotion in China. Further regulations, regarding the efficient renewable development of the energy sector, have been also imposed. In 2005 the Chinese government introduced the Renewable Energy Law. This law was revised in 2009 and supported the renewable energy development. In 2015 China aimed to use 11.4 percent renewable energy. The new target is 15 percent by 2020. The general aim of the Chinese government is to decrease the energy consumption by 16 percent and in the same way decrease the carbon production by 17 percent. Xing Jinping has made the statement that China will make a great effort in decreasing the percentage of emissions and will promote the use of non-fossil fuels until it reaches 20 percent of the primary energy usage. This plan has to be realized by 2030 (Chu, 2015, pp. 1-3).

The Chinese government has taken climate change issues into account and in its 11th Five Year Plan from 2006 to 2010 it set the goal to reduce the energy consumption by 20 percent. The outcome was a reduction of 19.1 percent. In its 12th Five Year Plan from 2011 to 2015 the Chinese government had the goal to reduce the carbon emissions in the country by 17 percent

and to reduce the energy consumption by 16 percent. Part of this plan is the 10,000 enterprises programme, which nowadays comprises about 17,000 enterprises and has the aim to reduce their energy consumption. The 10, 000 enterprises programme was expected to cover 40 percent of the Chinese set reduction goals. The Chinese Government created also various programmes, which aimed to reduce the air pollution in the urban areas (Stockholm Environment Institute, 2015, pp.2-3).

The country holds the first position in the East Asian region in regard to the urbanised area, which covered in 2010 about 23,600 square kilometres. The registered annual rate of urbanisation in China amounted in 2010 to 3.1 %. (World Bank Group, 2015, p. 11). The urbanisation process in China has developed at an incredibly fast rate and in 2011 the number of urban residents exceeded the number of residents in the rural areas. Due to this process, the soil and food securities in the country became an issue as well as the increase of environmental pollution problems. Further challenges, such as the limited number of housing and traffic jams, emerged in the cities. The public health was also negatively impacted by the urban development in China (Zou & Li, 2014, p.18). The relationship between people and the natural environment hasn't been attracting much attention until the 1970s. Reasons for this shift were the increase in the Chinese population, deforestation, water pollution, soil erosion and air pollution. It has been predicted that the Chinese population will reach a number of 1.7 billion by 2050 (Zhirong, 1996, pp.165-166). Nowadays, the Chinese population amounts to about 1.3 billion and more than 40% of the total population lives in the urban areas in comparison to the 26% registered in 1990 (Natural Resources Defense Council, 2007, p. iv). It is expected that by 2030 1 billion people in China will be living in the urban areas. Therefore, the sustainable urban development represents an important issue for the policymakers (Hu, Wu & Shih, 2015, pp.2-3). Further issues connected to the urbanisation process in the country are:

the comparative high rate of urbanization, large and growing urban-rural income gap, too many cities with too few people, unbalanced economic structure of cities, and strict administrative hierarchy. The large gap in income between urban and rural residents is the main reason for rural to urban migration in China (Tan, Xu & Zhang, 2016, p 83).

There is a connection between the urbanisation, the growth of the cities and the increase in the number of rural migrants to the urban areas. This is especially obvious in the case of China since 1978. During this year the government removed the limitations on the migration within the country (Tan, Xu & Zhang, 2016, p.82). This was caused by the 'Reform and Opening-up' policy and is considered to be the reason for the sharp growth of the urbanisation process in the country. The increase in the urbanisation amounted to more than 30 percent in 2011 in comparison to the registered numbers in 1980 (Wang, 2014, p.332). This Chinese policy has neglected the wellbeing of its citizens in regard to creating a livable environment in the cities and has empowered the local administrations in regard to their urban development. Due to this, the local governments have been able to cooperate with the private sector for the creation of land development companies. This has been beneficial for the fast implementation of big projects. The political and economic development in China has contributed to the creation of mega city projects by the local governments. Therefore, there has been and will be the development of mega-cities in the country. In the last 20 years, the urban landscape in China has been undergoing a process of transformation. The borders of the administrative areas have been altered and continue to change. The greater governance power, which has been given to the local governments along with the economic growth in the urban areas have contributed to the emergence of mega cities in the country. The power that these local governments have in the urban development of their respective Chinese states has proven to

be positive for the environmentally friendly development only in regard to the creation of eco-towns (Bayulken & Huisingh, 2015, p.156).

5.3.2 Eco-city Initiatives

The Chinese government has envisioned in its 12th Five Year Plan the promotion of ecological sustainability in the country. The strategies and measures, which have been applied have been internationally recognised and China has acknowledged its commitment to the environmentally friendly development. Among these strategies is the eco-city development. The eco-city development has been considered as a way for the country to conduct an urbanisation process, which is creating an environmentally healthy setting for the residents. It has been seen as an efficient method of reduction of the carbon emissions (Ghiglione & Larbi, 2015, p. 101).

In order that the Chinese policy, regarding sustainable urban growth, proves to be successful, the government has taken an innovative approach. It has been investing in the construction of eco/sustainable cities and is promoting the use of renewable energy. The Chinese government envisioned in the green growth policy various measures and concepts related to the urbanisation process in the country. These are the “Green City”, “Garden City”, “Low-Carbon City” and several frameworks in this area have been developed in China. Examples of these frameworks are the “Eco-County, Eco-City and Eco-Province Framework”, which have been developed by the Ministry of Environmental Protection (MEP). A further example is “the Eco-Garden City Framework”, which was created by the Ministry of Housing, Urban-Rural Development (MHURD) and “the Low Carbon City Framework”, which was created and is nowadays supervised by the National Development and Reform Committee (NDRC) (Zou & Li, 2014, p.18). The Chinese government has agreed on a ‘Sustainable Development Strategy’ in 1992. Therefore, the eco-city development in the country has been promoted by the local administrations and has a significant role in the achievement of sustainability. The first reason behind the introduction of the eco-city development in China is the ambition of the Chinese government since 2007 to create ‘Ecological Civilization’ in the country. The second reason behind the eco-city development is the need for environmentally sound development. The local governments have to conduct such development due to the expectations from the central government and the residents. This can be done, as the local governments require the implementation of ecological building standards and other environmentally friendly urban projects. A third reason for the eco-city development could have emerged due to the international funding opportunities and the benefits of less tax presented by the central government. An example of such project can be seen in the Sino-Singapore eco-city (Organisation for Economic Co-operation and Development, 2009, p.26).

The concept of “eco-civilisation” emerged in China in the mid-1990s but the government officially introduced it in 2007 at the 17th National Congress of the Chinese Communist Party. It is assumed that the introduction came as a result of the information, which was provided in the 2006 annual report on the environment in China. According to this annual report, the environmental situation in the country was deteriorating. The “eco-civilisation” represents the aim of the government to establish ecological industry, green growth and eco-consumption in the country and to ensure their energy- and resource-efficiency (Liu et al., 2014, p.26). The implementation of “ecological civilization” in China has become an important goal of the government. This idea has been considered as the reintroduction of Confucian principles. In order that an “ecological civilization” in China is established, several policies needed to be introduced. The eco-city development became the major policy of the government for achieving “ecological civilization”. Typical for the Chinese way of creating eco cities became the approach of building an entirely new city or the application of the grassroots approach.

