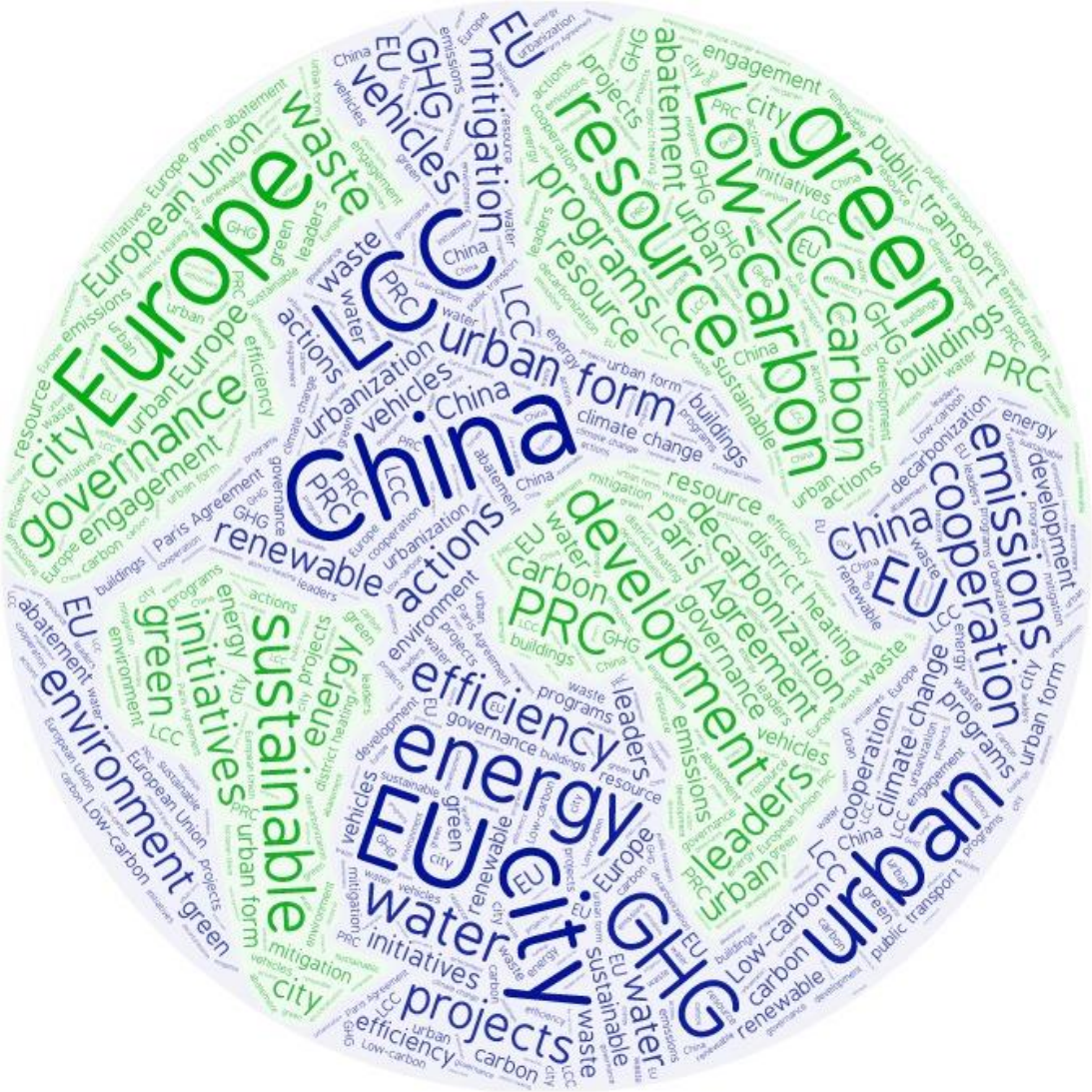

LOW-CARBON CITY DEVELOPMENT IN EUROPE AND CHINA: DIFFERENCES AND COMMON INITIATIVES

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Summary

The importance of climate change action has grown in recent years and the international community has turned its attention towards the steps necessary to mitigate its effects. The Paris Agreement signifies the latest global effort and a commitment by countries around the world to the cause of climate engagement. Both, European countries and China currently represent leaders in the sphere of climate change abatement and were, therefore, chosen as the research subjects for the paper.

One of the main environmental problems the world is facing at the present time is the reduction of greenhouse gasses and the cities are responsible for 70% of these emissions. Urban areas also serve as centers of business, industry and residential spaces for more than half of the world's population, which makes them crucial in the efforts of lowering the amounts of global greenhouse gasses. Limiting the emissions in the urban areas and creating eco-cities, green cities, and low-carbon cities has thus become a focal point for urban planners and developers, as well as governments around the globe. The paper focuses on low-carbon cities in Europe and in China, different approaches and initiatives they pursue and the overall state of sustainable development in both regions. Furthermore, their joint efforts and projects are reviewed and the reasons for their cooperation assessed against the backdrop of the current situation in the combat against climate change.

The analysis is conducted in two parts; firstly, the differences in the sustainable development projects are examined by utilizing the theoretical concept of 10 principles of low-carbon development. Measures with decarbonization prospects taken by the cities are sorted and subsequently analyzed in the categories of low-carbon urban form, energy efficiency, and inclusive urban governance. The results indicate that the low-carbon development is currently still at higher level in European cities than in their Chinese counterparts. Nevertheless, the urban areas in the PRC show significant progress on the path to sustainability and if they are able to

solve certain problems they are currently encountering, they can fully utilize their potential to become inspiration to other cities in the world.

Secondly, the analysis reviews different forms of cooperation between China and Europe by applying the International Relations' theory of liberalism. Despite the fact that partnerships are established on multiple levels, the actual implementation of their common agreements and is not always apparent and the assessment of their efficiency remains problematic as well. However, the collaboration brings benefits to both parties as China can gain and utilize know-how and experience of the European cities in the area of sustainable development and Europe, on the other hand, can expand its market with green technologies, innovations and renewable energy through its cooperation with China and create many valuable partnerships between the cities in both regions.

Overall, it is important that strong actors, such as China or the European countries, and cities in particular, join their forces in the mitigation of climate change as it is not only in their own interest, but also in the interest of global community. By striving for becoming leaders and role models for other urban areas, they can come a step closer to a sustainable and carbon-free future.

Key Words: Europe, China, low-carbon city, climate change, mitigation, urban form, resource efficiency, urban governance, cooperation

Keystrokes: 142,910

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List of Abbreviations

- CHP - Combined Heat and Power
- COP - Conference of the Parties
- EU - the European Union
- FYP - Five Year Plan
- GHG - Greenhouse Gases
- IR - International Relations
- LC - Low-carbon
- LCC - Low-carbon City
- PRC - People's Republic of China
- UNFCCC - The United Nations Framework Convention on Climate Change

1.0 Introduction

The problem of climate change and its impact on people's lives has received a lot of attention in the recent past and remains one of the biggest challenges the international community needs to face in the upcoming years. The society has recognized the rising urgency of this issue and started taking necessary steps in order to mitigate the effects of climate change. The initial efforts can be traced back to the United Nations Framework Convention on Climate Change (UNFCCC) in 1992 when the main international players took the lead in the campaign aiming for sustainable development and greener future (United Nations Climate Change-a, n.d.). Further actions in this field include annual conferences of the Parties of the UNFCCC or legally binding Kyoto Protocol which introduced emission reduction targets for developed countries (United Nations Climate Change-b, n.d.). The latest act contributing to the past efforts of mitigation and abatement of climate change was the Paris Agreement[1] in 2015 where China joined the global climate actors and showed a strong commitment to the cause (Lee et al., 2015). Cooperation between the People's Republic of China (PRC) and other leaders in this area, such as the EU, thus represents a promising partnership that could be globally beneficial.

One of the main environmental problems the world is facing at the present time is the reduction of greenhouse gasses (GHG). The unprecedented amounts of GHG produced worldwide caused multiple countries to create and implement various strategies aimed at limiting emissions and mitigating the climate change, as well as adapting to the effects of the unavoidable climate conditions changes in the future.

More than half of the world's population currently resides in urban areas and cities represent the biggest emitters of GHG in the world, forming 70 percent of

[1] Paris Agreement builds upon the UNFCCC and sets its main goal to keep the global temperature rise below 2 degrees Celsius during this century and increase climate resilience of the countries (United Nations Climate Change-c, n.d.)

energy-related greenhouse gases (Ohshita et al., 2015). Emission-cutting actions taken in the cities are therefore of high importance in the climate change mitigation and the impact of locally taken steps can be reflected on the much greater global scale. Limiting the emissions in the urban areas and creating eco-cities, green cities and low-carbon cities (LCC) has thus become a focal point for urban planners and developers, as well as governments around the globe (Baeumler et al., 2012:xl).

European countries with the European Union in the forefront are considered to be an important leader in the fight against climate change and they have been on the track of green development for several decades now. Over the years, countries in this region introduced numerous strategies, programs, and initiatives for climate change mitigation and pursuance of environmentally friendly development in their domestic settings. Low-carbon (LC) urban planning and actions for GHG reductions can be observed across multiple European cities as can be the efforts to further develop technologies and solutions for sustainable development. Furthermore, European cities are taking part also in some international initiatives, such as the Global Covenant of Mayors[2], with goals of decarbonization of city territories and fulfillment of the Paris Agreement objectives (Global Covenant of Mayors for Climate & Energy, n.d.).

China, on the other hand, represents a country which has undergone an impressive development process over the past forty years and where the focus was put mainly on economic growth. Its immense industrial enlargement has, however, caused it to become not only one of the leading world economies but also a major global polluter. In fact, the PRC is the largest producer of carbon emissions in the world (Baeumler et al., 2012:xl). This was caused by the carbon-heavy and emission rich industry, which was centralized in the cities as well as by the significant amount of people moving into cities. The number of urban residents is expected to further increase in the upcoming years and the need to create more environmentally friendly

[2] Global Covenant of Mayors is an international platform uniting over 9.000 cities around the world with the common vision of increasing cities' involvement in the pursuit of low-carbon and resilient society (Global Covenant of Mayors for Climate & Energy, n.d.)

districts and cities has, therefore, become more pressing matter than in the past. The Chinese leadership has recognized the necessity of lowering the emissions of its country and in 2009 President Hu Jintao committed to decreasing the carbon dioxide emissions per unit of GDP by 40-45 percent before the year 2020, compared to the year 2005 (United Nations Development Program, 2010). Ever since then China has engaged in actions leading to achieving this goal, whether it was through its own projects and policies, through cooperation with other countries or through the commitment to international agreements and their implementation.

1.1 Research Question

The aim of this paper is to analyze the low-carbon city initiatives in Europe and China, review their joint projects and answer the research question:

How does the low-carbon city development differ in Chinese and European urban areas? Why do China and Europe conduct cooperation in the area of climate change?

The cities in Europe have begun their combat against climate change many years ago and this region is currently considered to be one of the leaders in climate engagement. Not only are the European cities part of international climate action through organizations and accords such as the Paris Agreement, but they are also subject to their national and local agendas, plans and regulations. Furthermore, the EU member states are legally bound also to several policies set out by the Union, for instance, the 2020 Climate and Energy Package, the 2030 Climate and Energy Framework or the 2050 Long-term Strategy, all of which are targeting GHG emissions reduction and transition into a low-carbon economy (European Commission-f, n.d.). Climate change abatement is thus pursued on several fronts and it is at the center of urban development plans in this area.

Climate action has solidified its place also in the national Five Year Plans (FYP) of the PRC in recent years and in the most recent one, the 13th FYP, the country set

its national targets of emissions peak in 2030 (Zhang, 2015-a). China also launched a national Low-Carbon City Pilot program in 2010 with 8 pilot cities and 5 provinces[3] selected to utilize low-carbon solutions in their development and the program continued to grow ever since then (Ibid). Moreover, the country began experimenting with carbon trading in the 7 pilot schemes[4] during the 12th FYP (Zhang, 2015-b). Currently, the country is set to reach its climate targets introduced in the 13th FYP and follow sustainable urbanization goals anchored by the Chinese National New-Type Urbanisation Plan 2014-2020 (Kontinakis & Zhang, 2018). Except for national programs and steps taken by the individual cities, there are also international partnerships with the intention to limit the GHG produced by Chinese urban areas.

The aim of this paper is to research different approaches and initiatives in the development of low-carbon cities in European countries and in China. Various programs with a plan to lower the amount of GHG emissions are reviewed, both in Europe and in the PRC, followed by an assessment of their common projects, as well as the examination of the reasons for their cooperation. The preliminary hypothesis is that the experience and know-how of the European cities in dealing with environmental problems are considerably more advanced than that of China, which is still in the early stages of its LC development. Partnership with the cities and countries in Europe and implementing some of the strategies that proved to be effective there is thus considered to be greatly beneficial for China. The hypothesis further extends to the assumption that cooperation is also in the interest of the European countries. China is the largest GHG emitter in the world and decarbonization of its cities and pursuance of a greener development in the future would have notable effects on the global combat of the climate change, therefore benefiting not only China itself but the European countries and other international actors as well.

