



european post-carbon  
cities of tomorrow

## WORKING PAPER

# COMPARISON OF XIAMEN AND EU CASE STUDY CITIES AND OUTLOOK FOR COOPERATION

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D1.2: Report on Key Performance Indicators

D3.3: Integrated Case Studies Assessment Report

D4.4: Qualitative scenario building for post-carbon cities

D6.3: Report on activities in non-EU cities involved in the project (WP6)

Policy Brief No. 1 - LOW-CARBON URBAN DEVELOPMENT IN CHINA: CURRENT INITIATIVES, FUTURE PLANS AND FIRST LESSONS

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## LIST OF ABBREVIATIONS

- DRC** Development Reform Commission
- RBM** Renminbi, the Chinese currency with a Yuan as main unit
- SEZ** Special Economic Zones
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# I EXECUTIVE SUMMARY

This paper aims at expanding the analysis on low carbon development of selected European cities as carried out in the POCACITO project to the Chinese City of Xiamen and compare it with the results for EU cities. On this basis, similarities, differences and potential starting points for cooperation and transfer of know-how or technologies are discussed. Based on generic quantitative city data as well as “key performance indicators” for low carbon development a quantitative comparison between Xiamen and EU case study cities is undertaken. The results show that Xiamen catches up quickly in terms of economic development and currently may be situated already at the lower end of EU cities.

A participatory process for the development of visions and scenarios for low carbon city development was carried out in Xiamen but to a more limited level as compared to EU cities. Besides the identification of key projects in the city, this process contributed to the identification of similarities with EU cities. Low carbon development is one of the important targets of Xiamen, that is part of the first batch of low- carbon pilot projects announced in 2010. Xiamen was imagined by stakeholder to become a liveable, sustainable, beautiful city with the charm of history and culture. Thus, a new model of development was emphasized to achieve the targets, which means an innovative, harmonious, green, open and inclusive development.

A major element for cooperation may be the sectors which are of major importance but also of concern for cities in order to have a common ground for exchange. Given the historical and economic development-related proximity to Europe and its specific situation as special economic zone and low carbon pilot city, Xiamen might thereby act as a “hot spot” for cooperation. Xiamen is highly active in the IT and technology sectors that are of relevance for, e.g. transport and the development of the building sector. Tourism is a major economic sector and the coastal situation with its major harbour provide for specific potentials, low carbon solutions as well as development challenges.

Overall, due to the relative high progress in the past, the reduced availability of low hanging fruits in city development will require a high degree of innovation. Xiamen shared the importance of technology and innovation as well as tourism with Litomerice, Barcelona, and Lisbon where the latter two also share the costal situation and may thus be of prime interest for cooperation. Given that all EU case study cities equally share important challenges such as in transport, cooperation may equally be of interest but would require further analysis in order to identify more specific areas/projects in which a valuable exchange would be possible.

## II INTRODUCTION

This paper aims at expanding the analysis on low carbon development of selected European cities as carried out in the POCACITO project to the Chinese City of Xiamen. On this ground, similarities, differences and potential starting points for cooperation and transfer of know how or technologies will be discussed.

A number of methodologies were applied within the POCACITO project to identify major factors that impact city development. Information was gathered in a participatory way during workshops in the case study cities of Barcelona, Copenhagen, Malmö, Istanbul, Lisbon, Litoměřice, Milan, Turin, Rostock, and Zagreb. Workshops highlighted the current successes and challenges the cities face and supported a discussion on city-specific innovative measures based on lessons learned from local experience and best practices. Besides gathering of general data such as size, location, and other, the collected and discussed data included so called key performance indicators which were used to establish a “Post carbon city index” serving to assess the status quo and to monitor city development.