The government of China is sometimes collaborating on the eco-cities projects with other governments and multi-national planning companies (Zhuang, 2015, p.142). The Ministry of Housing and Urban-Rural Development MOHURD created in 2009 the Low-carbon Eco-city as a mean for the achievement of “eco-civilisation”. This concept of urban development represents a mixture of the eco-city and low-carbon city concepts. The eco-city concept emerged in 2003 along with the concepts of eco-county and eco-province. They were developed by MEP with the aim to promote sustainable development of the economy, the environment and the society. The two major kinds of eco-city initiatives in China are the one organised by MEP and the one developed on a local level. However, the third kind of eco-city initiatives is emerging recently. It involves cooperation on the projects with other countries and requires international knowledge transfer. Often the projects of this third kind are considering the construction of completely new urban areas and sometimes of entirely new cities. An example of an eco-city build from the scratch is the Sino-Singapore Tianjin Eco-city. Characteristic for the third kind of projects is that they usually gain more publicity and are directed by the central, the provincial and municipal governments (Liu et al., 2014, p. 26). There have been over 40 eco-town and eco-city projects that have been implemented in the country, but these projects are greatly differentiating from the European model of an eco-city development. The process of eco-city development in China has been altering as the politicians learn from the mistakes, which have occurred by the implementation of the previous eco-town projects (Bayulken & Huisinigh, 2015, p.156).

The launching of Agenda 21 in China in 1994 promoted the eco-city development in the country. During the same year, eco-conservation strategies were developed in several cities. In 1996 model cities emerged and in 1999 began the construction of eco-industrial parks. The eco-city development has six levels of development: Eco-province, Eco-city, Eco-county, Eco-town, Eco-village and Eco-industrial Park (Yang, 2013). The National Development and Reform Council (NDRC) in China has promoted the eco-city development. Eight low-carbon city initiatives have been supported by the NDRC. The eco-city development has been governed centrally in the capital of China and also on a national level. The local governments are taking a big part in the eco-city projects as they have managed to successfully implement the policies of the central government and have additionally created innovative eco projects on a local level (Tan-Mullins et al., 2017, p.2). The Tianjin city in China is taking part in this programme along with seven other cities and there are also five provinces since 2010. The Low-Carbon Pilot Cities and Provinces programme is developed after the Ministry of Housing and Urban/Rural Development (MHURD) initiated the development of eco cities in China. In 2011 the government presented the program for Carbon Trading in Pilot Cities and Provinces. The city of Tianjin has been chosen along with six other cities. In 2015 the Chinese government committed to achieving an increase in the use of non-fossil energy by 20 percent and a decrease of the carbon emissions by 65 percent during the period 2005-2030 (Stockholm Environment Institute, 2015, pp. 2-3). In order to promote this eco-city development, the Environmental Protection Ministry (EPM) created several policies. These policies had a very positive effect on the development of the National Planning of Eco-demonstration Zones. The National Planning of Eco-demonstration Zones started in 1996 and is projected to last until 2050. It has the purpose to support the implementation process of eco measures in the urban areas. After the introduction of the new policies, the eco measures in cities increased sharply. This was part of the initial development of the National Planning of Eco-demonstration Zones and therefore the direction of development was in the greening of cities and the increase of landscape plans. The other elements of the eco-city development, such as infrastructure, waste management, social and cultural aspects, were not taken into account at that time (de Jong et al., 2013, p.210).

The eco-city development plan has been promoted by the government as a mean to support the implementation of the Chinese policy of a harmonious society. This policy was created in

2006 and has the purpose of decreasing the level of poverty in the rural areas and the damage to nature. It also aims to establish equality between the standards of living and other social aspects in the Chinese population (Caprotti, Springer & Harmer, 2015, pp.499-500). The following institutions and policies of the Chinese government have promoted the green growth and the development of eco cities in China: “1970 State Environmental Protection Law”, “1980-1990s Fundamental pollution-regulating policies”, “1998 State Environmental Protection Administration of China”, “2003 SEPA issued “The Constructing Indices of Eco-county, Eco-city and Eco-province””, “2006 The Eleventh Five Year Plan’s Energy Efficiency Goal + The Renewable Energy Medium-Long Term Plan”, “2007 China Climate Change Program”, “2008 China’s Policies and Actions for Addressing Climate Change (White Paper)” and “2012 The Twelfth Five Year Plan’s Sustainable Development Goal”(Ghiglione and Larbi, 2015, p.102).

Economic, regulatory and voluntary instruments have supported the creation of Eco-Industrial Parks in China. The economic instruments are: “2007 Water quote pricing system”, “2008 Annual funding for environmental protection (Budget: 50 million RMB/year)”, “2008 Annual funding for energy saving (Budget: 15 million RMB/year) and “2012 Annual funding for green building. Green building certificate; Applying renewable energy to buildings; Installing monitoring system for energy audit; Label of energy efficiency for buildings; Retrofitting existent buildings” (Yu et al., 2015, p.268). The regulatory instruments are: “ 1995 Measures on Environmental Protection for Construction Projects”, “1995 One-vote veto rule by environmental and energy inspection”, “1997 Prevention measures on hazardous waste”, “1997 Measures on supervision and management for wastewater plant on environmental issues”, “1999 Measures on wastewater discharge management”, “2007 Eliminate all coal-fired boilers except for the cogeneration plant”, “Enhance the environmental entry conditions for new projects”, “2009 Mandatory energy audit for energy intensive consumers”, “2010 Stop recruiting chemical projects and eliminate backward chemical companies” and “2010 Mandatory energy audit for energy intensive consumers” (Yu et al., 2015, p.268). The voluntary instruments are: “2005 Label of circular economy demonstration organizations and individuals”, “2009 EHS (Environment, Health and Safety) association”, “ 2009 Training and workshops for cleaner production audit and energy audit”, “2010 Low carbon business association” and “2012 Voluntary environmental information disclosure” (Yu et al., 2015, p.268).

In 2010 World Expo in Shanghai outlined the importance of the creation of eco cities. The slogan of this event was “Better City- Better Life” and it presented the opportunity to the municipal representative to express their concern in regard to the introduction of sustainable urban regulations and measures. Consequently, the Shanghai declaration was proposed. It was officially signed on 31st October 2010. The Shanghai declaration envisions the creation of “Cities of Harmony”, which are promoting the balance between nature, society and urban settings. It is comprised from a vast range of components, which are related to the provision of a better standard of living in the urban areas. Moreover, the Shanghai declaration envisions the innovation in the technology and science fields and the easy access to information. It also supports the establishment of habitable neighbourhoods, better urban economy and harmonised relationship between the urban and the rural areas (de Jong et al., 2015, pp. 25-26). The hub-and-spoke scenario model has been chosen for the development of eco cities, which has been based on the number of population and the vast land of China. The idea behind this model is that it is comprised by “a cluster with one or two cities playing the central “hub” role, surrounded by several neighbouring city “spokes”, closely linked to the hub by means of connected transportation, state grid networks, and economic ties” (Hu, Wu & Shih, 2015, p.3).

Chapter 6

Eco-City Cases

6.1 Overview

In this chapter, the eco-city cases will be briefly presented and compared according to the MEP framework. The purpose of this comparison would be to outline the differences and the similarities between the eco-city development in China and Japan. The Tianjin Eco-City and the Suzhou Eco-Town are the cities, which have been chosen for the research purposes. These two cities are chosen to be the examples of the Chinese eco-city development program. The Kitakyushu Eco-town is the representative city for the Japanese eco-city development. The case studies will be reviewed in separate subchapters and the Analysis subsection will deliver the comparison based on the indicator framework.

6.2 Tianjin Eco-City

The Tianjin eco-city is an urban project of the governments of China and Singapore. Tianjin eco-city is located nearby the fourth largest city in China Tianjin. In 2013 there were about a hundred eco-city projects in the country and 259 set the target to achieve low-carbon development. In the 21st century, the eco-city development became wide spread in China and abroad. Therefore, many eco-city projects have emerged in the country. The Sino-Singapore Tianjin eco-city (SSTEC) has surpassed the planning stage and is nowadays under construction. What has been done regarding the construction process, is the emergence of roads, sewage systems, solar power installations and wind turbines. There has been also some residential housing construction, conducted by international companies. The completion of the project is expected to occur between 2017 and 2022. At the beginning of the year 2013, there were already 5,500 eco-apartments ready for sale. It has been estimated that about 2000 people became residents of the Tianjin eco-city (Caprotti, Springer & Harmer, 2015, p.495).