[3] Cities of Tianjin, Chongqing, Shenzhen, Xiamen, Hangzhou, Nanchang, Guiyang, and Baoding and provinces of Guangdong, Liaoning, Hubei, Shaanxi, and Yunnan (Zhang, 2015-a).

[4] Beijing, Shanghai, Tianjin, Chongqing, Guangdong, Hubei, Shenzhen (Zhang, 2015-b).

By answering the research question, the hope is to draw differences in the ways China and Europe approach decarbonization of their territories and clarify the reasons for the cooperation between the EU and the PRC regarding climate change and low-carbon cities particularly. Moreover, the paper denotes areas in which the Chinese cities could seek improvement and enhancement of their low-carbon capacities, whether through knowledge acquired from the past experience of the European cities or through the joint Europe-China initiatives.

1.2 Outline of the Research

The first chapter of this paper represents an introduction to the topic of climate change and actions towards its mitigation. The growing urgency of decarbonization and development of low-carbon cities is explained and the importance of European countries and China in this process is summarized. Furthermore, this chapter includes the research question and the main objectives of the paper, as well as a short synopsis of it.

The second chapter introduces the literature previously written on the subject matter and allows positioning of the paper in the current research. Academic writings on European and Chinese initiatives in the LCC development are reviewed, together with their collaborative projects in this area.

The methodology is the subject of the third chapter of this paper. It explains the methodological procedure used, from the collection of data through the selection of theory and conduction of the analysis. Types of the data used are listed and limitations to the research are presented.

The subsequent, fourth chapter, is dedicated to the theory used in the process of analysis. Firstly, a theoretical scheme presenting 10 principles of low-carbon urbanization is listed and explained. Afterward, the main assumptions of the IR theory of liberalism are introduced. Furthermore, the use of the aforementioned theoretical frameworks is depicted.

The fifth chapter delves into the analytical component of the paper. Through the utilization of the selected theoretical perspectives, the analysis is conducted in two parts. The first part focuses on examining the differences in low-carbon city programs and initiatives in both, European cities and in China; the second part pertains to their common projects and the underlying reasons for their partnership.

The sixth and last chapter aims to answer the research question and summarize the findings compiled in the paper, namely in the analysis. The conclusion provides also an overview of the paper and reflections on the findings, as well as on the used theoretical perspective and methodological process.

2.0 Literature Review

The following chapter reviews existing literature on the topic of low-carbon cities, joint initiatives of Europe and China in this area, as well as their individual actions in pursuance of low-carbon development.

The evolution of society, industrial advancement, and extensive urbanization meant easier access to and use of natural resources; it also meant that people's lives became more comfortable and effortless. However, it resulted in the degradation of the natural environment, pollution of land, water and air, as well as continuously increasing amount of emissions in the atmosphere. People begun to recognize these changes in the environment and scholars in the 1960s and 1970s started warning the general public about the effects they could have on humanity and its development. Meadows et al. from the Club of Rome published a book *The Limits to Growth* in 1972 where they discussed the inevitable termination of human development and the likely reasons for it. Despite the limited knowledge of certain aspects of environmental changes at the time, they made predictions about the harmful effects of pollution, overpopulation or agricultural production and they anticipated a collapse before the

year 2050. They called out the individuals and governments to prevent it because *"taking no action to solve these problems is equivalent to taking strong action"* (Meadows, 1972:183).

The steps taken against environmental deterioration and climate change have increased in numbers since the 1970s, and so has the amount of literature written on this topic. At present time, there are publications (KeTTHA, 2011) discussing environmental problems recognized by general public and some authors (Asakawa & Kojima, 2016) propose various measures that should be adopted by countries to combat the climate change on multiple fronts, such as carbon emission pricing and trading, as well as green tax. KeTTHA (2011) focuses on carbon emissions with specific attention given to greenhouse gases and what they consist of based on definitions provided by the UN. The fact that greenhouse gases are produced mostly in the cities and therefore their role is significant in any attempts to fight the climate change is stressed by some (KeTTHA, 2011; Ohshita et al., 2015). The realization that urban areas can be an important player in the climate change mitigation has lead to efforts for creating sustainable cities, eco-cities and low-carbon cities. Lundin & Ng (2009) discuss low-carbon cities and the rising prominence of this concept.

Currently, there is no universal definition of a low-carbon city and the tendencies are to perceive it as a path of development, and ongoing process, rather than a final outcome of it. KeTTHA (2011) claims the LCC definition corresponds to a general definition of a sustainable city, i.e. a city with low carbon emissions pursuing green strategies and using green technologies, trying to limit impacts of climate change. Chinese scholars (Su et al., 2012) understand LCC as a city that limits its carbon emissions but is still focused mainly on the pursuance of economic growth. Research done by Hu et al. (2016) claims that economic development and sustainability can go hand in hand and the LCC practices should be encouraged. Notwithstanding the definition of a low-carbon city, multiple scholars (Lundin & Ng, 2009; Su et al., 2012; KeTTHA, 2011) agree that individual cities have different

conditions and are faced with different challenges, therefore their approach to achieving low-carbon development goals should vary as well.

Some authors aim their attention at low-carbon cities in certain areas. The European Union was subject of research of Bergamaschi et al. (2015) who discussed different projects suggested by members of the EU. They debate what various high-carbon and low-carbon investments would include, evaluate member states' proposals and analyze hindering aspects of LCC development in the EU, such as the excessive reliance on Russian energy by some members, which causes them to prioritize new gas infrastructures over energy efficiency, etc.

A lot of authors focus also on China and its attempts for low-carbon development. They (Khanna et al., 2013; Khan & Chang, 2018) describe the historical background that resulted in today's pollution and emissions levels of the PRC. China Urban Sustainability Coalition (2015) stresses the fact that during the process of China's rapid development, the focus was on the speed and not on the quality of urbanization what reflected on the environment and caused problems connected to it. Today the climate change represents an important topic for China and some authors (Ohsita et al., 2015; Khanna et al., 2013) present the key national policies and programs on energy and climate change in China and Ohshita et al. (2015) talk also about socio-economic benefits of urban climate action. Khan & Chang (2018) analyze the Environmental Protection Law and suggested amendments to it, as well as other laws pertaining to climate change and environmental protection in China. Zhang (2015-a) addresses the emissions peak plans of the PRC and the main challenges it faces in achieving its ambitious goals. In another article Zhang (2015-b) also talks about the pilot carbon trading schemes in China, evaluates their first year of performance and suggests potential pathways for their evolution.

Many scholars (Ohshita et al., 2015; Lee et al., 2015; Zhang, 2015-a; Zhang, 2015-b; Hu et al., 2016) address the Chinese Low-Carbon City Pilot Program, which started with initial actions in 2008 and was officially launched in 2010; some (Khanna et al., 2013) list also domestic parallel programs or international programs in which

Chinese cities are involved. Su et al. (2012) emphasize the need for a unified evaluation system of LCC, however, there are some who try to evaluate LCC development regardless. Hu et al. (2016) conclude that even though there is some improvement in the LCC development in the PRC, its overall level is not high. Ohshita et al. (2017) base their assessment on a different model but come to a similar conclusion that the LCC transition in China is in its early stages. Khanna et al. (2013) also assess Chinese low-carbon development and discuss various barriers hindering it. Several authors (Zhan et al., 2018; Lundin & Ng, 2009) acknowledge that due to China's size and diversity, there is not one ideal model that would fit all the cities around the country. Zhan et al. (2018) focus on the financing aspect of eco-cities and LCC in China and propose a generic model that could be adopted.

There are authors (Hu et al., 2016; Ohshita et al., 2017) who propose numerous actions that should be taken by the PRC to achieve effective low-carbon urbanization. Ohshita et al. (2015) provide guidelines that should be implemented in city planning and development whilst China Urban Sustainability Coalition (2015) advocate for a set of 10 principles that should be followed by cities in China. Others (Zhang, 2015-a) talk about future necessary changes China needs to implement into its development strategy, such as reform in energy pricing and explain (Lee et al., 2015) the background of a dispute between energy-intensive companies and groups lobbying for climate security and LC actions. Zhang (2015-a) stresses the importance of harnessing the power of market-based instruments which would complement the PRC's administrative measures.

Lee et al. (2015) acknowledge that both, EU and China face resource and climate insecurity and claim that these problems can be addressed by collaboration between them. Kontinakis & Zhang (2018) point out that sustainable urbanization has become central in the cooperation between the EU and China in recent years. They report on the results of joint activities between European and Chinese cities and describe the process of selecting the matching European and Chinese cities, followed by documenting the progress of their joint projects regarding urban sustainability.

Furthermore, they provide guidelines for future cooperation and outline potential plans and common programs. Lee et al. (2015) recommend increased EU-China cooperation, enhancement of market opportunities and promotion of collaborative actions on green growth. Lundin & Ng (2009) claim that cooperation should take place both on micro and macro level and Kontinakis & Zhang (2018) put forward the fact that it is peer-to-peer cooperation that currently remains the main form of LCC cooperation between EU and China. Lee et al. (2015) also list several documents and plans pertaining to climate change mitigation, such as the EU-China Partnership on Urbanization, EU's 2020 Resource Efficiency Plan, or 2030 Energy and Climate Package proposed by EU. The same group of authors (Lee at al., 2015) suggests the establishment of EU-China Green Growth Forum and explains what its function would be. They suggest stronger cooperation through the platform of AIIB, where some of the EU countries are involved; moreover, they stress the importance of cooperation in multilateral forums. Lee at al. (2015) further discuss problems in aligning the objectives and policies of the EU and China and conclude that the collaboration remains mostly in the technical sphere. Other authors (Lundin & Ng, 2009; Kontinakis & Zhang, 2018) also analyze the obstacles these two partners still need to overcome in the future.

This paper aims to analyze and compare current low-carbon initiatives in European countries and China and assess their joint projects. It examines the different approaches of both parties through a selected theoretical structure of LCC development. Despite differences in factors such as size, the number of inhabitants, density of population or natural environmental conditions, the generic framework allows for a comprehensive evaluation of both, European and Chinese urban areas and their decarbonization initiatives. By conducting the analysis, both, strong and weak points in the LC development in the regions are denoted.

Moreover, the paper explores different levels of cooperation between Europe and the PRC conducted in the area of low-carbon city development and examines the reasons for it together with the benefits it brings to each party.

3.0 Methodology

This chapter clarifies the methodological procedures used in the paper in order to answer the research question. It describes the process of data collection, the types of documents used, together with delimitations of the research.

3.1 Method

The research design of this paper is set as a comparative study where various low-carbon city programs and initiatives in European cities and in China are studied and contrasted. The comparison is based on a theoretical framework of low-carbon urbanization developed by the members of the China Urban Sustainability Coalition with the help of several other organizations involved in green development and sustainability. Each chosen example of a low-carbon city initiative is assessed within the structure of 10 principles, which are divided into three categories (low carbon urban form, resource efficiency, and inclusive urban governance). This assessment then serves as a groundwork for a comparison of similar projects in the European and Chinese cities.

The regions of Europe and China were chosen for this analysis against the backdrop of the current situation in climate change combat. At the present time, they represent important actors in global politics and strong supporters of international initiatives leading to the mitigation of climate change. The EU consists of a group of countries that have been promoting sustainable development and implementing green solutions into their national development schemes for many years now, and thus embodies one of the leaders in the environmental endeavors on a global scale. These efforts are backed also by other European countries, such as Norway or Switzerland, which may not be the member states of the EU, yet, play an important role of innovators in the field of decarbonization and supporters of sustainable development. The purpose of including more than just the EU actors is to illustrate

that not all the LC projects in the region are conducted under the framework of the EU but also through the initiatives of the individual cities or national agendas of the European countries. China too has become one of the most important countries in the arena of international politics and its importance in the fight against climate change has grown as well. It introduced ambitious plans of green and sustainable development and it is on its way of pursuing them. Both, Europe and China possess the potential for creating a change and making a difference in climate change mitigation and abatement efforts and were thus selected as interesting subjects for this research.

Despite differences in size, population, density, climatic conditions and levels of development, the chosen initiatives were selected to represent multiple areas of low-carbon development, such as public transport, waste minimization or awareness raising projects. The assorted efforts in the cities that are compared in this paper were selected to best reflect the current state of low-carbon development in each region. The theoretical framework serves as a common tool to assess the decarbonization efforts in urban areas with different conditions. The comparison is conducted to unveil the strong and weak aspects of sustainable and low-carbon urbanization in Europe and in China and the results serve as a background for the next part of the analysis.

In the successive part, the cooperation between Europe and China in the area of low-carbon city development is discussed. Several joint projects are examined and the assessment of the benefits brought to each party is given. The reasons for their mutual cooperation are analyzed and the IR theory of liberalism is utilized throughout the process. The aim is to explain the underlying reasons for the partnership between the parties conducted on different levels and in various forms.

Through the analysis of the given subject matter, the hope is to answer both parts of the research question. In order to do so, empirical data is collected and qualitative research applied. The data on particular examples of low-carbon initiatives in both regions is selected to represent a sample of projects that generally

reflect the state of LCC in both regions. Compiled data is acquired from the official websites of the European Union, the PRC, and the individual projects respectively. A large part of the respective projects conducted in the cities is collected from an international platform C40 Cities, which unites over 90 cities worldwide through green initiatives leading to more sustainable development. The platform presents a comprehensive and uniform collection of projects conducted both in Europe and in China and is therefore considered to be a relevant source utilized throughout the analysis. Moreover, official statements, academic writings and studies conducted by bonafide experts in the field of urbanization and sustainable development are employed, as well as available news articles since they provide up to date information on the matter.