Tianjin eco-city has been projected on an area of 30 square kilometres. It's exact location is the so-called Tianjin Binhai New Area. There is a distance of 45 km between this area and the city centre of Tianjin. In the development plan of the Tianjin eco-city, has been estimated that about 350,000 people will occupy the city after the project is completed. The Yong Ding River is situated south from the eco-city. The Chinese government took into consideration by the choice of location of the eco-city the fact that in China the farmland is limited and has to be preserved. The chosen land is not suitable for farming purposes and therefore responds also to the general idea of the transformation process that the eco-city construction can create. The construction is taking place at a salt marsh that has been reclaimed. It has been previously used by the heavy industry, which was located nearby this area. Before this, the salt marsh has provided the country with salt. Nowadays the salt marsh proves to be of little economic value for the Chinese government and therefore it has been approved as a construction site (Caprotti, Springer & Harmer, 2015, 503-504).

A further reason behind the choice of location is that Binhai New Area is part of the third largest economic area in China, namely Bohai Rim. This point is important, as it guarantees the economic stability, which is needed for the achieving of sustainability in the eco-city (United Nations Environment Programme, 2013b). The Tianjin city has a population of about 11 million people and it is located in the coastal region, the Bohai Rim, which has a great significance for the Chinese economy, as it is known as a manufacturing hub. Also, one of the biggest Chinese seaports is situated in this area. The Bohai Rim region, as mentioned earlier,

has been described, as the third economic development zone in the country. The other two zones of economic development are the Yangtze River Delta and the Pearl River Delta. It has been estimated that one-fourth of the GDP in the country has been produced in the Bohai Rim region. The economy in Tianjin is growing every year since 10 years by about 16 percent. This could attract in the future a big amount of migrants in the area. The Tianjin Binhai New Area (TBNA) is experiencing a fast growth and construction processes are taking place in this area. The location of the Tianjin Eco-City provides high levels of accessibility, as it is also situated close to the Tianjin Binhai International Airport and the city of Beijing is at a distance of 150 km from Tianjin eco-city. Several Highways and boulevards are granting fast ways of travelling in the region (Sino-Singapore Tianjin Eco-City Investment and Development Co. Ltd, 2016, p. 7).

Envisioned in the project is the construction of an Eco-Valley. This valley has been constructed with the purpose of connecting the commercial centres and the neighbourhoods. The Eco-Valley has the length of 12 km and is also 50-80 km wide. It offers to the residents of the eco-city the opportunity to socialise and exercise healthy sports such as jogging, cycling and walking. The eco-city is divided into 5 districts. 26 key performance indicators will be used so that the eco-city continues to develop in a sustainable manner. The 26 key performance indicators are part of a framework for eco-city development, which has been created in cooperation with the governments of China and Singapore and has been only applied in the eco-city development in Tianjin. The indicators are divided into seven main sections: “clean water”, “ecology”, “clean environment”, “green building”, “green transport”, “clean energy” and “city management”. The aims, regarding these sections, are that the tap water will be 100% potable and 50% non-traditional resource. The domestic water use <12square meter per capital and zero loss of natural wetland. Further indicators are: local plant index>0.7, grade IV water bodies, green space> 12square meters per capital, zero loss of natural wetland, 100% green building, >90% green trips by 2020, 100% non-hazardous treatment, ambient air quality to meet grade II>310d/yr, domestic waste generation<0.8kg/d, noise pollution 100% meet respective functional area standard, > 60% overall recycling rate, >20% renewable energy use, <150 ton-c/mil US\$ GDP, free recreational/sports facilities within walking distance of 500m, >20% public housing provision, 100% barrier free accessibility, >50nos research/engineers per 10000 labor force, employment housing equilibrium undex>50 % and 100% coverage (Sino-Singapore Tianjin Eco-City Investment and Development Co. Ltd. (SSTEC), 2017).

The three main visions behind the SSTEC project are related to the establishment of social harmony, environmental responsiveness and resource efficiency (Cheshmehzange, 2017, p.53). Additionally, the construction of the Tianjin eco-city is influenced by two principles. The first one is called “Three Harmonies” and shows the importance of the balance between nature and people, the economy and people and between the people and people. The “Three Harmonies” are close in meaning to the concept of the “Three Pillars of Sustainability”. The second one is called the “Three Abilities”. This principle promotes practical ideas. It also encourages replication of the measures, construction or measures that are taken in the eco-city. Scalable actions are also promoted by the principle of the “Three Abilities” (United Nations Environment Programme, 2013b). The eco-city of Tianjin will be divided into two zones. These zones will represent the industrial and business services. The Eco-Industrial Park represents one of these zones. It is 130 hectares and will be attracting companies that are promoting renewable energy use, green construction, environmental management along with waste and transportation management. The other zone was created in June 2009. It is consisting of the Eco-Business Park. The Eco-Business Park covers an area of 26.6 hectares. It is mainly related to the business services (Caprotti, Springer & Harmer, 2015, p.503).

What makes the Tianjin Eco-City project distinctive is the cooperation on the project between two governments. Both the government of Singapore and the government of China

are aiming at achieving sustainable urbanisation, which is key to the achievement of sustainable development. The governments also want to show with this project their policies, which support sustainable building and criteria of planning. Along with the commitment of the governments, representatives of the private sector also support the construction of the Tianjin Eco-City. The Tianjin Eco-city has been designed to become an outstanding green city (Weiss, 2014, p.1). It has been acknowledged as a flagship project of the eco-city development in China. The eco-city of Tianjin is built from scratch and the urban design of the city is environmentally friendly and supports the creation of a socially sustainable environment (Caprotti, Springer & Harmer, 2015, p. 495). What makes the Tianjin eco-city also different from the other on-going eco-city projects in China is the structure of ownership in the project. It is owned partially by “The Sino-Singapore Tianjin Eco-City Investment and Development Co. Ltd”. The Chinese Consortium led by Tianjin TEDA Investment Holding Co. Ltd owns this company. This ownership is representative for the Chinese share in the project. The Singapore Consortium led by the Keppel Group also has an ownership share of the Company and is representing the participation of Singapore in the eco-city plan (Caprotti, Springer & Harmer, 2015, p. 501). The main entities that are taking part in the construction of the Tianjin eco-city are the Singapore’s Ministry of National Development, the People’s Republic of China’s Ministry of Housing and Urban-Rural Development, the Sino-Singapore Tianjin Eco-City Administrative Committee, the Sino-Singapore Tianjin Eco-City Investment and Development Co., Ltd. (SSTEC), the Singapore Consortium led by Keppel Group and the Tianjin Eco-City Investment and Development Co. Ltd (United Nations Environment Programme, 2013b).

The green building construction in the Tianjin eco-city is planned to reach 100%. Therefore, China and Singapore cooperated on the development of the Green Building Evaluation Standard (GBES). This rating system has the purpose of certifying that the buildings in the Tianjin eco-city are meeting the standards of green buildings. Typical for the Green Building Evaluation Standard is that it combines the best strategies of the Singapore’s Green Mark and China’s Green Star system. The main goals of GEBS buildings are to minimise the energy, to save materials and water and to contribute to the efficiency of the management process and further operations. Along with this comes the idea that the green buildings should be able to ensure the existence of an eco-friendly environment, inside and outside of the building. The waste management is also influenced by the approaches, which have been applied in these two countries. The Singapore’s National Environment Agency (NEA) and the Eco City Administrative Committee (ECAC) are cooperating on ensuring the water quality by developing a monitoring system (United Nations Environment Programme, 2013b). The main objectives of the SSTEC Project are to:

- build a vibrant local economy with good environmental conditions; foster the formation of socially harmonious and inclusive communities; adopt the formation of socially harmonious and inclusive communities; serve as reference for other cities in the PRC in the management, technological and policy aspects of the development and protection of their ecological environment (Low, Liu & Wu, 2009, p. 374).

The Chinese government is supporting the development of the Tianjin eco-city project with the idea to use it as a test project. The development of new environmentally friendly technologies will be first introduced in this eco-city and in such way tested. It has been projected that the eco-city will be in parts supplied with energy, which has been produced in a clean and renewable manner. The China Academy of Urban Planning and Design is taking part in the planning of the master plan of the Sino-Singapore Tianjin Eco-City. It is working together with the Tianjin Urban Planning and Design Institute. These Chinese institutions

were also cooperating on the project with a team from Singapore headed by the Urban Development Authority. In the plan, the significance of the wind and solar energy along with other types of renewable energy is outlined. A further point connected to the energy sector in the plan is the utilisation of heat, which has been produced by the industry. The heating of districts will be enabled by the utilisation of heat from a power plant. This power plant is situated close to the Sino-Singapore Tianjin Eco-City (Caprotti, Springer & Harmer, 2015, p.503).

There are several key points that concern the project. Among them, as already mentioned, are the spatial and the urban design. The good urban planning could prove to be very beneficial for the citizens. It could create proximity in the neighbourhoods and present the comfort to people who live there to reach other places within a walking distance. This could also increase the general use of the public transportation and bicycles. Out of great importance for the construction of Tianjin eco-city, is the provision of effective waste management and recycling, green transportation and renewable energy. For the achievement of an effective waste management and recycling, the cooperation of the eco-city citizens is needed. The citizens would be asked to follow a certain pattern when they are getting disposed from their waste. The waste should be sorted in categories so that it could be later recycled in an efficient manner. The waste that is not meant for recycling will undergo incineration process and as a result will assist the generation of electricity for the eco-city. As part of the green transportation, an Eco-Valley will provide citizens with the chance to walk and use bicycles. The Eco-Valley has been envisioned, as mentioned previously, to connect the neighbourhoods with the city centre. Envisioned in the eco-city plan are also community walkways along with large streets, which will have in each direction cycling paths. The renewable energy is out of great importance for the achievement of sustainability in the eco-city, because it leads to the reduction of the consumption of fossil fuel. The renewable energy consumption should reach 20 percent. This percentage has been set as a long-term goal (United Nations Environment Programme, 2013b).

6.3 Suzhou Eco-City

Suzhou is a prefectural city and is located in the South-eastern part of China. It is part of the Jiangsu Province. The Suzhou area consists of the main city and several counties. According to statistical data from 2014, the main city comprises a territory of 2742 square kilometres and has a population of about 5.45 million people. The Suzhou counties comprise a territory of 5745 square kilometres and the number of people living in them is about 5.09 million. Suzhou has been regarded to be among the wealthiest cities in the country. In 2014 the GDP per capita amounted to \$ 20,000. The city of Suzhou took part in the Eco-garden City program of the Ministry of Housing, Urban-Rural Development (MHURD) and was one of the first cities to receive the award national eco-city during 2013. This program was a result of the implantation efforts of the government of the National Agenda 21 since 1994 in China. The city of Suzhou has a rich history and is more than 2500 years old. It has been internationally acknowledged for its efforts to sustain its economic growth and at the same time to preserve its nature, history and traditions (Li & Qiu, 2015, p.59). The city has a central location in the Yangtze River Delta, which is an industrial area. It is also known as a manufacturing hub and has been also attracting many energy-intensive industries. The local economy relies on import and export activities and the city is considered to be one of the best economically developed in China. Therefore, the city of Suzhou is attracting a large number of migrants. In 2005 the urbanisation rate in the city was about 65 percent, which increased by 5 percent in 2010. This considering the national rate of urbanisation during 2010 of 50 % is a

considerably higher rate. This resulted in a rise in the emissions and a higher need for energy (Wang et al., 2014, p.483-487). Since the beginning of the 21st Century, the creation of Eco-Industrial Parks (EIP) in China has been promoting the emergence of a circular economy in the country (Shi & Yu, 2014, pp. 6325-6326).

The governments of China and Singapore worked together on the development of the Suzhou Industrial Park during the period between 1992 and 2002. It is situated close to Shanghai city in China (Caprotti, Springer & Harmer, 2015, p. 501). The Suzhou Industrial Park was officially established in 1994. Nowadays, the Industrial Park is undergoing a process of transformation in direction eco city. The Industrial Park covers 288 square kilometres and is situated in the city of Suzhou. The population of the Suzhou Industrial Park (SIP) amounted to 700,000 in 2012. The territory of the Suzhou Industrial Park has been divided as it follows: 25 percent industrial area and 30 percent residential and business area. The other 45 percent are grassland and water areas. The Suzhou Industrial Park is benefiting from a strategic location as it is reached within 20 min by train from Shanghai and within 60 min from Nanjing. Based on the collaboration between China and Singapore Suzhou Industrial Park has benefited from the Singaporean experience in regard to the urban planning and the development of a market economy. The Singaporean model of management was also adopted. Further transfer of knowledge occurred in regard to the provision of social services (Yu et al., 2015, p. 266). The Suzhou eco-city has been compared to Venice in terms of European urban approaches. It holds the name “The Venice of the East”. This is due to the environmental setting in Suzhou. Several channels surround the city of Suzhou. It mixes in its urban development local and European traditions. An example could be seen in the Chinese tradition that the streets should be facing towards the south and West-East. In addition to this traditional approach comes the bio-climatic design, which is currently being integrated in Suzhou eco-city (John Tompson & Partners, 2011, p. iv).

The Environmental Protection has been taken into account in the construction process of the Suzhou Industrial Park. The first environmental law, which influenced the project was passed in 1995, namely the “Measures in Environmental Protection for Construction Projects”. This was followed by the introduction of further regulations in the 1990s. These were concerned with the hazardous waste disposal and wastewater treatment (Yu et al., 2015, p. 267). The Eco-industrial Park in Suzhou evolved into an Eco-Town because of the job opportunities, which it offered. Many workers migrated to Suzhou Eco-Industrial Park with their families, which in turn required the provision of new houses and promoted an eco-construction process in this area. Further governmental and social institutions needed to be created such as hospitals, schools and shopping centres. An additional factor behind the creation of the eco-town and the undergoing urban development is the expansion of the tertiary industry. When the tertiary and the secondary industries became substantially important for the industrial development in the Industrial Parks this is considered as a sign for undergoing an evolution of the Industrial Park into an Eco-Town. A further sign of the transformation process is the emerging need of creating not only industrial but also sustainable urban plans in the Industrial Park. It has been accepted that the eco-city development in China follows a plan, which has the main idea to create eco-cities by completely constructing them from the scratch. In the case of Eco-Industrial Parks, however, the eco-city development is not planned but the eco-transformation process is promoted and it eventually leads to the creation of an Eco-Town (Yu et al., 2015, p 272).

Suzhou eco-city has been considered as one of the best examples of the eco-city development in China. The local government began the transformation process of the city of Suzhou into an eco-city in 2004. The city succeeded in becoming such in 2013. This has been considered as a great achievement of the local authorities as the title “eco-city” is not easily granted. The eco-city development represents a long process of transformation, which also requires a lot of effort (Li & Qiu, 2015, p. 58).