3.2 Delimitations

Despite climate change being a global problem, the presence of international actors in this research is fairly limited and their actions narrowed only to their participation in some of the cooperative projects. This allows a greater focus on the country of China and the block of countries in Europe and on the low-carbon city development initiatives administered there. Moreover, prevalently recent projects are included as China has not had many low-carbon projects prior to 2008. As for the European initiatives, both older and newer programs are included, however, priority is given to the current ones in order to conduct a comparison of their contemporary ideas, projects, and technologies. Field research was not conducted neither in the PRC nor in the European countries due to the time limitation of the paper and financial constraints; the analysis is thus dependent on secondary sources. The theoretical part of the research revolves around a selected urbanization framework and an IR theory of liberalism since both of them were considered to be the best tool for analyzing respective parts of the subject matter. Other theoretical concepts and perspectives were discarded since they were not deemed able to provide sufficient theoretical background for analysis and a full assessment of either LCC nor the cooperative aspect

of the Europe-China relations. Further limitations of the paper regard the linguistic spectrum as only English language sources were utilized. Nevertheless, sources in English pertaining to the topic of LCC and sustainable development written by both, Chinese and Western authors were chosen so as to reduce possible bias.

4.0 Theory

Following chapter provides a theoretical background for the paper. The framework within which the low-carbon cities are assessed is explained together with the main assumptions of selected international relations theory applied during the analysis. Moreover, the use of chosen concepts and perspectives is outlined.

4.1 The Need for Sustainability in Urban Development

In the past, the amount of population living in urban and rural areas was relatively balanced. However, the 19th century and the industrial revolution meant the beginning of urbanization rate increase. Cities were becoming bigger and the number of people moving to the centers of industrialization and development grew as well. In 2018, there were 548 cities with more than one million inhabitants, which is 177 more than in the year 2000; the number of megacities (with more than ten million inhabitants) also increased up to the current count of 33 (UN, 2018). Overall, according to the UN, more than half of the world population, precisely 55,3%, lived in urban areas in 2018 and this trend is expected to grow to 60 percent by 2030 (Ibid). This speed of urbanization and its continuous growth are closely intertwined with the general development of modern society and the industrialization level required by it. Combination of these elements has resulted in numerous effects the human activity has on the natural environment which will, in turn, impact the quality of people's lives in the long term. That is one of the reasons sustainable development has received a lot of attention in the past years and why the international community has

adopted measures aimed at creating a model of city development that can be sustainable. These efforts induced the creation of concepts such as eco-city, smart city or low-carbon city.

4.2 Low-Carbon Development

There is not one uniform definition of a low-carbon city or its essential attributes; nonetheless, some authors attempted to provide explanations of it. From a combination of these, a definition can be drawn: Low-carbon city represents an urban unit that adopts green technologies and pursues green strategies with a goal of limiting its carbon emissions and approaching carbon neutrality. However, leaving zero carbon footprint does not stop such city from preserving and improving its economic growth. Each city attempting to apply low-carbon measures in its development should take into account its own specific conditions so as to exploit its assets and achieve the best possible results (KeTTHA, 2011; Su et al., 2012; Hu et al., 2016; Lundin & Ng, 2009).

China Urban Sustainability Coalition and its six central members - the Environmental Defense Fund, Energy Foundation China, Institute for Sustainable Communities, Natural Resources Defense Council, World Resources Institute, and World Wide Fund for Nature, together with 13 other, non-profit organizations[5] released a document in 2015, in which they present 10 principles of low-carbon urbanization (China Urban Sustainability Coalition, 2015). These were based on the observation of Chinese cities and the weak points they still display in their efforts of becoming low-carbon. Nevertheless, these standards can be applied to other cities around the world as well, since they represent solid guidelines for any city with the

[5] China Association for NGO Cooperation; China Business Council for Sustainable Development; the CDP; U.S.-China Energy Cooperation Program; Eco Forum Global; Innovative Center for Energy and Transportation; International City/County Management Association; International City/County Management Association China Center; Innovative Green Development Program; Institute for Transportation and Development Policy; Oak foundation; The Ecologic Sequestration Trust; the United Nations Development Programme China (UNDP China) (China Urban Sustainability Coalition, 2015)

ambition of lowering its carbon footprint. The ten principles were divided into three categories:

- Low carbon urban form
- Resource efficiency
- Inclusive urban governance (Ibid)

4.2.1 Low Carbon Urban Form

Within the low carbon urban form following 4 principles were defined:

1. Be efficient in land use in urban renewal projects and in the new development of the city. Develop a compact, efficient and mixed-use design that is functionally balanced.

This principle includes measures such as setting an urban growth boundary within which the city should be developed until the density of the population has risen to a certain level. Moreover, it suggests to increase the closeness of street networks and create small urban blocks. These can increase the efficiency of urban transport as the walking distance is minimized and the citizens are able to reach all services and facilities easily; motorized transport can thus decrease. Furthermore, a mixed-use design of development should be utilized by combining commercial and residential areas; brownfield sites redevelopment is encouraged as well (Ibid).

2. Help the development of less motorized public transport by allowing walking, cycling, and public transit to become the main component of transport in the city.

The main step that can be taken in order to follow this principle is to develop a street system for walking and biking that is well-connected and complete and at the same time limit the number of obstructions or detours the pedestrians and cyclists encounter. Sufficient parking amenities for bikes, a high number of walk-through communities, and increasing the overall safety and convenience of non-motorized

transport are imperative. In addition, the connectivity between various types of public transport, such as the underground, buses or light rail should be thought-through and the distance between their stops optimized (Ibid).

3. Decrease the use of private vehicles by improving the city layout, designing the public transport network in an efficient way and ensuring good management of public transport.

In accordance with this principle, cities should not favor private motorized vehicles over the rights of pedestrians and cyclists with regards to the street space, e.g. bus rapid transit lines are encouraged in cities with a lot of commuters. Private vehicle use can be further reduced by introducing higher parking fees in the central areas of the city, by establishing low emission zones or imposing financial and tax measures on private vehicle owners. Public transport system routes, as well as public transport services quality is stressed and measures for calming the traffic, such as speed limit in residential areas, are supported too. Furthermore, raising public awareness and advocating the use of vehicles with zero-emissions are emphasized in this principle as well (Ibid).

4. Design and develop public spaces for citizens to enjoy their urban life. Establish environmentally friendly and functional spaces of high quality.

The last principle in the low carbon urban form category emphasizes the importance of citizens feeling well in their urban area which can be achieved through the creation of easily accessible public spaces located throughout the city. Including facilities that make their life more convenient, such as activity spaces or outdoor furniture, or facilities making life more enjoyable, such as landscapes or art, should increase the quality of life of urban citizens and suit all their needs. This principle supports integrating nature into the city design as well as protecting traditional architectural and cultural features that are part of the public spaces in the city (Ibid).

4.2.2 Resource Efficiency

There are 4 principles identified in the category of resource efficiency in the cities:

5. Technology upgrade and process management should receive the same amount of attention when attempting to achieve efficiency regarding resources and energy.

To implement this principle, a city can adopt several measures. The most crucial one is control of the city's GHG emissions through developing a plan of greenhouse gases reduction and also through carbon trading. Letting energy efficiency become an alternative source of energy should also become a city's practice in order to follow this principle. Mechanisms that are energy and carbon-intensive should be avoided in the urban development process and instead, renewable energy should be given priority. Investment into green energy should be continuous and the actual use of this type of energy should increase together with the city's capacity to provide it. Moreover, commercial and industrial players should be supported in implementing low-carbon solutions (Ibid).

6. When promoting green buildings and their energy efficiency, the whole life cycle of a building needs to be considered with the objective of limiting its energy consumption and reducing the impact it has on the environment.

It is required for energy efficiency standards to be applied in all stages a building goes through, from its design to demolition and become more stringent over time. Buildings' energy consumption can be reduced also by using its natural conditions to its benefit and the energy efficiency in building operations can be decreased also by utilizing market-based actions (Ibid).

7. Adopt waste minimization instruments, enhance recycling and use the remaining municipal waste as a resource.

The concept of reduce-reuse-recycle should be implemented in accordance with this principle of low-carbon urbanization. Businesses and manufacturers should be encouraged to start the process of reducing waste by using recyclable and more durable materials as well as limit their packaging. Next step that can be taken by the cities is the development of facilities for reusing and recycling materials and waste, and turning it into resources; this can be supported by policies and regulations. The disposal facilities should be operated and managed by professionals and supervision should include both public and government. Educating the citizens on waste handling and establishing zero-waste communities can also prove to be beneficial (Ibid).

8. Increase water use efficiency in the cities and create nature-based water circulation system that leaves low-impact on the environment.

There are several means through which urban areas can improve their water treatment, such as enhancing and upgrading the facilities for sewage treatment or increasing the rate of recycled water by providing new buildings with water reclamation system. Furthermore, water circulation process can be improved through nature-based means, which can help to reduce the surface runoff and lower the need for drainage facilities. Additionally, this principle demands urban construction to consider its impact on the environment and urges it to lower it by keeping it in its original state when possible (Ibid).

4.2.3 Inclusive Urban Governance

This category consists of 2 main principles:

9. Turn “city management” into “city governance” with the goal of ensuring a pleasant living environment for the residents and providing them with quality public services.

This principle emphasizes the importance of public participation in the governance of a city. The citizens should be able to supervise and be part of urban, transportation, and community planning in their city; ensuring public awareness and transparency of information is thus crucial. Communities consisting of organizations, government units, and local enterprises are encouraged to pursue cooperative governance and management. Urban residents should be encouraged to lead a low-carbon lifestyle which can be enhanced with the right facilities and services provided by the local authorities (Ibid).

10. Support low-carbon development in urban areas through green investments and financing.

Cities should explore the green financing options and one of the steps they can take in this direction is to implement policies that direct threshold investments; projects fulfilling low-carbon norms should be able to receive funding easier than high-polluting projects and industries. Another measure that can be taken to facilitate green financing is to create risk-sharing mechanisms. Assessment mechanisms should be applied by local governments to evaluate the environmental impact and social benefits of green projects. Green financing systems, such as green internet banking, green credits or green insurance can also support low-carbon development (Ibid).

4.3 Liberalism

The theoretical perspective of liberalism has offered an alternative to realism in its view of International Relations (IR) ever since the creation of this academic discipline and represents one of the essential international relations theories up to this day. Liberalism is characteristic with its positive perception of the world and human nature in particular. Its origins can be traced back to Europe of the 18th century and the Enlightenment period (Jackson & Sørensen, 2013:101).

John Locke is considered as one of the philosophers who provided the ideological basis for liberalism; he claimed a state should allow its citizens to pursue their happiness by ensuring their liberty. English thinker Jeremy Bentham attached importance to states adhering to international rules and Immanuel Kant built on this idea and outlined a world where the states would respect its citizens internally and other states internationally and "perpetual peace" could be established (Ibid).

Throughout the 20th century, liberalist ideas presented realism's adversary and contested for being the dominant perspective in the IR. After the First World War, the ideas of a peaceful international arena with states cooperating rather than struggling for power were supported and only the Second World War pushed liberalism back into the background and made the realist perspectives more prevalent. Liberalism regained its position after the Cold War, became one of the preferential theories once again and gave rise to multiple sub-theories (Ibid).

4.3.1 Main Assumptions

Liberalism, not unlike realism, believes that states are the main actors in international relations and their interactions take place under the state of anarchy. According to this theoretical perspective, however, anarchical society lead by no central authority can be regulated by different tools and peace among the states can be achieved. It believes that people are good in nature and they are willing to cooperate with one another. International relations are thus characterized not by hostile relations between the states but rather by collaboration and mutual interdependence, which can be strengthened through a free trade functioning at the international level (Meiser, 2017:24).

The theoretical perspective of liberalism claims that states are the main units in the international relations who pursue their individual goals; it does not refute the fact that conflicts may arise among the states. Nonetheless, it perceives diplomacy as a powerful tool able to resolve these problems and protect the nonviolent and harmonious environment in international politics. Furthermore, it believes that

chances of disputes between the states and wars which could result from them decrease as the mutual interdependence and interconnectedness among the states increases. All forms of interdependence, whether it is in the economic, financial or cultural area, therefore help the international community in preserving amicable relations and avoiding frictions, regardless of the actors being states, organizations, groups or individuals (Jackson & Sørensen, 2013:106).

Liberalism opposes the traditional realist notion of states being in a constant struggle for power and attempting to reach the ultimate goal of hegemony. Rather, it believes that states, despite having their own interests, are able to coexist and create partnerships among themselves. Shared ideas, beliefs, and aspirations represent compelling incentives for establishing such alliances and pursuing common goals. The states under this theoretical perspective regard the absolute gains as more important than relative gains and, therefore, are likely to pursue any cooperation with a prospect of raising welfare and prosperity (Meiser, 2017:25).