6.4 Kitakyushu Eco-Town

The city of Kitakyushu has taken a path of a balanced development of the economy and the industry. It is a Japanese city, which had an important role in the modernization of the country. In the beginning of the 20th century after the end of the Second World War, the city experienced strong industrialisation and as a result became heavily polluted. After the period of industrialisation, the Japanese government and the local authorities introduced policies in order to preserve the environment (Holroyd, 2012, p.9). The Kitakyushu Eco-town is situated at a site, where iron and steel production used to take place. The Kitakyushu industrial zone is positioned as the fourth biggest in the country. The eco-town development of Kitakyushu has the goal to make the city an international hub for companies that are concerned with the protection of nature. The international hub will assist the education initiative. It will also promote the research and technology development along with the business development (van Berkel et al., 2009, p.1547). The reason behind the eco-town development of Kitakyushu can be found in the need for more landfills and the fact that the creation of new landfill areas was problematic due to the public disapproval. Therefore, the local government reinforced the waste recycling legislation in the city. A further reason behind the implementation of eco-town initiatives in Kitakyushu was the decline in the economic growth in Japan, which had affected the local business and the industrial development in Kitakyushu. In order to support the local economic growth, the government encouraged the industries in the city. However, the manufacturers of steel, cement, and chemical products along with other industries were obliged to integrate environmental considerations into their production. Therefore, various recycling businesses emerged (Fujita, 2011). The city became also part of the Eco-Town Project in Japan in July 1997 (Holroyd, 2012, p.10).

The city of Kitakyushu has a land area of around 485sq.km. It is situated in the north part of Kyushu area. Kitakyushu is famous in Japan as it used to be the leading area in iron manufacturing, however, due to international competition in the iron area, the role of iron manufacturing in the city declined. As a result, the city authorities managed to successfully impose environmental protection measures. From the 1950s till the 1970s the economy in the city of Kitakyushu grew rapidly, which led to air and water pollution. Dokai Bai became known as the “Sea of Death” due to the contamination by wastewater from the industry and the urban households. The air pollution in the city of Kitakyushu was also quite significant and there was plenty of smog in the sky. These levels of environmental pollution have been drastically reduced as the city undertook specific plans and measures for dealing with the environmental problems (City of Kitakyushu, 2008). Along with the environmental issues, there were issues related to the lack of landfill areas and resources. Therefore, the environmental industries have been promoted along with resource efficiency, waste management and recycle-based society (Hashi, 2005, p.2). The city of Kitakyushu has the fourth largest urban area by built-up area and the sixth largest by the amount of population in Japan (World Bank Group, 2015, pp. 89-90). These characteristics of the city show that the city administration needs to apply a sustainable urbanisation approach in their urban policy making and have played a role in its choice to take part in the Eco-Town Project in Japan.

The national policy of Japan envisioned the establishment of an environmentally friendly economic pattern of development in the country. This envisions the development of strategies, which will promote sustainability in the urban areas. Characteristic for achieving national and international economic competitiveness of the city of Kitakyushu is the investment in innovation and technological development, which are environmentally friendly. Local initiatives are also out of great importance for the creation of job opportunities and sustainable development in the city. The population of the city amounts to about 1 million and is supporting actively this new ecological path of development. In the past women’s

organisations used to protest against the industrial activities in the area, which were the source of the heavy water and air pollution in the 1960s. The result of this movement was the transfer of more authority to the city administration. The local officials began the promotion of a transition from the heavy industrial development to an environmental one (Holroyd, 2012, p.10).

The first phase of the Eco-Town Project from the period from 1997 to 2002 envisioned the application of the concept of recycling. In the second phase from 2002 to 2010, the concept of reuse was also applied. The main objectives of the Kitakyushu Eco-Town project are the development and promotion of industries, which are environmentally friendly and are applying in their operations a recycling approach. The project also aims to innovate and to develop the best technologies in regard to the recycling process. The establishment of new eco-towns in the area within and around the city of Kitakyushu is also an important goal set in the project. In order to reach these goals, the regional authorities envisioned the conduction of research related to the development of new technologies. Demonstration research and new methods of production are also taken into account in the Kitakyushu Eco-Town Project (Hashi, 2005, pp.1-2).

The city of Kitakyushu has been acknowledged as the best-developed eco-city in Japan. After the overcoming of the industrial pollution problems, it became a model for the other Japanese urban areas. It has been selected as an “Eco-model City” in 2008 and “Future city” in 2011 by the Japanese government. International awards such as the United Nations Local Government Honours at the Rio Earth Summit in 1992 and OECD green growth city have been also given to the Kitakyushu eco-city (Li & Qui, 2015, p. 60). The city of Kitakyushu is since 2009 taking part in the “Green Frontier Plan”. The “Green Frontier Plan” has the aim to promote the development of low-carbon urban areas in Japan and has set the target to reduce the greenhouse gas emissions in Kitakyushu by minimum 50 percent until 2050. Moreover, it aims to achieve simultaneously an economic growth of forty percent in the city. It has been envisioned in this plan that by 2050 it will be possible to “i) covert Kitakyushu into a stock-based city, ii) establish industrial clusters, iii) develop a pro low-carbon learning system, iv) create a fulfilling society, and v) transfer low-carbon technology to other Asian cities” (Organisation for Economic Co-operation and Development, 2013b, p. 50).

The city of Kitakyushu joined the eco-towns project in Japan in 1997. It is one of the first cities to take part in this project. Among the other Japanese cities that joined in the same year are India City, Kawasaki City and Gifu City. The initial goal of the Kitakyushu Eco-Town was the development of the 3Rs model and the promotion of green industrial development within the city. This goal became more ambitious as the Kitakyushu Eco-Town began to expand its influence beyond Japan. It started a process of systematic accumulation of a different type of industrial companies, which is connected to waste recycling and is promoting environmentally technologies. In such way, the new vision of the city became not only the utilisation of resources in Japan but also the cooperation on an international level. Examples of such cooperation can be seen in the Japan-China cooperation projects. There has been an arrangement reached by Japan and China in 2007 that cooperation between the Kitakyushu Eco-Town, Qingdao, Tianjin and Dalian will take place. Apart from the eco-town model, which has been developed in Kitakyushu, and the transfer of technology, the city cooperated also on the implementation of the legislative system and operational management. The city of Kitakyushu has also transferred information on the implementation of waste collection system. Different companies from abroad have been discussing Eco-town business strategies with the businesses in Kitakyushu. Therefore, the eco-city development in Kitakyushu has not only considerable importance for the eco-city development in Japan but also through the process of cooperation it has gained international significance (Shiroyama & Kaijiki, 2016, pp. 113-131).

The involvement of the residents in the eco-town development in Japan and especially in the Kitakyushu Eco-Town has been promoted. Every year about 80,000 people are taking part in facilities tours in the city. In this way, the visitors get greater awareness of the recycling process and are encouraged to get involved in it (Ohnishi et al., 2012, p. 220).

The Kitakyushu Eco-Town is part of the Eco-Town Project in Japan and this Eco-Town development is of a significant importance as it is the first one to be approved by the programme. Therefore, it symbolises the Eco-town development in Japan, which has the aim to establish a zero-emission society in the country. Part of the Kitakyushu Eco-Town project is the Comprehensive Environmental Industrial Complex, the Hibiki Recycling Area and the Practical Research Area. The Comprehensive Environmental Industrial Complex is situated in the coastal area of Kitakyushu - Hibikinada. The goal of the 8 projects that are connected to this zone is to concentrate recycling industries in this zone so that the energy and materials will be circulating in a projected manner. The Hibiki Recycling Area is situated nearby the Comprehensive Environmental Industrial Complex. The goal of this area is to assist smaller recycling businesses and it achieves that by renting out land for a given period of time. Typical for these small recycling firms is that they are operating on a local level (Hashi, 2005, pp.1-4). There are 25 recycling facilities, which are recycling “waste plastics, PET bottles, home appliances, office machines, fluorescent lamps, automobiles, medical equipment, waste paper, waste wood, food waste, cooking oil, construction wastes, organic solvent, cleaning solution” (Fujita, 2011). Kitakyushu Eco-Town receives from the Japanese government and businesses about 390 million dollars for the development of the recycling and environmental industry (Higuchi & Norton, 2008, p.231). The Hibiki Recycling Area has been classified as the Automobile Recycling Zone and the Frontier Zone. The Practical Research Area encourages the development and further stages of research concerning cutting-edge environmental technologies. It mobilises different research parties so that new recycling and waste treatment technologies could be introduced. In 2003 there were 19 institutions, which were doing research in this area. Among them were universities as well as private firms. The number of people taking part in the Practical Research Area by the conduction of research amounted to 250 (Hashi, 2005, pp.1-4).