According to the liberalist approach to international relations, states are not the only actors able to influence the global arena with regards to politics or economy. Non-governmental entities are not held futile as the liberalists believe they have the power to influence a state and the way it behaves. International organizations are considered an important player in international relations as well since they are able to regulate the behavior of the states despite having no direct power over them. Rules and regulations which the institutions provide on cooperation and competition among the states are generally agreed upon by the states involved. These are duly expected to follow these rules and alter their behavior in accordance with the given rules (Ibid, 2017:24).

Except for international organizations, liberalism takes notice also of other actors, such as transnational corporations. It perceives international relations to consist of a variety of relations, from the ones between people and groups, through the interstate relations to the transnational relations (Jackson & Sørensen, 2013:105).

4.4 Use of Theory

Chosen theoretical frameworks and perspectives are utilized in the following parts of the paper, namely in the process of analysis. Ten principles of low-carbon development are providing a structure for the analysis and outline the categories in which the decarbonization initiatives of European and Chinese cities are analyzed. The international relations theory of liberalism serves as a medium to examine the cooperation between the two actors and explain the reasons for it.

5.0 Analysis

Following chapter examines multiple low-carbon initiatives; the actions taken in the cities across the EU and the PRC are reviewed in the categories of low-carbon urban form, resource efficiency, and inclusive urban governance and thereupon compared. Last part of this chapter is focused on the mutual cooperation of the actors in the area of low-carbon city development.

5.1 Low-Carbon Urban Form

There are four main principles falling into the category of low-carbon urban form. They pertain to the effective use of land, efficient urban design and changes in the city's infrastructure that support increased use of public transport and decreased use of private vehicles. It includes also the initiatives focused on creating a resident-friendly and human-centered environment for the citizens.

Effective use of land can include setting certain growth boundaries within which the city's development should take place until a specific quota has been reached, e.g. population density. This principle is followed, for example, in **Hamburg**, Germany. The city lies on a river Elbe and its port is one of the most important in

Europe. Its geographical expansion would be a viable option to increase its capacities, however, more sustainable solutions are being pursued through filling up the expandable basins in the harbor; the land is thus used in a more efficient way (European Commission-a, n.d.). In China, the situation is dissimilar. With the growth in the number of inhabitants, the cities tend to spread in space without many limitations. The way the land ownership system is set in the PRC causes that the cities' governments here benefit from providing the land to developers and turning the rural land into an urban area. The land concession revenues that the local authorities receive then drive them to expand the outer borders of the city and there is no incentive for them to use land in a more efficient way. This has reflected on the urban development of many Chinese cities and the spatial inefficiency seen there (Li & Xie, 2015).

Another way of making better use of the city's territory is rearranging its internal structures by creating dense street networks or creating city blocks with a mixed-use design. An example of such city is **Barcelona** where the city layout allows it to create urban units called **superblocks**, which represent an area bigger than a regular block but still smaller than a neighborhood (400x400 meters). Restructuring public space and citizen mobility are part of an innovative urban model where pedestrians are promoted over cars. The project required certain changes in the road network as the motorized vehicle use is restricted only to the exterior parts of the superblocks. The internal roads are used primarily by pedestrians, making their mobility in the city easy and convenient. The superblocks initiative not only promotes sustainable mobility and decreases the amount of carbon emissions, but it also allows revitalization of the public space, expansion of green areas and an increase of energetic self-sufficiency of the blocks (C40 Cities, 2014-a). Superblocks in the context of Chinese cities have a somewhat different connotation. They encompass a whole neighborhood with less dense street network and reduced walkability within the area; the blocks consist of residential buildings with repetitive architecture and functionality while the mix-use design remains scarce and diversity is lacking (Li &

Xie, 2015). Superblocks here thus represent an inefficient land use giving priority to cars rather than pedestrians and cyclists. Despite this being the prevalent pattern in the cities around the country, there are efforts to break down the blocks into smaller areas with a denser structure of streets and increased accessibility. For example, **Chenggong New Town** in Kunming used to represent a typical example of inefficient urban planning in China until it underwent these transformations and increased the functionality of its neighborhoods, which allowed for a lower amount of emissions and higher land use efficiency (Ibid).

Mix-use design can be implemented also within districts, whether it is through new construction or through a redevelopment project. **Quartier Massena** in **Paris**, which represents such district, was built in the 1990s in order to create a space for the citizens which would combine residential buildings with work and entertainment facilities, as well as retail activities. By providing citizens with all the daily necessities within walking distance, their need for the use of cars or public transport was lessened and the levels of carbon emissions thus decreased as well (C40 Cities, 2016-a). A case of redevelopment of an old brownfield site into a district with low environmental impact can be seen in **Stockholm's Hammarby Sjöstad**. This regeneration project of an industrial and harbor area resulted in a modern and sustainable district, with the main goal of 80% of the trips within the area being made by walking, cycling or using public transport (Berger, 2017). The largest zero-emissions district in the world, **Bahnstadt**, is located in the German city of **Heidelberg**. Part of a redevelopment project commenced in 2008 and expected to finalize in 2022, Bahnstadt stretches to 116 hectares and consists of passive houses with minimal energy consumption. Use of private transport is very low here not only because of the central location of the district in Heidelberg but also due to electric car-sharing facilities easily accessible to the citizens. Moreover, environmentally friendly modes of transport, such as walking and biking, are highly promoted and supported (Cities 40, 2015-a). These projects help in the reduction of the overall amount of GHG emitted into the atmosphere by

the urban areas and their development also creates a large number of jobs and thus contributes to the economic development of the individual cities.

Rehabilitation practices and transformation of brownfield sites are becoming increasingly common in Chinese cities as well. The city of **Wuhan**, for example, created a new, low-carbon district **Gutian Ecological New Town** by redeveloping an old industrial park. The chemical industry businesses have been relocated and residential buildings powered by green energy will be built in their place. Public transport will be easily accessible for the citizens and walking and biking further promoted; which will significantly help the reduction of CO2 emissions (C40 Cities, 2015-b). The city also works on the transformation of **Jinkou landfill** into a green area and restoring the soil through aerobic processes with the goal of improving the environment for the inhabitants and reducing pollution (C40 Cities, 2016-b). **Hong Kong** is also restoring its brownfield site into a district with low-carbon emissions. **Kowloon East** is modified into a business area resilient to the effects of climate change and with one-third of the district being public space (C40 Cities, 2016-c). There are many industrial areas around China that no longer fulfill the environmental standards and have, therefore, been closed. By leaving behind extensive abandoned complexes, oftentimes with contaminated land, they represent numerous possibilities for rehabilitation and reuse of the sites (The World Bank, 2016). However, increasing urbanization level in China results also in a lot of new development in the cities around the country. There is a focus on the integration of the existent cities through the establishment of new urban areas which serve as connecting hubs. Such cities implement various sustainable development solutions during their construction as well as in their management process. An example of such a city is **Xiong'an New Area** which is supposed to connect Beijing, Tianjin and Hebei (Wong, 2019).

Some cities focus on lowering their GHG emissions by using **green areas** in and around the city. For example, **Lisbon**, which has been elected the European Green

Capital[6] for the year 2020, focuses on sustainable land use by protecting its natural areas. Moreover, it plans to connect these areas with a green corridor (paths for pedestrians and cyclists) in order to provide Lisboners with easy access to recreational areas and activities. The city makes sure the fauna and flora along this corridor prosper and the biodiversity is protected and growing (European Commission-b, n.d.). Similarly, **Master Plan for Barcelona's Trees 2017-2037** is trying to enhance the biodiversity in the city, improve air quality and raise the residents' quality of life. The enlarged tree canopy will help to cool the air in the city, reduce the urban heat island effect (UHI) and provide more resting places for the people, which is important especially during the hot summer months. Planted trees are heat and drought resilient, making them ready for future changes in the climate (C40 Cities, 2017-a). China is taking the greening efforts a step further; it plans to create the world's first city where trees are enveloping all the buildings and in this manner establishing a Forest City powered by renewable energy in **Liuzhou**. The construction of the city should finish in 2020 and the positive effects of it should be not only a decreased temperature in the area but also increased biodiversity and climate change resilience (Stefano Boeri Architetti-a, n.d.).

The city of **Athens** is also focusing on cleaner air and the safety of its citizens with its **Greener and Cooler City project**, which includes increasing the tree canopy and reorganizing the green spaces in order to achieve their equal distribution throughout the city. The aim is to provide citizens with a cooling place within walking distance and protect them from heat-related health complications. A mechanism available for smartphones and computes was developed in order to inform the users about current temperature, warn them against heat waves and navigate them to the closest cooling spot (C40 Cities, 2016-d, 2016-e). In China, similar protection of the citizens focuses not on heat waves but on heavy air pollution, especially during the

[6] European Green Capital is an initiative established by the European Commission in 2008. Since 2010 an annual award is given to a European city that showcases high environmental standards, actively pursues sustainable development and its practices can serve as an inspiration to other urban areas (European Commission-g, n.d.)

autumn and winter months. **Beijing** created an **Emergency Plan for Extreme Air Pollution** back in 2012 and updated and improved it throughout the years. It helps to warn people in case of high levels of pollutants in the air via both, traditional and new media and allows for a more efficient application of pollution control actions (UN Environment Program, 2019). However, rising temperatures and heat waves connected to it have been occurring at a greater extent lately also in China and the trend is expected to continue in the foreseeable future. Efforts in cities focused on increasing the number of green areas and decreasing the UHI and overall temperature in cities will, therefore, become crucial in preventing the heat-related problems and protecting the health of city dwellers.

Except for making a city more walkable and greener, the low-carbon urban form principles focus also on the use of **public transport** and decreasing the use of private vehicles. For example, the city of **Hamburg** adjusted its public transport stops in a way which ensures that citizens can reach them within 300 meters almost anywhere in the city (European Commission-a, n.d.). **Nantes** became European Green Capital in 2013 also because of its development of a sustainable public transport system and promotion of cycling. Moreover, it became the first French city to re-introduce electric tramways into public transport (European Commission-c, n.d.). The city of **Beijing** has been working on its subway and bus system of public transport and increasing its convenience for the passengers in recent years and managed to lower the number of trips taken by private motorized vehicles (UN Environment Program, 2019). Nevertheless, it is the city of **Guangzhou** that has developed an innovative approach to public transport by opening its system of Bus Rapid Transit, the first of its kind in Asia. It efficiently and effectively combines transportation by bus with transportation by subway through direct connections to the subway stations. Moreover, it further integrates walking and biking into the system through walkways and paths, together with easily accessible bike stations along the bus rapid transit corridor (Ohshita et al., 2015).

The city of **Stockholm** focuses not only on the infrastructure of the **public transport** system but also on the **type of vehicles** used for it. Its inter-city buses and trains are fueled by renewables and the city plans to have a public transport system with only clean vehicles by 2025 (C40 Cities, 2011-a). An example of other parts of Europe trying to follow the lead of the Nordic countries in the clean vehicles can be **Warsaw** in Poland, which has been investing in electric buses and charging stations and which plans to further enlarge its e-buses fleet also in the future. The realization that despite initial investment in the electric vehicles for public transport may be high, the savings made on non-diesel fuels are higher and therefore the transition is, in the long term, beneficial, caused the city to join the many urban areas on the path of sustainability (C40 Cities, 2017-b). Chinese cities started to pay attention to transforming their public transport vehicles and taxis into cleaner variations as well. **Beijing** has been continuously upgrading its standards for emissions of motor vehicles and increasing the number of new energy vehicles or vehicles run on clean fuels in recent years and **Shenzhen** is implementing similar measures trying to reach the goal of a zero-emission system eventually (Un Environment Program, 2019; C40 Cities, 2016-f). **Wuhan** started labeling the vehicles which had high pollution levels and withdrawing them from the operation and **Nanjing** managed to put over 4,300 electric vehicles in circulation within just one year (C40 Cities, 2016-g; 2015-c).

Reducing the use of private vehicles is another important element in the plans of decarbonization for cities around the world and there are various ways individual municipalities are trying to achieve goals in this area. Enhancing the walking paths and giving pedestrians more street space is a popular option, oftentimes accompanied by the development of cycling lanes. Redevelopment and new development projects in Chinese cities are also pursuing these methods nowadays and **Wuhan**, for instance, is determined to ensure that newly built roads not only serve the cars but also have a space reserved for pedestrians and cyclists (C40 Cities, 2016-h). The city of **Copenhagen** is one of the world leaders in the use of bicycles and it continues to develop its infrastructures in order to further promote

their use. Intertwining public transport with biking is facilitated through parking stations for bikes located at train and bus terminals. The city is investing also in the modernization of its traffic lights system; the real-time control enables more efficient traffic flow and makes the biking smoother. The development of **Super Cycle Highways**, **Green Cycle Routes** and the 'cycle snake' or '**Cykelslangen**' all represent ways the city is prioritizing the cyclists and their needs. Creating these safe tracks isolated from cars while also applying interesting design and elevating the cycling experience helps to maintain the popularity of this mean of transport in the city (C40 Cities, 2016-i, 2016-j).

Another way of reducing carbon emissions in the cities is the **replacement of fossil-fueled private cars** with more environmentally-friendly vehicles. **Lisbon** advocates for the use of alternatively-fueled cars (European Commission-b, n.d.), **Stockholm** assisted in the expansion of the market with hybrid cars and vehicles fueled by ethanol or biogas (C40 Cities, 2011-a) and the city of **Oslo** supports zero-emission transport and a transition to the use of electric cars for its inhabitants (European Commission-d, n.d.). Electric vehicles represent 30% of the vehicles sold in the city (Ibid); and the municipality provides various benefits to the drivers of electric cars, such as tax exemptions and subsidies, free parking in the city or permission to use bus lanes (C40 Cities, 2014-b). **Madrid** is also supporting the use of electric vehicles through advantages in mobility, as well as tax incentives for its users (C40 Cities, 2013). Citizens of **Heidelberg** who decide to switch to a cleaner transport are also targets of certain benefits granted by the city, receiving a financial bonus for the purchase of an electric or hybrid car or, alternatively, getting one year of free public transport after selling their fossil-fueled car (C40 Cities, 2017-c). In China, the use of new energy vehicles, such as electric, hybrid or fuel cell vehicles is subject to national and local subsidies. In **Wuhan**, for example, the combined subsidies can reach up to 60% of the new energy vehicles' price and in **Shenzhen** also the providers of charging facilities can receive financial support; the cities are in such way

supporting the individuals or companies in the purchase and use of new energy cars (C40 Cities, 2017-d; 2018-a).

There are also cities which decided to use **restrictive measures** to lower the carbon emissions in their urban area. **Oslo**, for example, started establishing car-free zones around the city and **Paris**, while providing a financial aid for a public transport pass, or subscription to the city car-sharing service (Autolib) or bike-sharing service (Velib) for the citizens who cease using their cars, also decided to pass a ban on the use of diesel vehicles by 2020 (European Commission-d, n.d.; C40 Cities, 2016-k). Furthermore, some cities decided to delimit areas in the city where the vehicles are subject to a congestion charge. **Milan** outlined a section of the city called Area C, where the vehicles have to pay a fee to enter. This pricing scheme was launched in 2012 and has led to relieving the pressure of the traffic in the area, lowering the amount of carbon emissions and enlarging the public space previously taken up by parking spaces (C40 Cities, 2015-d). **Stockholm** introduced the congestion charge even earlier, in 2007, with the main goal of achieving a better environment in the city center and ensuring more fluid traffic. Payment of the congestion charge has been made easy - after the cameras and computer system recognizes the car plate, the fee can be subtracted directly from the drivers debit card or through payment in a store or online. Some vehicles, e.g. emergency ones, have an exemption from paying the congestion fee (C40 Cities, 2011-b). Cities in the PRC are designing various restrictions for the car owners as well. The city of **Shanghai** limits the number of private vehicles through auctions where the citizens can buy a license plate and **Beijing** is trying to control the traffic flow by allowing only certain cars on the roads during certain days, also depending on their car plate; **Guangzhou** decided to use the strengths of both practices and created a system which combines them (Ohshita et al., 2015). The capital extended the restrictions also to the number of new cars sold by limiting the number of license plates released every month, with the allotment becoming increasingly strict (UN Environment Program, 2019). Furthermore, a mechanism to control vehicle pollution has been developed for regional control of

emissions released by vehicles through inspection of the cars in the area and awarding penalties to those violating set standards (Ibid).

Popular measures taken in the decarbonization efforts of the city are also **bike-sharing and car-sharing services**. Some municipalities are trying to reduce the use of private motorized vehicles in general, some are pursuing a more specific goal. For example, by commencing a bike-sharing program, **Lisbon** is trying to get its citizens to cycle in the more mountainous parts of the city apart from the city center (European Commission-b, n.d.). **Wuhan** uses its bike-sharing program, which is one of the largest of its kind in the world, not only to lower the emissions in the city but also to solve the last-mile transportation problem. The municipality focused especially on sufficient connectivity of the system to the rest of its public transport. The special carbon credit feature makes the system more attractive for the users as their CO2 reductions are calculated and converted to credit which can be used for purchasing small goods and services (C40 Cities, 2016-l). Bike sharing is popular also in other Chinese cities, however, the number of bicycles provided outnumbered the demand and many cities now have to deal with the surplus of bikes that are not being used (Taylor, 2018). **Milan** launched a scheme which allows the citizens, as well as visitors, to use one of the city's electric cars, bikes or scooters freely available throughout the city. Locating the vehicles of this ride-sharing program is facilitated through a smartphone application, making the access easy and convenient for the users (C40 Cities, 2015-e). Most car-sharing services in China consist of electric cars as well, however, the first hydrogen car sharing service has just been introduced in **Chongqing's** district of Nan'an and the goal is to put 10,000 hydrogen-powered cars into circulation between 2020 and 2021 (New Mobility, 2019).

Sub-chapter conclusion

As can be seen from the case studies, there are manifold decarbonizing initiatives focusing on various aspects of low-carbon urban form category both in

Europe and in China. Adopting an urban layout that would allow the city to be walkable and the citizens to have easy access to residential, working and commercial activities within their reach have been in focus of European countries for a rather long period of time whilst most Chinese initiatives are relatively recent. Different size of the cities in Europe and the PRC pose one large variation between them; generally speaking, European cities are much more compact and smaller in the number of inhabitants which makes most efforts taken and changes done in the urban form in this region small-scale when compared to China. Increasing walkability and connection to public transport here is easier and more straightforward than in the PRC and so is the direct connection of walking and cycling paths to public transport.

This is further highlighted by the fact that Chinese cities' spatial layout tends to stretch without many restrictions and the use of land is fairly inefficient. Setting population density quotas that would limit the growth of the city and utilizing the existing urban areas in a smarter way would not only make the traveling distances of the residents shorter but through a mix-use urban design also increase the quality of their life and satisfaction with the area they live in. Development of mix-use green districts is becoming more and more common in Europe, whether it is through the redevelopment of an old brownfield site or through new development. In China, similar efforts can be seen mostly in the redevelopment area. There are plentiful industrial sites around the country, many of which are closed and abandoned either because of not fulfilling present environmental standards, being relocated to a different area or because of simply not being necessary anymore due to the country's turn from sheer heavy industry towards more service-oriented sectors. These present abundant opportunities for transformation into green, low-carbon districts; however, in many cases, the urban areas first need to address the problem of residual pollution of soil or water in the area and the process of revitalization is thus slowed down.

Another difference can be seen in green areas around the cities across Europe and China. The European cities are focusing a lot on increasing the green spaces in and around their urban areas and conducting small and large-scale initiatives that

include municipality but also citizens and other stakeholders. The trees improve the air quality in the city and thus provide a healthier environment for its residents, but they can also retain water during rainy seasons and help in easing the pressure on the sewer system. Furthermore, they help with energy efficiency in the city by reducing the UHI effect and thus lowering the need for the use of air-conditioning in the buildings. They also provide shade the citizens need during hot days and park areas can serve as a spot for recreation as well. They can be used also to grow fruits and vegetables and increase the city's food self-sufficiency. Chinese cities have a lot of potential for implementing similar measures, including green rooftops in their urban design and increasing the number of parks around the city. However, projects relating to greening efforts are seemingly sporadic and despite current large-scale efforts, such as the forest city in Liuzhou, there exists a necessity for more constant and strategic planning for the expansions of such areas in the Chinese cities.

The infrastructure of public transport and its connectivity to walking and cycling paths is being developed in both regions and despite Europe having a denser structure of streets and stops, China is trying to resolve this problem with numerous bike-sharing programs which help to create a more accessible and convenient system for the citizens and scale down the problem of the last-mile transportation. These initiatives become even more effective once the problem with the surplus of bicycles in numerous cities is solved. The type of vehicles used for public transport also presents an area where there is a space for improvement. Both regions are transforming their bus fleets, taxis, and public vehicles into more environmentally friendly versions run on cleaner fuels, however, the utilization of renewable energy in public transport could be undoubtedly higher. Such green shift could have a significant impact on the carbon emissions level in the urban areas and on sustainable development in general.

Private vehicle ownership is a subject to change in the upcoming years as well. There are attempts to lower the number of privately-owned cars and replace them with more sustainable means of transport. The citizens are encouraged to sell their

cars or change them for a cleaner alternative. In China, the purchase of electric vehicles is subsidized both nationally and locally and in Europe, the citizens who own such vehicle are enjoying tax relieves as well as benefits while driving, and in some countries also additional financial bonuses. Incentives to give up personal vehicles in some European cities extend also to free use of public transport for citizens in order to accelerate the process of change. Private vehicle ownership decrease is further pursued through restrictions and limitations. In Europe, these pertain mostly to carbon-free areas and congestion tax areas in the cities and in China, the restraints are focused on the number of license plates issued and non-daily use of a car for certain drivers.

5.2 Resource Efficiency

Measures taken in the resource efficiency category of the low-carbon urban development principles include not only conscious management of natural resources and their efficient utilization and reuse but also setting building standards or controlling the greenhouse gases.

One of the main elements seen in the efforts for a more sustainable development and resource efficiency is the change in **energy sources**. Instead of traditional coal and other non-renewable resources, the cities are transferring to cleaner forms of energy, such as sun, wind or water. **Solar power** represents a kind of renewable energy that is employed in various parts of Europe and the city of **Barcelona** even made the use of solar energy for hot water supply compulsory for the buildings in the city with its **Solar Thermal Ordinance** in 2000, which made it the first city in Europe to implement such measure. Since then, many other Spanish cities have adopted ordinances like this as well (C40 Cities, 2011-c). China has been investing in green and renewable energy projects in recent years too. For example, the former coal mine in **Huainan** was transformed into a large solar farm. 160,000 solar panels are positioned on the surface of an artificial lake, which not only helps with the cooling of the panels and increases their efficiency but also saves the space

on the land that can be utilized for other purposes. This project currently represents the largest floating solar power plant in the world (Planète Énergie, 2018).

Wind power is also a very wide-spread option of renewable energy and Denmark, with its sufficient wind resources, is a country leading by example in this area of renewables, aiming to have the wind turbines produce half the amount of energy necessary for the country by 2020 (Danish Ministry of Housing, Urban and Rural Affairs & Danish Energy Agency, 2014). The city of **Sønderborg** started building an onshore wind farm in a coastal area close to the city and **Aarhus** aims to incorporate wind power even into its local heating system (Ibid). China is continuously building wind turbines and increasing its capacities in renewable resources, however, there are certain problems with the actual delivery of the clean power to the consumers. The power grid is not sufficient to carry the large amounts of energy that are created through harvesting wind, solar or hydro power and the resources are thus wasted and not used up to full potential. The city of **Yanan** in Shaanxi province is now limiting the number of wind projects due to the grid deficiencies through a lottery system and allows only a certain number of them to proceed (VOA, 2018).

Norway is also one of the leaders in the use of renewables, specialized in handling the power of water; **hydropower** here produces 98% of all electricity in the country (C40 Cities, 2012). Another Nordic country, Iceland, was the pioneer in experimenting with **geothermal** power and it remains the world leader in this area. Currently, 90% of heating in the country is generated by this type of power and the number grows to 95% in **Reykjavik** where it is used in the district heating system (Green City Times, n.d.). Geothermal energy in China is utilized as well, however, not on such a wide scale as hydropower which represents the biggest source of renewable energy in the country. The PRC has built many great water dams in the recent past with the **Three Gorges Dam** being the largest in the world. Despite the environmental damage and the need for the people to relocate connected to its construction causing controversy, the hydropower remains the main source of

renewable energy in China, representing 20% of total generation (Nikkei Asian Review, 2019).

Furthermore, countries and cities are supporting research and development in the energy sphere, which helps them reach higher efficiency levels. For example, **Combined Heat and Power** (CHP) technology allows not only to harvest the electric power but also the heat, which would normally be just a side product of the process, can be collected and reused, e.g. in a city's district heating. Some power plants in **Copenhagen** are using this technology and the original energy sources they employ are becoming greener as well; one of the plants has already converted to 100% biomass (Danish Ministry of Housing, Urban and Rural Affairs & Danish Energy Agency, 2014). **Stockholm**, too, uses **biomass** to power its CHP plant, which powers the city's district heating system and in such way approaches its goal of using only renewable energy by 2050. Waste and biomass in Stockholm are utilized also in the **Biochar Project**, which helps to transform garden waste from the city into a product similar to charcoal. It can endure in soil for a very long time, increase its fertility and it can be used also in the city's carbon sinks. Biochar plant in the Swedish capital is first of its kind in the world but already received a lot of interest from other cities (C40 Cities, 2016-m, Nordregio, 2018). **Oslo** uses its biowaste to produce **biogas** later utilized in the transport sector and the city of **Sønderborg** has a construction of two biogas plants scheduled as well, hoping to substitute natural gas with biogas in 25,000 households (European Commission-d, n.d.; State of Green, 2017). Similarly, in **Hong Kong**, the CHP system is using biogas for generating electricity, which is later used in the sewage treatment facilities, and the residual heat is utilized in the process of sludge digestion (C40 Cities, 2011-d). Moreover, by constructing a plant for incineration of wastewater sludge, the city makes sure it is transformed into energy rather than just transported into a landfill as it used to be in the past. This infrastructure is energetically self-sufficient, exports energy also into the city's grid, reuses rainwater and does not release any effluent water into the sea (C40 Cities, 2017-e). The city of **Qingdao** is trying to reduce its dependence on non-renewables

as well. It utilizes the waste heat and in such way reduces the reliance on coal, which, together with the municipal energy efficiency plans, lowers the emission levels in this urban area (C40 Cities, 2017-f).