The population in the city of Kitakyushu is decreasing and has been defined as ageing. Therefore, the companies are facing difficulties in the recruitment of younger and at the same time qualified employees. The city centre needs a new design, which provides better transportation links and better use of land. Characteristic for the energy consumption in the city is that it has changed from the principal consumption of energy, which has been produced from coal to the consumption of energy produced by oil and by gas. As the Japanese government has introduced the feed-in-tariff for renewable energy the energy supply in the city of Kitakyushu is expected to include renewable energy. The Kitakyushu Eco-Town benefits from waste-to-energy generation. This type of generation comes mainly from industrial waste. The green building's construction in the area is also advantageous for the efficient use of energy. In the city of Kitakyushu, most of the new constructions meet the CASBEE requirements. The initiatives, which have influenced the sustainable building in Kitakyushu are the CASBEE Kitakyushu and the green roof programme. The local government have envisioned the introduction of LED street lighting. The residents have played a great role in the development of environmentally friendly initiatives in the city and in the future such active participation needs to be also encouraged. Currently, the city faces issues such as high levels of greenhouse gas, rising energy demand, decline in the population growth. The quality of water meets the standards but the stormwater management requires improvement (Organisation for Economic Co-operation and Development, 2013b).

6.5 Analysis

In order to compare the development of the Tianjin, Suzhou and Kitakyushu Eco Cities, the framework developed by the Ministry of Environmental Protection in China will be applied. The fact that in the case of Kitakyushu Eco City the Japanese government uses a different eco-towns development framework and that in the case of Tianjin a new framework has been especially designed in collaboration between China and Singapore needs to be taken into account. The use of different frameworks in the three eco-cities has been an obstacle in the data collection process. Therefore, some indicators couldn't be properly compared. A further limitation to the research was due to the fact that the Tianjin eco city is still under development. Therefore, the indicators, which were developed by Ministry of Environmental Protection in China for the required minimum standard of eco-city development, will be assumed to correspond to Tianjin Eco City. The comparison could be efficiently done based on the MEP framework, only between the cities of Suzhou and Kitakyushu. During this process the ideal indicators for eco-city development are also mentioned in order to offer a ground for comparison. The standard indicators, as mentioned earlier will be also used for comparison. It will be assumed for the research purposes that the eco-city development in Tianjin has met the minimum required standards in respect to the indicators of the MEP framework.

The indicators of the MEP framework are divided into three main spheres: economic development, environmental protection and social progress (Li & Qiu, 2015, p.59). In the economic sphere belong 5 indicators: “annual net income of farmers”, “tertiary industry share in GDP”, “energy consumption per unit of GDP”, “water consumption per unit of industrial added value”/ “water efficiency of agricultural irrigation”, “compliance rate of enterprises, which have to conduct Cleaner production” (Zou & Li, 2014, p.22). The environmental indicators are 11: “forest coverage”, “proportion of protected areas in total land area”, “ambient air quality”, “water quality”, “emissions density of key pollutants”, “water quality compliance rate of centralized drinking water source”, “centralised municipal waste water treatment rate”, “environmental quality of noise”, “urban garbage safe disposal rate”/ “industrial solid waste treatment & utilization rate”, “urban public green area per capita” and “environmental protection investment share in GDP” (Li & Qiu, 2015, p.61). The social indicators are 3: “public satisfaction rate on the environment”, “urbanization rate” and “centralized heating supply rate in heating region” (Zou & Li, 2014, p.27). Therefore, the analysis would be divided in three main sections, which will correspond to the aspects of economic development, environmental protection and social progress.

The comparison of the economic development in the Kitakyushu Eco-Town and in the Suzhou Eco City would be discussed first. For that purpose, the eco-city indicators for economic development will be compared. The indicator “annual net income of rural farmers” responds to in the case of Suzhou, 21,389 Yuan per person and in the case of Kitakyushu Eco City it amounted to 116,007 Yuan per person. The requirement, which has been set by the Ministry for Environmental Protection as a minimum eco-city standard is that it should be equal or more than 8000 Yuan per person. The “tertiary industry share in GDP” is 47.1percent in Suzhou Eco City and 74.9 percent in Kitakyushu Eco City. In order that the eco-city standard is met it needs to be equal or more than 40 percent. A further economic indicator is the “energy consumption per GDP” and the eco-city standards require it to be equal or less than 0.9 tons of standard coal/ 10k Yuan. In the case of Suzhou Eco City it is 0.824 and in Kitakyushu Eco City the number amounts to 0.153 tons of standard coal/ 10 k Yuan. The “water consumption per unit of industrial added value” needs to be equal or less to 20 m3/ 10k Yuan. The data shows that in the case of Suzhou Eco City it represents 15.9 m3/10k Yuan

and in the city of Kitakyushu Eco City the information in regard to its percentage is lacking. The “compliance rate of enterprises should carry out cleaner production” needs to be according to the Chinese eco standard 100 percent and it corresponds to 100 percent in the case of Suzhou Eco City. However, the needed information in regard to the percentage of the “compliance rate of enterprises should carry out cleaner production” in Kitakyushu Eco City couldn't be provided (Li & Qiu, 2015, p. 60).

The statistical comparison between the economic indicators of Kitakyushu Eco City and Suzhou Eco City provides a better idea of the eco-city model in Japan and China. The fact that the net income of the farmers in Kitakyushu Eco City is higher in comparison to the one in Suzhou is very unusual given the fact that China has the largest economy in the world. An explanation of that could be that this is a reflection of the higher numbers of GDP per capita in Japan. When it comes to the differences between the urban and rural income in Suzhou eco city it has been estimated that the urban residents have an income, which is twice higher than the one of the rural residents. The urban-rural income gap is an issue, which needs to be taken into account by the Chinese government in order that the sustainable development is promoted and the eco-city development program improves. In the economic category the indicator “share of tertiary industries in GDP” has been also used for comparison. It is notable that the percentage is considerably lower in Suzhou eco city than the percentage of the tertiary industries per GDP in Kitakyushu eco city. This is a difference, which is quite remarkable due to the fact that the city of Kitakyushu is one of the most industrial cities in Japan. The “energy consumption per GDP” is partly affected by the percentage of “tertiary industries per GDP”. It proves to be slightly higher in the case of Suzhou Eco City than in Kitakyushu Eco City. This could be related to the lower percentage of the tertiary industry in Suzhou. The other two indicators, which are related to the economic development in the eco-cities couldn't be compared, because the data couldn't be retrieved (Li & Qiu, 2015, p. 60). After comparing the economic indicators it became evident that the Chinese model for eco-city development is less successful than the Japanese model.

The second category in the analysis will review the Kitakyushu Eco-Town and the Suzhou Eco-City, in regard to the indicators, which have been set for environmental protection purposes.

The environmental indicators are especially important for the achievement of sustainable development in the urban areas and more specifically for the creation of eco cities. In the framework, which the Ministry for Environmental Protection in China has created, these indicators amount to eleven (Zou & Li, 2014, p. 23).

The “forest coverage” indicator comprises from four subsections. One of them is “mountainous areas”, where it should be equal or more than 70 percent in order to meet the eco-city standards. The next one is “hilly areas” and the requirement for it is that it should be equal or more than 40 percent. The next subsection of the “forest coverage” indicator is the one of “plain areas” and it should be equal or more than 15 percent. The fourth subsection is called “alpine area and grasslands” and it is required to be more or equal to 85 percent. In the case to Suzhou Eco City the data found corresponds to the subsection plain areas and is 29.4 percent and in the case of Kitakyushu Eco City the subsection corresponds to “hilly areas” with a percentage of 38.3 (Li & Qiu, 2015, p. 61).