Attempts to reduce fossil fuels in **Oslo** can be seen also in the life cycle of buildings, from their construction to demolition. Using public procurement to enhance the development of **fossil fuel-free construction** machinery and vehicles proved to be an effective way to reduce emissions in yet another area (C40 Cities, 2016-n). **Beijing** is enforcing policies control of **dust pollution** at construction sites and released guidelines which should help with its reduction (UN Environment Program, 2019). Considering the ever growing status of Chinese cities and ongoing construction in them, implementing similar measures as the ones in Oslo could be of large impact and could significantly reduce the pollutants released into the atmosphere.

The renewable energy sources are becoming more common also in the **district heating** systems of the European cities. **Copenhagen's** system, which is one of the oldest and largest in the world, provides the residents with heat produced by the CHP plants run on renewable resources, but other cities are reducing the use of non-renewable energies in their district heating as well, e.g. **Paris** to 50%. (C40 Cities 2011-e, 2016-o). **Warsaw** is retrofitting its local system, modernizing it and modifying the sources of energy used to power it in order to include more non-fossil fuels; it is taking steps to reduce its emissions in the energy sector which presented the largest portion of GHG emitted in the city back in 2013; **Rotterdam** is undergoing an even bigger challenge of installing a heating system that is city-wide and to which the houses, previously individually heated, will be able to transfer (C40 Cities 2016-p, 2017-g). Chinese district heating system represents the biggest in the world and it is, therefore, important for achieving a sustainable development now and in the future that the share of coal in the fuel mix in the PRC is on the decrease. The coal-run district heating is one of the major sources of emissions in the cities and the reason for increased air pollution during the winter months. Nevertheless, the efforts

of replacing the coal-fired boilers and coal-fired CHP systems can be seen for example in **Beijing**, where natural gas, electricity and other, less-polluting, systems are being promoted and subsidized with the goal of expanding a coal-free zone throughout the city (UN Environment Program, 2019). Some cities are innovative also with the ways of **district cooling** they are using. **Copenhagen** takes cold seawater from the harbor area and cools the buildings in the city center through a pipeline system; **Amsterdam** is using cold water from a lake to do the same. This method of district cooling reduces emissions by 70% when compared to traditional systems and it also helps with lowering the UHI effect (Danish Ministry of Housing, Urban and Rural Affairs & Danish Energy Agency, 2014; C40 Cities, 2011-f). The Chinese city of **Wuhan**, more specifically the area of Baibuting, uses geothermal heat pumps for both, heating and cooling purposes alongside with other energy efficiency measures implements low-carbon designs into its development (C40 Cities, 2016-q). Similarly, the area of **Dayou Tianyuan** close to the city of **Dalian** is becoming an example of a community utilizing innovative systems with low emission levels through its solar-based water heating system and boilers with high efficiency (C40 Cities, 2019-a).

Increasing energy efficiency of the buildings can be enforced also through the establishment of **building standards** or making the existent standards more strict and demanding. Not only do the countries have national regulations pertaining to energy efficiency in buildings, but some cities, for example, **Heidelberg**, set their goals past these and want to reach more ambitious goals. This German city is achieving this through passive house standards and ultra-low energy buildings (C40 Cities, 2015-a). Similarly, **Stockholm** requires all new houses in its Royal Seaport Project, the goal of which is to create an eco-district, to be passive as well (Berger, 2017). The cities in the PRC have been focusing on energy efficiency in buildings more and more, and for example, the research center in **Wuhan** implemented many zero-emission and clean energy solutions during its construction, such as natural lighting and shading, water retention and reuse system with a rooftop garden and solar panels ensuring energetic self-sufficiency of the building (C40 Cities, 2016-r). The before

mentioned **Dayou Tianyuan** community increases the energy efficiency of the houses not only by using smart heating systems but also through insolation of the houses and water recycling system (C40 Cities, 2019-a). The use of renewable energy applications in buildings and promotion of ultra-low energy efficiency in **Fuzhou** or **Beijing** is increasing the performance of the structures and ultimately reduces the carbon emissions produced within the urban area (Sherlock et al., 2018). The Institute of Building Research in **Shenzhen** also represents a building with high energy efficiency and performance achieved through the utilization of passive design and innovative technologies and materials (Ohshita et al., 2015). There are also cities enforcing building energy codes setting compulsory levels of renewable energy used in buildings' operation, such as **Tianjin** (Ibid).

Since a lot of the older buildings are not up to standards which are mandatory today, multiple cities are investing in their **retrofitting** which will allow increasing the energy efficiency and result in energy and financial savings. **Paris**, for example, initiated a project for retrofitting more than 25% of the buildings owned by the city composed of kindergartens and primary schools buildings and achieve remarkable energy savings; **Madrid** is addressing the low construction standards and improving the energy performance of its buildings as well through an urban plan called Mad-Re (C40 Cities, 2016-s, 2018-b). **Shanghai** is focused on retrofitting its commercial and public buildings while the city of **Qingdao** is upgrading the residential areas, mostly through improving the envelope of the existent structures and adding extra insulation to them (Sherlock et al., 2018). **Guangzhou** is conducting energy audits in order to assess the performance of its public buildings and consequently implement necessary measures to improve it (C40 Cities, 2016-t). Other cities are cooperating with local shops and companies to increase their energy efficiency and reduce overall energy consumption in the city, e.g. **Sønderborg** created a special program for them and has more than 140 participants now; **Heidelberg** is working also with the industrial sector and aspires to lower the energy use through improving the process of production

(Danish Ministry of Housing, Urban and Rural Affairs & Danish Energy Agency, 2014; C40 Cities, 2017-c).

An important component in the process of becoming a low-carbon city and reaching a development path that is sustainable is **waste management**. Reducing, reusing and recycling waste, as well as its management are spheres in which the cities are seeking innovative solutions. Although it has become a common practice to collect and separate biowaste at its source, in households and businesses, the city of **Athens** implemented this method only in 2013; nevertheless, it proved effective and spread to other parts of the country since then (C40 Cities, 2016-u). **Copenhagen** has created a user-friendly separation system and increased the efforts in waste prevention and post-collection treatment and **Milan** created an integrated waste collection system with traditional color-coded bins for separation and transparent bags which help to spot and collect materials that were not separated by the citizens (C40 Cities, 2011-g, 2014-c). Waste treatment in China has also witnessed progress in recent years, for example, the city of **Guangzhou** is advancing the sorting in households, upgrading the treatment facilities and improving management of the sorting process; moreover, the link between waste sorting and recovery is emphasized. The city plans to further optimize the management mechanisms in the future through reductions in waste production and redundant packaging, through improved management of construction waste or utilization of green technologies in the city's treatment facilities (C40 Cities, 2018-c). **Beijing** is implementing a comprehensive system of waste handling in the Circular Economy Industrial Park in its Chaoyang district; with centers for solid waste recycling, research and development of solid waste treatment, and for advancement and display of circular economy' industry it seeks to follow the principles of sustainable development (C40 Cities, 2019-b). **Hong Kong** is focused on managing food and yard garbage, which represent the largest constituent of its solid waste, mainly through the means of reduction, reuse and recycling (C40 Cities, 2016-v).

Cities, districts and areas that most likely to be affected by the changes in climate in the future are aiming at becoming **climate-resilient** and climate-proof. Extreme weather conditions, such as heavy rainfalls or extended periods of droughts are occurring more and more often and the cities, realizing the risks this presents for their territories, have begun to take steps to prevent the devastating effects of these climate conditions. **Østerbro Climate Quarter** in **Copenhagen** decided to combat the heavy rainfalls by using green infrastructure. Parks and green streets serve as water retention areas and basins, while the new pipe system allows local squares to collect and re-distribute water from the surrounding buildings. Investing in new green infrastructure was more affordable than an expansion of the sewers and its maintenance will be less costly as well (C40 Cities, 2015-f). **Hong Kong** operates under an overall plan called Total Water Management Strategy, which aims to extend water resources, fix the existing water pipes and thus lower the demand, enhance the means of water conservation as well as analyze other possible sources, such as desalinated and reclaimed water. The city is also threatened by heavy rainfalls which it combats by enhancing the water pumps and storage structures and upgrading the drainage system (C40 Cities, 2016-w, 2016-x). The city of **Wuhan** is addressing its problems of flooding and excessive usage of water through a Sponge City Programme, which is enhancing the city's ability to cope with climate changes and increase its resilience through green and blue infrastructure projects. Through water system melioration and boosting rainwater capture capacities the municipality is pursuing the goal of reduced waterlogging and increased water quality (C40 Cities, 2016-y).

The Dutch city of **Rotterdam** also faces the problem of **heavy rainfalls**, droughts and will be affected by the rising sea levels in the future. Apart from investment in the green infrastructure, such as green rooftops, which help with retainment of rainwater, the city uses also some innovative measures in its local water treatment. Car parks here serve as water catchment basins as they are able to hold millions of liters of water and the city also built a first full-scale water square in the world - **Benthemplein Water Square**. It can keep 1.8 million liters of water and

serves also as an urban public space - a playground that can be used by the citizens during the dry periods. Similar projects might be replicated around Rotterdam as water square not only helps the city to relieve pressure on the sewer system but it also creates a recreational area for its residents (C40 Cities, 2015-g). Multifunctionality of a water square makes it an attractive solution also for cities elsewhere.

Wastewater treatment and **flooding prevention** have also become part of the development strategy of cities across Europe. **Oslo** is approaching the risk of flooding through reopening its waterways so as to manage stormwater in a more efficient way, furthermore, their free accessibility for citizens transforms them into a recreational area as well (European Commission-d, n.d.). **Stockholm** is looking to achieve two goals with its New Slussen project; it should build infrastructure able to safeguard the city from rising sea levels and at the same time protect the local source of drinking water that supplies 2 million people (C40 Cities, 2018-d).

Apart from the aforementioned initiatives pertaining to resource efficiency, the instruments getting to the forefront in this field are innovative and **smart technologies**. **Aarhus**, for instance, is using intelligent meters in its district heating system installed in the residents' homes which will, with its automatic report function, replace manual checking of the heat consumption. In addition, the customers are able to check their consumption through a mobile application (Danish Ministry of Housing, Urban and Rural Affairs & Danish Energy Agency, 2014). The city of **Stockholm** works with the IT sector to reduce its GHG emissions. It created the Green IT Strategy which targets 9 different areas, e.g. improving the energy efficiency of its buildings (C40 Cities, 2016-z).

Sub-chapter conclusion

The category of resource efficiency and its principles present an important part in the process of low-carbon growth and it is, therefore, crucial that the cities include these principles in their development plans. In Europe, it is pursued largely through

the use of renewables and it has become a common practice to opt for fossil fuel-free rather than non-renewable energy sources. In China, there has been a massive growth in the investments into renewable energy and utilization of solar, hydro or wind power in recent years and the country is also supporting the use of green energy in its large, multinational projects. However, there still exist certain problems that do not allow the utilization of these resources in their full potential. The capacities of the power grid are often not sufficient to deliver the energy to the final consumer and the extensive projects, which aim to promote sustainability and green growth are sometimes counterproductive; the large building schemes do not account for the surrounding environment and cause irreversible damage, such as was the case of some water dams construction. It is, therefore, important that all the aspects and consequences of turning towards renewable energy are considered and respective actions are taken.

The technology of combined heat and power plants are present in both regions, however, in Europe, there has been an increase in the use of biomass and biogas to power them whilst in China, the use of coal is still prevalent. Including more renewable resources also in the district heating would bring improvement and significantly reduce pollution in the urban areas around the country. Furthermore, Chinese cities could find inspiration in their greening efforts also in some of the projects utilizing innovative technologies conducted in Europe, e.g. the biochar power plant or fossil fuel-free construction sites.

High energy efficiency reduces the necessity for increased heating or cooling of the buildings and can help reduce the emissions in the city as well. In Europe, there are tendencies to create whole areas and districts which follow low-carbon standards and run on ultra-low energy. Retrofitting is a very common practice as well, especially in the historical buildings where the efficiency standards are much lower than in modern structures. In China, the building efficiency standards have been getting more stringent in recent years, slowly approximating the ones in the United States or Europe (Lee et al., 2015), and the projects of retrofitting have been growing in number

as well. The use of renewable energies is becoming compulsory and in some cities, there already are buildings that can serve as an example for the construction methods and use of low-carbon technologies also in other buildings and areas. With a large number of old industrial sites across China, there is space for the redevelopment of these lots and transforming them into green sustainable neighborhoods or urban public spaces.

In Europe, the cities are integrating also businesses and industrial sector in the low-carbon initiatives through various projects, partnerships and educational programs, a method that could be utilized in a greater extent also in the PRC.

The area of waste management is the subject of initiatives seeking sustainability as well. Reduce, reuse, recycle is a daily practice in a growing number of European cities. In China, landfills and incineration of the garbage are still a common solution for waste treatment, however, there has been visible progress in this sphere and the recycling rates have been growing.