A further indicator, which is related to the assessment of the quality of the environmental protection in the eco-cities, is the “proportion of protected areas in total land area”. The standard of eco-city development in China requires it to be more or equal to 17 percent. The percentage in Suzhou amounts to 37.8 and therefore meets the requirements, but data on the one in Kitakyushu couldn't be retrieved (Li & Qiu, 2015, p. 61).

In respect to the “ambient air quality” indicator, 6 further indicators have been chosen for its measurement purposes. The annual means for sulfur dioxide in Suzhou Eco City amounted to 24 mg/m³ in 2013, whereas the one in Kitakyushu Eco City it corresponded to 8. The eco-city

standard level should be less than 60 mg/m³. The annual mean for nitrogen dioxide is required to be less than 40 mg/m³ and it is 53 mg/m³ in the case of Suzhou and 35 mg/m³ in the case of Kitakyushu Eco City. The 24-h average for carbon monoxide is expected to be at a level, which is not higher than 4 mg/m³. In the case of Suzhou Eco City it is 0.92 and in the case of Kitakyushu Eco City, it amounts to 0.4 mg/m³. The 8-h average for ozone is expected not to exceed 160 mg/m³. It amounts to 95 mg/m³ in Suzhou and to 79 mg/m³ in Kitakyushu Eco City. The annual mean for PM₁₀ shouldn't be more than 70 mg/m³ in order to meet the standards of eco-city development in China. In the cases of Suzhou Eco City and Kitakyushu Eco City, the annual mean for PM₁₀ amounts to 86 mg/m³ and 17.4 mg/m³ respectively. The annual mean for PM_{2.5} shouldn't be more than 35 mg/m³. It is 66 mg/m³ in Suzhou and 22 in Kitakyushu (Li & Qiu, 2015, p.61). The analysis of the “ambient air quality” in Kitakyushu Eco City and Suzhou Eco City has shown that the air quality in Kitakyushu Eco City is higher than the air quality in Suzhou Eco City. The higher air quality in Kitakyushu Eco City represents the greatest difference between the eco-city development model in China and Japan.

When it comes to the indicator water quality it is used for comparison by the selection of further subindicators such as potential of hydrogen, chemical oxygen demand, biochemical oxygen demand (BOD₅), ammonia nitrogen (NH₃-N), phosphorous, cadmium, lead and mercury. According to the standards, the level of potential of hydrogen should be between 6 and 9 and the registered number in Kitakyushu Eco City is 8. There is no data in regard to the potential of hydrogen indicator in the case of Suzhou. The requirement for chemical oxygen demand is that it should be equal or less to 20 mg/l. In the case of Suzhou it is 4.6 mg/l and in the case of Kitakyushu Eco City, it amounts to 3.6 mg/l. A further indicator is BOD₅. It should be less or equal to 4 mg/l and the numbers in Suzhou and Kitakyushu correspond to 2.44 mg/l and 0.6 mg/l respectively. The NH₃-N indicator shouldn't exceed 1 mg/l. It amounts to 2.93 mg/l in Suzhou Eco City and data on it couldn't be found when it comes to Kitakyushu. The indicator P is required to be less or equal to 0.2 mg/l. In Suzhou Eco City, it is 0.44 mg/l and in Kitakyushu 0.01 mg/l. A further indicator is cadmium and it is required to be less or equal to 5 mg/l. Lead is another indicator, which according to the Chinese standards should be less or equal to 50 mg/l. In Kitakyushu Eco City, it is less than 5 mg/l but no data was retrieved in regard to the number in Suzhou Eco City. The levels of mercury shouldn't exceed 0.1 mg/l. In the case of Suzhou Eco City such information couldn't be retrieved and in the case of Kitakyushu Eco City mercury wasn't detected (Li & Qiu, 2015, pp. 61-62). The water quality in Kitakyushu Eco City proves to be better than the water quality in Suzhou Eco City.

The “emissions density of key pollutants” is measured in the unit kg/10 k Yuan GDP. The emission density of chemical oxygen demand should be less than 4 kg/10 k Yuan GDP. Information on its amount could be found only in the case of Suzhou city and there it is 0.59kg/10 k Yuan GDP. When it comes to the emissions density of sulfur dioxide, the minimum standards for eco-city development require it to be less than 5 kg/10 k Yuan GDP according to the Chinese eco city standards. The number in Suzhou is 0.76kg/10 k Yuan GDP but no data on the number in Kitakyushu could be retrieved (Li & Qiu, 2015, p.62).

The “water quality compliance rate of centralized drinking water source” is a further indicator from the MEP framework. However the information on its amount in the case of Kitakyushu Eco City and Suzhou Eco City couldn't be retrieved (Zou & Li, 2014, p. 24).

The “centralized municipal waste water treatment rate” indicator and the sub-indicator “industrial water reuse rate” are also used for comparison purposes. It is required that the “centralized municipal waste treatment rate” is more or equal to 85 percent by the Chinese eco city standards. In the case of Suzhou Eco City and Kitakyushu Eco City it is 95.49 percent and 99.9 percent respectively. In this aspect, the eco-city models prove to follow a similar pattern of development. The indicator “environmental quality of noise” is expected to meet

the national standards in a given area and in the case of Suzhou it hasn't be met. In regard to Kitakyushu Eco City, such data couldn't be retrieved (Li & Qiu, 2015, p.61).

The "urban garbage safe disposal rate" should be more or equal to 90 percent and it amounts to 100 percent both in the city of Suzhou and in the city of Kitakyushu. A sub-indicator of the "urban garbage safe disposal rate" is the "industrial solid waste treatment and utilization rate". It should be more or equal to 90 percent. In Suzhou Eco City it is 98 percent but there is no data on the percentage in Kitakyushu Eco City. A further indicator is the "urban public green area per capita". The "urban public green area per capita" is expected to be more than 11 m²/person. In Suzhou Eco City it is 17.45 m²/person and in Kitakyushu Eco City it is 12 m²/person. The "environmental protection share in GDP" is expected to be equal to or more than 3.5 percent and in the case of Suzhou Eco City it is 3.9 percent and in Kitakyushu Eco City 3.1 percent (Li & Qiu, 2015, p.61).

In general information for comparison was not present for both cities when it came to the indicators: "proportion of protected areas in total land area", "industrial water reuse rate", "water quality compliance rate of centralized drinking water source", "environmental quality for noise", "emission density of key pollutants" and the "industrial solid waste treatment & utilization rate". There are certain similarities between the two cities in regard to "urban garbage safe disposal rate", "environmental protection investment share of GDP", "centralized municipal waste water treatment rate" and to "forest coverage". A difference could be seen in the slightly higher percentage of "urban public green area per capita" in the case of Suzhou Eco City. Further differences could be found concerning the "ambient air quality" and the "water quality" indicators. The Kitakyushu Eco City has proven to have more ecological standards of "ambient air quality" and "water quality" in comparison to Suzhou Eco City.

The third part of the analysis is concerned with the comparison between the Suzhou Eco City and Kitakyushu Eco City, which has been based on the social indicators. The social indicators are the "urbanization rate", "centralized heating supply rate in heating region" and the "public satisfaction rate on the environment". The "centralized heating supply rate in heating region" is an indicator, which has been applied specifically to the development of eco cities in the northern part of China. Therefore, it is not applicable for the comparison with Kitakyushu Eco-Town (Zou & Li, 2014, p.27).

The "urbanization rate" in Suzhou has been registered to be 79.13 percent, which is with about 15 percent lower than the registered rate of urbanisation in Kitakyushu Eco City. Both rates of urbanization represent a high percentage and a similar pattern of the eco-city development. The standards, which have been envisioned by the Ministry of Environmental Protection in China for the "urbanization rate" in the MEP framework, are that it should be equal or more than 55 percent. A difference between the eco-city development models can be seen in the "public satisfaction rate for the environment". The "public satisfaction rate for the environment" is 93.83 percent in Suzhou Eco City and 61.6 percent in Kitakyushu Eco City. The Chinese eco-city standard requires that the "public satisfaction rate for the environment" should be more or equal to 90 percent (Li & Qiu, 2015, p.63).