The realization that some effects of climate change are inevitable was followed by the decision of various cities to become more climate-resilient and lower the risk of flooding. Aside from blue and green projects helping the water control in the city, there are some innovative projects, such as the water square in Rotterdam, which can serve as an inspiration for cities both in Europe and in China as it not only helps with the urban water management but it also provides a recreational area for the residents.

5.3 Inclusive Urban Governance

Ideas behind inclusive urban governance include increased citizen participation, promotion of low-carbon lifestyle and involvement of multiple stakeholders, as well as creating clear financing and investment mechanism of LC projects.

It is important that cities pursuing low-carbon development include its citizens in the projects, either through providing them with enough information on different projects, raising their awareness on the matter or requiring their direct

participation. **Paris**, for instance, gave its inhabitants a 'license to green' inviting them to plant trees and create gardens around the city (C40 Cities, 2015-h). In **Milan,** residents were involved in the establishment of the aforementioned Area C through a public referendum where they could express their opinion (C40 Cities, 2015-d). **Barcelona's** initiative Commitment to Climate Change, which is citizen-led, has created nine projects revolving around citizens aimed at reducing their carbon footprint and raising their climate change awareness (C40 Cities, 2016-aa). **Guangzhou** is enhancing the active participation of the citizens in the low-carbon initiatives by encouraging them to use subsidized solar panels (C40 Cities, 2018-e). **Wuhan** set its goal of emissions peak before the national target year and the municipality has involved its inhabitants in creating the action plan on achieving it by asking them for comments and remarks (C40 Cities, 2017-h). Moreover, it promotes environmentally conscious lifestyle among residents with the help of 40,000 volunteers who spread awareness and good habits among the citizens (C40 Cities, 2016-q).

Involving not only citizens but also multiple other stakeholders, such as NGOs, businesses, research institutions, schools and universities and ensuring their cooperation with the municipality can lead to stronger urban governance. The traditional city management is transforming into collaborative governance of diverse actors. For example, **Lisbon** includes a variety of stakeholders in the development of its policies and urban modernization projects (European Commission-b, n.d.). Danish cities of **Aarhus, Sønderborg,** and **Copenhagen** are also supportive of the innovative partnerships among the city and its residents, corporations, knowledge institutions and they are putting the public-private collaboration at the center of their innovations in the area of sustainable development with the goal of altering the attitude and mindset of the society (Danish Ministry of Housing, Urban and Rural Affairs & Danish Energy Agency, 2014). **Shenzhen** also encourages cooperation between various stakeholders and enhances their relations through an open platform; public and private actors were thus both involved in the city's transitioning to new

energy vehicles which made it smoother and easier (C40 Cities, 2016-f). **Beijing** created a "Green Traveler Platform" which brings together various stakeholders, such as car companies, banks, insurance firms or citizens to support an innovative low-carbon model, where the residents are rewarded for limiting their driving and thus lowering their carbon footprint. The citizens then receive a monetary prize the height of which depends on the volume of their emission cutbacks (C40 Cities, 2019-c).

The city needs to not only involve the citizens and various stakeholders, but it should also provide them with information in an accessible and transparent way. **Aarhus**, for example, is providing its residents and other stakeholders with information about current and future initiatives the city plans through a dedicated website Go Green with Aarhus (Danish Ministry of Housing, Urban and Rural Affairs & Danish Energy Agency, 2014).

Moreover, the promotion of low-carbon lifestyle and awareness raising among the inhabitants is important as well, since getting citizens on board can help the city to reach its goals faster and more efficiently. Some cities, e.g. **Sønderborg** are using awareness-raising campaigns to enlighten all types of stakeholders about climate change and their strategies for its mitigation, which allows them easier implementation of some projects and initiatives (Ibid). German city **Heidelberg** put emphasis on the education of its residents since a very young age. Beginning in childcare centers, where sustainable development education is compulsory, continuing through elementary and high school, the students are encouraged to increase their knowledge in this area and create their own sustainable solutions for the future (C40 Cities, 2018-f). **Wuhan** is the first Chinese city to establish a set of principles to be thought at primary and middle schools and increase the awareness levels among students and through them of the general public as well (C40 Cities, 2017-h). **Shanghai** decided to provide the citizens with a demonstration zone for electric vehicles, enhance their understanding of low-energy vehicles and encourage them to switch to cleaner private vehicle transportation (C40 Cities, 2016-ab). **Beijing** not only uses different offline and online media to promote events such as

Environmental Culture Week or Green Communication Conference, but it also establishes education centers accessible to all residents with the goal of spreading green ideas and spur more active participation of the citizens in environmental activities (UN Environment Program, 2019). **Hong Kong** is using a large-scale media campaign and involvement of multiple stakeholders in its attempt to change the food waste situation in the city and lessen the amount of waste ending up in landfills, which would lower the health risks for its citizens and create a more prosperous environment (C40 Cities, 2015-i). **Suzhou** is trying to raise awareness with its Energy Efficiency Star Program. It gives the enterprises which participate a star ranking - the higher is the compliance with criteria and energy efficiency, the higher is the ranking. Energy audits, workshops and technical aid are available in order to help the companies obtain a higher ranking (Ohshita et al., 2015).

The ways through which development projects are financed can help the promotion of low-carbon solutions as well. The city can help the expansion of clean car market or provide an incentive for zero-emission machinery market to flourish as the cities of **Stockholm** and **Oslo**, respectively, have done (C40 Cities 2011-a, 2016-n). Stockholm also decided to provide biogas stations with grants in order to further support the increase of clean transport around the city (C40 Cities 2011-a). Support of low emission vehicles can be seen also in **Shenzhen** where both, the government and the local authorities, are allocating finances to promote the spread of greener transport. State subsidies are provided mainly to the manufacturers whilst the local subsidies go to organizations which can purchase and operate the low emission vehicles, research centers and other entities (C40 Cities, 2016-ac). **Amsterdam** created a system of two funds, the Sustainability Fund and the Amsterdam Climate and Energy Fund, which are responsible for allocating financial loans to initiatives of low-carbon nature. Each of the funds has its own responsibilities and deals with different projects, depending on their type and scope. The municipality is using newspapers, social media and a dedicated website to further promote both Funds (C40 Cities, 2016-ad). In **Madrid** the projects for retrofitting buildings receive subsidies

only after they can prove that they will increase the energy efficiency at least by one or two levels and the higher the savings they can create, the higher grant is (C40 Cities, 2018-b). **Shenzhen** is not only part of the national carbon trading scheme but it has also established an emission trading scheme among multiple companies and public infrastructure projects in its region. The enterprises are regularly assessed based on their compliance with the regulations and in case of non-compliance, they can be fined or punished in another way. Through such control mechanism, the city ensures the companies take the emission reduction seriously and pursue corresponding actions (C40 Cities, 2018-g). **Paris** uses a mechanism of energy performance contract in its city lighting system through which it ensures the reduction of electricity consumed. The performance is assessed every year and either penalties or bonuses are awarded depending on the levels of compliance with the contract (C40 Cities, 2015-i). The city is also working with climate bonds, which are specifically designated for climate-related projects and which secure the municipal finances in this area (C40 Cities, 2015-j). In 2017, the city of **Oslo** introduced the first climate budget which counts carbon dioxide in the same way the municipal budget counts money. Every year it establishes the maximum amount of GHG the city can release and the implementation tasks are then divided among various stakeholders in order to fulfill the set targets (The City of Oslo, n.d.). **Nanjing** has created a system of carbon credit where the citizens earn points for walking, cycling and using public transport, which are then quantified and converted into credits applicable in the green store. Citizens can purchase commodities and services for their low-carbon behavior, which helps the overall promotion of green lifestyle and habits. The project is planned to be expanded to other financial products, such as green insurance or green loans (C40 Cities, 2018-h).

Sub-chapter conclusion

In Europe, there seems to be a higher level of citizen participation in low-carbon projects when compared to China and the focus on the promotion of such projects is higher as well. Involvement in the decision making and engagement in the decarbonization projects themselves is rather limited in China and despite increasing the general public awareness on the matter of environmental protection and sustainable development, there is still a relatively large space for improvement. Nevertheless, Chinese cities are working on the partnerships and involvement of multiple stakeholders and thus increasing the strength of urban governance.

The green lifestyle in China is promoted through financial rewards for citizens who cut back their emissions through walking and biking more, as well as limiting the use of their car. Similar initiatives are not so common in Europe but could be an interesting addition to the various programs with public involvement. What could be further developed in China are portals and information services for the citizens, which would allow for higher information transparency, increased awareness and public involvement, and thus stronger and more inclusive urban governance.

Furthermore, despite increasing the number of facilities for promotion of decarbonization efforts and spreading awareness, more emphasis should be put on the environmental consciousness of the citizens and their education from a young age in the PRC. It is becoming standard in Europe to include environmental education in the curriculum of the students and teach them to be more mindful about their daily actions. By integrating green practices into their lives since child care or primary school, the students acquire low-carbon lifestyle habits and spread them to their family and other members of society. It is therefore important not to overlook this aspect of sustainable development.

European cities are trying to be more involved also in the market with low-carbon technologies and spur its growth. In China, the administrative measures are utilized and the market-based instruments are of a supplementary character and

could be further employed. However, there are certain improvements also in this sphere, such as the green credit system and plans for its evolution.

Control mechanisms for tracking the reductions of carbon emissions are still lacking certain cohesion, which would bring more clarity and uniformity to the assessment process, both in Europe and in China. There are multiple systems, each using their own set of criteria, nevertheless, a generally unified framework is still missing.

5.4 Europe-China Cooperation on Low-Carbon Development

The cooperation between Europe and China in the area of sustainability and low-carbon development takes place on various levels. Not only does the collaboration pursuit help the cities discover and implement low-carbon solutions that are suitable for their conditions but also the mutual relations between the municipalities, countries or regions are being reinforced and strengthened throughout the process.

The mayors and urban authorities develop friendly relationships with city management in the other parts of the world and bond the municipalities in amicable relations and partnerships. The city twinning is relatively common and such a relationship can be formed, for instance, through international organizations or platforms. An example of twin cities which cooperate in their development, share ideas, conduct common projects and organize mutual visits of the city representatives, can be the Danish city **Aarhus** together with the Chinese city **Harbin**. The municipalities have been conjoined in a city friendship program for over 30 years now and their partnership extends also to the area of sustainability. There is a special focus on energy efficiency, particularly in the district heating and the use of renewable wind energy in the system. At present, there is a project of analyzing Harbin's energy system and integrating wind power into it through district heating and CHP technology (Danish Ministry of Housing, Urban and Rural Affairs & Danish

Energy Agency, 2014). Similarly, since 2008, **Sønderborg** and **Baoding** are sister cities and this Danish municipality cooperates also with **Haiyan County** which serves as one of the zones for demonstration of sustainable development in China. Utilization of renewable energy through solar panels and wind turbines, together with efforts to increase the energy efficiency of the buildings are part of a holistic plan of sustainable development the city outlined on the basis of a similar plan created by its Danish counterpart (Ibid). Sister cities can be created also through various platforms, e.g. Urban EU-China focuses on a bottom-up approach to sustainable urbanization and facilitates cooperation between EU and China on national, supranational as well as city level. It analyzes different cities and based on their characteristics creates pairs that show good prospects of working together and later follows the development and performance of their joined projects (Kontinakis & Zhang, 2018). An example of a partnership established through this platform is the one between **Bonn** and **Chengdu**. Match of these cities was created on the basis of the tourist-oriented character of both urban areas and increasing energy efficiency within the field of tourism field thus became the main objective of the cooperation between the cities. This type of partnership is trying to prevent simple one-way cooperation, where the experience, skills, and knowledge in this domain of European cities are directly transferred to the Chinese partner cities and rather ensure the mutual exchange and equality between the partners. There exists threefold communication between the local businesses, NGOs and city authorities which increases the commitment of the parties to the cause, helps the spread of innovation and expands the cooperation to an extent which would not be obtainable only on the governmental level (Ng, 2016). Many city pairings are realized through International Urban Cooperation, an EU program which assists the cities in various regions to form collaborative relations and pursue sustainable development through joined projects. Examples of such pairings are **Granada** - **Kunming**, **Prague** - **Longyan** or **Burgas** - **Shantou**. Currently, there are 10 partnerships between European and Chinese cities established through this program, however, there is not much follow-up information available on their mutual

efforts and results of shared projects and the overall effectiveness of it is, therefore, not easily traceable (International Urban Cooperation, n.d.). Furthermore, due to different evaluation of low-carbon city systems in both regions, there is a lack of common framework through which an assessment of their joint efforts could be conducted.