The comparison of the eco-city model, which has been developed in the Tianjin, Suzhou and Kitakyushu Eco-City, is representative for the eco-city development in China and Japan. There were certain obstacles connected to the data collection in the case of Tianjin eco-city and therefore the analysis is mostly based on the comparison of the eco-city models in Suzhou Eco City and Kitakyushu Eco City. After the 19 indicators of the MEP framework were applied in the case studies the differences and similarities of the eco-city model in Suzhou Eco City and in Kitakyushu Eco City could be clarified. The analysis shows that there are more differences than similarities between the eco-city development in China and Japan. It became also evident that the Japanese eco-city development programme is more successful.

Chapter 7

Conclusion

The on-going process of change from rural to urban societies is influencing the economic, social, political and environmental development in the world. The urbanisation process needs efficient governance so that it could become more sustainable. The rate of urbanisation in the East Asian region is considerably higher to the one in North America and Europe. This is due to the industrialisation process, which is now increasing in East Asia. Hundreds of millions of people in East Asia are expected to migrate to the urban areas in the next 20 years. An increase in the urban rate is expected in many other regions (World Bank Group, 2015, p. xv).

There is a worldwide acknowledgement that the urban development will be changing the pattern of economic development in many countries. It has been predicted that by 2030 2.2 billion more people will move to urban areas in comparison to the number of world urban population, which was registered in 2000. The developing countries are the one expected to get the greatest increase in urban population during this period. The total number of the urban population in these countries has been forecasted to reach about 2 billion and that it will again increase in 2030 and amount to the number of 3.9 billion. In the developed countries the increase in urban population would be not that high. It has been predicted that the number of the registered about 0.9 billion urban residents in 2000 will rise to a total number of urban population of 1 billion by 2030 (Allen, 2009). In Asia, the urbanisation rate is especially high. The urban areas are rapidly increasing along with their density. This rise is likely to continue over the next years, as the population that nowadays lives in the urban areas in Asia, is considerably less to the one in the other parts of the world. Such urban development has supported the economic growth of the Asian region, but at the same time poses certain threats to the sustainable development in this region. The implementation of sustainable urban development measures and laws is therefore out of considerable importance for the Asian region. This is needed so that the natural environment all over the planet could be protected and the global sustainable development goals could be realised (Asian Development Bank, 2012).

It has been reported by the Intergovernmental Panel on Climate Change that the expansion of cities is much quicker than the growth of urban population. An estimation suggests that over the first 30 years of the 21st century the expansion of the cities will be substantially larger in comparison to the urban growth which occurred during the years until the 21st century in the whole world. The largest chances for urbanisation, which will decrease the greenhouse emissions, could be found in the developing counties. In these countries the city infrastructure has not been completely developed, therefore it leaves space for a smart and efficient eco-city development. A further advantage of the eco-city development in these counties can be found in regard to the urban biodiversity conservation (Scientific and Technical Advisory Panel, 2014, p.2). The urbanisation process in the East Asian region is out of significant importance as in the next 30 years the infrastructure in the cities will be completely developed. This means that later alterations of the urban infrastructure will not be possible. The economic development is strongly connected to the urban development. Therefore, the urban design should be a priority for the urban policy makers in these countries (World Bank Group, 2015, p. 1).

The development of eco cities has been recently gaining influence as an approach, which could contribute to the achievement of sustainable urban development. It is providing many advantages for the urban residents. Examples of these advantages are in the areas of “employment, culture, recreation and consumption” (Flynn, 2012). The eco-cities are also providing more environmentally friendly setting, opportunities for better integration in the society, greater employment chances and are decreasing the “(air and water pollution, noise,

waste) associated with the city”(Flynn, 2012). A further reason behind the growing influence of the development of eco cities is due to the climate change and the necessity to find ways to respond to the climate change issues. In China the eco-city projects are constructed at a fast rate and nowadays represent the highest number worldwide (Flynn, 2012). This development is triggered by the benefits, which the eco-city provides, namely to make the use of resources more efficient and to “reduce environmental impacts, such as by reducing energy use, promoting renewable forms of energy over coal, gas or oil, reduce the consumption of water” (Flynn, 2012). The promotion of eco-city projects could be also beneficial for the local business development as it is promoting ecological industrial development. It also requires the public participation. The eco-city development could also “protect environmental assets and the resource base, for example, new development should not be on agricultural land, it will be of high density”(Flynn, 2012).

The eco-city development is seen as an answer to the urbanisation challenges in China and Japan. The policies and regulations, which are related to the eco-city development, have been discussed in the empirical part. Both countries have envisioned the creation of circular low-carbon economies through the development of eco cities. The eco-city development programmes in China and Japan are relatively new and are therefore still undergoing changes. The case studies, which have been analysed, are considered to be the best examples of eco cities in the respective countries. The comparison is based on an indicator framework and is outlining the similarities and the differences in regard to the economic development, the environmental protection and the social progress. The chosen cities for comparison are Kitakyushu Eco-Town, Tianjin Eco City and Suzhou Eco City. The Kitakyushu Eco-Town has been considered to be the most successful eco-city project in East Asia. The Tianjin Eco City is a new project and is still under development. The Suzhou Eco City is considered to be an example of a successful eco-city transformation project in China.

The results of the analysis have showed certain differences. An example can be seen in the economic indicators. It has been concluded that the average economic level in China is comparatively lower. This is reflected in the “annual net income for farmers” (Zou & Li, 2014, p. 28). A further suggestion is that there is also a lower efficiency of the energy consumption in China in comparison to the one in Japan. The indicator “public satisfaction rate for the environment” is considered to be very subjective and to be measured in different ways, which could be the reason for the higher percentage that has been registered in Suzhou Eco City. The rate of urbanisation in the Suzhou Eco City has been found to be adequate to the recent urban development in China. Similarities between the eco-city models in China and Japan could be found in regard to the creation of green areas. However, the quality of air and water has proved to be higher in Japan (Zou & Li, 2014, p. 28). The analysis subsection has confirmed the hypothesis that the eco-city model in Japan is more ecological and successful than the Chinese eco-city model.

The MEP framework, which was applied in the analysis, has been considered as the best one in China. However, when it is compared to other international frameworks it is proven that it lacks scope in regard to the measurement of the greenhouse gas emissions. Further indicators such as green transport and utilization of renewable energy also don’t exist in the Chinese framework (Asian Development Bank, 2010). A further criticism of the MEP framework concerns the waste indicators and it has been suggested that more attention should be given to this aspect (Zou & Li, 2014, p.28). The clarification of the weaknesses of the MEP framework could prove to be useful for the future development of the eco-city projects in China. It is extremely important that the Chinese government undergoes changes of the indicator framework, as the eco-city development in the country has recently started and is expected to develop further due to the urbanisation issues and the expected increase in the number of the Chinese population. Additionally, some limitations occurred in regard to the definition of the eco-city concept. As the eco-city programmes are considered as recently developed, the

research in this area is narrow. The eco-city definition is also diverse according to different scholars and governments. A specific limitation concerning the empirical work of this study occurred during the search of resources and data. The statistical information in regard to some indicators for eco-city development of the MEP framework is not available in both countries. What makes this research distinctive is that it outlines the need of international knowledge transfer for the improvement of the eco-city development projects.

An idea for a future research would be related to the investigation of the decision-making processes and to the comparison of the national-local relationship in the process of eco-city development in China and in Japan. The objective would be to outline the policy actors such as the initiators, the implementers and the adaptors and to compare them. The theoretical framework would be developed by combining the theories of policy networking and governance in the context of low-carbon transition. The aim of this research would be to present the similarities and the differences in the method of development of eco cities in Japan and in China.

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