Another type of cooperation present in these regions is the partnership between the states. For example, the **Sino-Swiss** Low Carbon Cities project mediates the cooperation between the Swiss Agency for Development and Cooperation and Chinese cities of Guangzhou, Shanghai, Yantai, Chengdu and Chongqing in individual partnerships. This project *"aims to reduce greenhouse gas emissions in Chinese urban areas, while sharing Switzerland's long term experience in environmental protection, its extended technological knowledge and high innovation capacity"* (Chen, 2016). The vision of lowering the GHG emissions in China through enhancing its low-carbon development poses, according to the liberal school of thought, an incentive for Switzerland to pursue this cooperation as it represents an example of absolute gains. Aiding the development of greener and more sustainable urban areas in the PRC will, in long-term, reflect also in the emission reduction on a global scale, and it thus embodies the enhancement of the overall prosperity. More examples of country-to-country cooperation realized in Chinese cities can be **Sino-German** Ecopark in Qingdao or Wuhan Eco-City, which represents **Sino-French** collaboration. Low-carbon and environmentally friendly principles were followed in the construction of the Ecopark in Qingdao and ecological development ideas that could be replicated elsewhere have been explored in recent years as well. New energy, intelligent manufacturing or passive houses are already part of the Ecopark's expertise and roadbuilding, lighting and other areas of urban engineering are expected to develop, too (SD China, 2017). The national cooperation between the PRC and France resulted in their first model of sustainable urban design and development in Wuhan's Caidian district. It not only uses low-carbon solutions within its territory but it also serves as

a test bed for new technologies and sustainable urban solutions (Arte Charpentier Architects, n.d.).

The EU plays an important role in the cooperation between the cities of its member states and Chinese cities as well. The environmental cooperation is becoming one of the focal points of relations between the EU and China and its importance has been growing even more since the ratification of the Paris Agreement. The United States' withdrawal from it meant that one of the world leaders and key players in the combat against the climate change was no longer there to help and take important steps necessary to mitigate the effects of it. China, however, showed commitment to the Agreement and its targets as well as willingness to become a country that will not only strive for decarbonization itself but also become an inspiration for others. In order to increase its capacities and capabilities in the low-carbon solutions, it was important to focus on domestic environmental agenda as well as to search for partnerships with more experienced countries which have more extensive knowledge in this area. The EU, representing another leader in the environmental sphere, thus became a crucial collaborator for the PRC and the two have pursued cooperation through various agreements, programs, and initiatives over the years.

The Urban EU-China program embodies only one of the joined efforts to explore cooperation options between paired European and Chinese cities and organize a mutual exchange of know-how in the sustainable innovations among them. Policies and programs that proved effective in Europe are shared with the Chinese counterparts and vice versa. Moreover, the market with green technology and industry is growing in both regions and the cooperation is thus pursued also there and economic benefits further strengthen the relationship by increasing mutual interdependence of the actors. Liberal ideas of the international market playing an important role in the connectivity between states and aiding their collaboration can thus be seen here. Furthermore, this theoretical perspective claims that shared ideas and beliefs can further reinforce the relations between states and lead them to

peaceful cooperation on the subject matter, in this case, mitigation of climate change, rather than focus on any potential disagreements between them. The partnership between the EU and China can be seen as mutually beneficial, not only due to providing economic incentives to continue it but also increasing the knowledge on this topic and helping the decarbonization efforts. As climate change is in the spotlight of the international community and becomes one of the most discussed topics in the political arena, partnerships pursuing decarbonization are becoming more important. It is not about the countries anymore but also about international organizations and non-governmental actors that play a role and affect the events in the global arena, which is in alignment with the liberalist thought of multiple actors in the international politics being able to affect the behavior of the states. Furthermore, cities themselves are relatively independent actors too and their role in the mitigation of climate change is growing. Strong leadership on the local level is therefore crucial in achieving the set goals.

China and the European Union established Climate Change Partnership in 2005 supported by a Joint Statement on Dialogue and Cooperation on Climate Change in 2010 and followed by other two joint statements in 2015 and 2018 (European Commission-e, n.d.). In 2012 they established also a Partnership on Urbanization and have been working on enhancing their mutual dialogue on sustainability and environmentally friendly urban designs as well as implementing the agreed upon agendas and increasing the efficacy of the partnership since then (Lee et al., 2015). Both sides are visibly committed to climate change abatement in their statements and agendas and their mutual cooperation is further strengthening this position. Individual interests of the EU and the PRC are put aside and their mutual interest of mitigating the effects of climate change and helping to achieve the global goals regarding sustainable development comes to the forefront. The ideas of sustainable development and urbanization are emphasized also in the EU-China Strategic Agenda for Cooperation 2020:

"*Ensure the success of the EU-China Urbanisation Partnership Forum, the EU-China City Expo and the EU-China Mayors' Forum, improve the governing framework of the EU-China Partnership, support the development of numerous relevant city pairings and steer EU-China urbanisation cooperation by the Joint Steering Committee of the EU-China Urbanisation Partnership. Support the development of EC-Link as a co-operation platform to enhance the impact of the Partnership*" (EU-China 2020 Strategic Agenda for Cooperation).

The need to share experience in various areas of urban development, the involvement of multiple stakeholders and the continuation of building demonstration cities are all part of the future plans of the EU and China (Ibid).

Except from city level and national level cooperation, low-carbon cities can be developed also by including multiple international partners with common interests and unite them in a joined project, such as the **Shenzhen Low-Carbon International City**. Originally planned as a Sino-Dutch cooperation, the initiative developed into joint effort of other countries and actors over time and became an area of international cooperation with the goal of creating an example of low-carbon sustainable urban development not only in China but also internationally. Retrofitting older buildings in the area and construction of new, low-carbon buildings and infrastructure, together with green spaces on and around the buildings are the basis for creating a future-oriented urban area, which aims to provide its citizens with clean air all year round and mitigate the intensity of UHI (C40 Cities, 2017-i).

Apart from aforementioned means of cooperation between European and Chinese cities, there are various international organizations and platforms where the cities and their mayors are brought together to share the ideas and decarbonization solutions that proved effective in their city and get inspired by initiatives that were successful in other areas and have potential to be realized also in their municipality. For example, **C40 Cities** represents a platform that connects 94 cities around the world dedicated to pursuing the goals set by the Paris Agreement. Such platforms

further support the liberal ideas of non-governmental and supranational actors playing an important role in the international political scene and affecting the behavior of individual states. Furthermore, the idea of coexistence of the states in the world with no single authority regulating their behavior and pursuance of mutual cooperation and joined actions can be also seen here.

6.0 Conclusion

The main purpose of this paper was to answer the set research question:

How does the low-carbon city development differ in Chinese and European urban areas? Why do China and Europe conduct cooperation in the area of climate change?

The topic of climate change and mitigation of its effects has been in the center of attention of the international community in recent years and continuous growth of its importance is expected to persist also in the future. As cities serve as hubs of international communication, business and industry and more than half of the world's population reside in urban areas, these units represent one of the crucial actors in the fight against climate change. Growing urbanization rates in countries around the world indicate that cities will maintain this role and actions taken in the area of urban development can have far-reaching effects for the abatement efforts. China and Europe represent important players in this combat and pursuit of sustainable development. It was, therefore, deemed compelling to research the current state of cities in both regions and their efforts in lowering the GHG emissions and initiatives promoting low-carbon progress.

In order to position the paper in the research within the area of sustainable development, a literature review was conducted. Works on green growth and decarbonization initiatives in Europe and in China were described and the expected

addition of this paper into the field was outlined. Subsequently, the methodological procedure was explained and the steps necessary to conduct the analysis and reach conclusion were clarified. The framework of 10 principles of low-carbon development served as the main theoretical basis for illustrating the variety of programs focused on the decarbonization of urban areas and the liberalist theoretical perspective proved to be of assistance when discussing the cooperation facets of the relations between the PRC and Europe and exploring the reasons for it.

The process of analysis aimed at illustrating the current state of low-carbon development in European cities and Chinese cities and defining the differences between them. It can be concluded that in the area of low-carbon urban form, the European cities are utilizing the land more efficiently than their Chinese counterparts, where the street network is not as dense, the interconnectedness with public transport is often not sufficient and the levels of city walkability are relatively low. Furthermore, the mixed-use design is more widespread in Europe than it is in China, nevertheless, the principle of utilizing buildings and blocks for multiple purposes than just a singular one is increasing in number also in this region. Europe conducts works on sustainable new development and redevelopment of brownfield sites and this area has a big potential also in China as there is a large number of old industrial parks and sites around the country and the growing urbanization rate leads to continuous new construction. There are efforts of creating smaller and more compact cities in the vicinity of the megacities that would relieve some of the pressure in the traffic or number of people, and these present a potent opportunity for applying the sustainability principles. Both areas are trying to increase the number of green and blue projects, decrease the UHI effect and create a more enjoyable environment for its citizens, however, the initiatives in China are oftentimes lacking a more holistic approach that is utilized in Europe, despite having significant potential in this sphere. Instead, China is investing in large, one-time projects not only in the city greening projects but also in the transformation of its public transport vehicles into more sustainable alternatives and fleets run on renewables. There are also differences in

the ways countries are trying to limit the number of private cars on the roads, in China, it is through restricting the number of sold cars and in Europe the establishment of carbon-free zones and congestion tax areas are becoming more prevalent.

In the sphere of energy efficiency there exist differences as well. In Europe, the employment of renewable energy has been a common practice for years whilst China has witnessed a massive expansion of the market with renewables only relatively recently. The rapid growth to the position of one of the leaders in this field, however, did not mean that all the energy produced was utilized as there still exist problems with Chinese energy grid and its insufficient transmission capacities. Resolution of these complications and the country's ability to process all the harvested energy and subsequently deliver it to the final customer would decrease China's overall dependence on the non-renewable sources of energy, e.g. coal in the heating systems. In Europe, there exists continuous expansion in the use of renewables as well as the development of new green technologies, and the demand for them is growing as well. Innovative solutions, such as utilizing waste to create energy or biochar power plant are posing attractive solutions for the future, regardless of the region. Differences between Europe and China can be seen also in the buildings standards. Despite the fact that the PRC has been making the norms more stringent, they still do not reach the quotas set in Europe or the US. Furthermore, the degree of cooperation of the cities with local businesses and shops and their inclusion in the decarbonization efforts, as well as the involvement of the industrial sector are currently higher in Europe than in China. However, lowering the emissions from the industry is an area which should be addressed in a more comprehensive way in the PRC, especially when considering the uniqueness of Chinese cities with more industrial character than cities elsewhere. Both regions are working on increasing climate change resilience in their urban areas and improving the capacities to deal with the effects of global warming.

The area of inclusive urban governance is marked by several differences as well. Citizen participation in low-carbon projects in Europe is higher than in China, and so is the inclusion of multiple stakeholders. Cooperation of several actors leads to a higher commitment to the project and stronger urban governance. However, connecting public and private sector is still considered somewhat troublesome in the PRC, where the actions are under the government's supervision, unlike in Europe, where new types of partnerships are sought after and innovation is seen also in this area. Dissimilarities appear also in the encouragement of the citizens to lead a low-carbon life and be more conscious about the environment. Europe works with the residents since a young age and increases their awareness in this field, whilst China is trying to provide its citizens with incentives in form of green credit which can be transformed into financial rewards, discounts or services. Market-based instruments are becoming more common in China these days as well. Since the New Environmental Law came into effect in January 2018, measures such as environmental tax are becoming part of the country's attempts to limit its emissions of GHG. Nevertheless, there are still improvements needed, as the law, for instance, exempts CO2 emissions which are a major component of the overall emissions.

It can be concluded that the level of low-carbon development is overall higher in Europe than it is in China, whether it is in the area of low-carbon urban form, resource efficiency or inclusive urban governance. As the European cities have been environmentally conscious for a longer period of time, a tradition of green innovations, technologies and development evolved over the years and continues to progress. As China has been focused mainly on its economic growth and development, the environment and changes done to it were on a side track for many years. However, the increased global attention to climate change, more stable position in the international arena and realization that sustainability and economic progress are not mutually exclusive, have led the country to become one of the leaders in the climate change combat. Visible progress can be seen in the PRC when compared to the past,

yet, there are still many areas where the Chinese cities can seek improvement and increase their capacities to mitigate the effects of climate change.

The paper reviewed also the cooperation between Chinese and European region in the area of low-carbon development. The collaboration is conducted on multiple levels and has various forms (city-city, country-country, EU-China, international platforms) and the number of agreements and partnerships is considerable. However, a lot of the cooperation is still on a theoretical level and the practical cooperation remains relatively scarce, with no common framework for assessing the success of the joined programs and initiatives. Considering the urgency of climate action, the withdrawal of such important actor as the US from the international movement against it and its disengagement in the Paris Agreement, it is necessary to further explore possibilities for cooperation and consequent implementation in real life among the remaining leaders combating the climate change. It is important that strong actors, such as China or the EU, join their forces in the mitigation of climate change as it is not only in their own interest, but also in the interest of global community. China can receive know-how and experience of the European cities in the area of sustainable development and utilize its increased capacities in LCC solutions in the development of its own cities. Furthermore, it can help the PRC to tighten its position as one of the reliable and devoted leaders in the climate action and project a positive picture of itself towards the rest of the international community. Europe, on the other hand, can expand its market with green technologies, innovations and renewable energy through its cooperation with China and create many valuable partnerships between the cities in both regions. Europe can thus acquire a strong collaborator for the climate change combat and enhance the mutual relations with China and its cities at the same time. Joint efforts in the area of green urban development between Europe and China further bolster their interconnectedness and present a hopeful vision for the international community as the cooperation of these two strong and committed actors can lead the world towards a sustainable, climate resilient and low-carbon future.

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