During June 2016, stakeholder meetings, field trips, and interviews were organized by the Chinese Academy for Social Sciences (CASS) in cooperation with the Xiamen Municipal Development Reform Commission. Stakeholders included Xiamen Municipal officials and low carbon development experts in Xiamen. During the stakeholder process, the role of international cooperation was highlighted: Xiamen was said to have more similarities to European cities than many other Chinese cities and stakeholders expressed the interest to learn from European experiences.. On this basis, this paper seeks to undertake a first effort to establish a profile of Xiamen comparable to the datasets gathered for European cities within the POCACITO project, to compare this with European case study cities and draw first conclusions on potential areas of cooperation.

There are various existing forms of cooperation between the EU and China. On a governmental level there is an EU-China strategic partnership that provides a framework for cooperation, including environment protection. To promote the project-level cooperation, the International Council for Local

Environmental Initiatives (ICLEI) set up an East Asian office in Seoul in 2013 to strengthen the connection with China. Another initiative is the UK-China Smartcities initiative,<sup>1</sup> driving the development of a Joint Smart Cities Laboratory. The initiative is co-located in Shanghai and Manchester. In addition, the World Cities initiative<sup>2</sup> promotes the exchange of experience and best practices between the European Union and third countries. There is still a lot of room, however, for improvement in know-how transfer. Due to barriers such as language skills, in general, Chinese local governmental officials have few chances to go abroad to learn about international experience or have access to material written in English. Thus, it is important to fill the gap by introducing Chinese experts to foreign experiences, enabling them to

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<sup>1</sup> <http://eu-chinasmartcities.eu>

<sup>2</sup> <http://world-cities.eu/regions/chinese-regions/>

disseminate them in China in their own words tailored to the Chinese context rather than translating papers or documents. Transferring know-how or exporting technologies needs to consider the differing technological, political or socioeconomic contexts in which smart cities are implemented. There is no general approach to transfer know-how, but the transferability depends a lot on the circumstances in specific cities. The city-to-city level work between the EU and China may therefore play an important role and China has a rapidly growing number of pilot cities to offer in which city-to-city collaboration should be established fast. At the same time, China includes types of pilot projects that so far are less covered by the EU, such as in the case of Xiamen green ports or industrial pilots. By providing a comparative analysis of the Chinese city of Xiamen with the EU case study cities included in the POCACITO project, this deliverable highlights differences and overlaps which may be useful for a further discussion on potential cooperation on city level for low carbon development.

### III METHODOLOGY

For gathering and comparing the core data of the assessment, this paper builds on existing reports describing the project methodologies and summarizing the European case study city assessments of the POCACITO project (in particular POCACITO Deliverables D1.1, D1.2, D3.3, D4.4). This reports cover the cities of Barcelona, Malmö, Istanbul, Lisbon, Litoměřice, Milan, Turin, Copenhagen, Rostock and Zagreb. The assessment of European case study cities included the prior selection of key performance indicators (see below), and a data collection and discussion process through meetings with city officials and local assessment workshops with a broader group of stakeholders. The following two approaches were applied to gather data within the project:

- Top-down approach – completion of the indicators list according to a review of main statistical findings, existing relevant strategic and planning documents, and legislation to assure an accurate quantitative data collection;
- Bottom-up approach – discussions with local authorities and other selected stakeholders used to complement the collection of quantitative data and enrich the contents of the case study assessment reports.

For Xiamen in principle the same approach was taken but in the bottom-up part the vision building and backcasting was conducted in one single workshop, accompanied by bilateral meetings and discussions over a certain timeframe.

#### III.I QUANTITATIVE AND ACTIVITY-RELATED DATA

Most of the required data for the EU could be retrieved by national/regional statistical offices, government departments, environment and energy agencies, research institutes and non-governmental organisations. The data collection was made for both years 2003 and 2012 in order to compare their evolution. Already at EU level the comparability was challenging due to the availability of data for different geographical scales and time periods and partial lack of data. Data for Xiamen was only available from 2005 on and as the following chapters show not always available or compatible. The analysis in this paper therefore has no strict focus on completeness but on finding common ground with Xiamen given the available information. Xiamen did not implement the full methodological vision building and backcasting process as in the European cities, but similar information was gathered to provide a basis for comparison. The comparison is based on three sets of data:

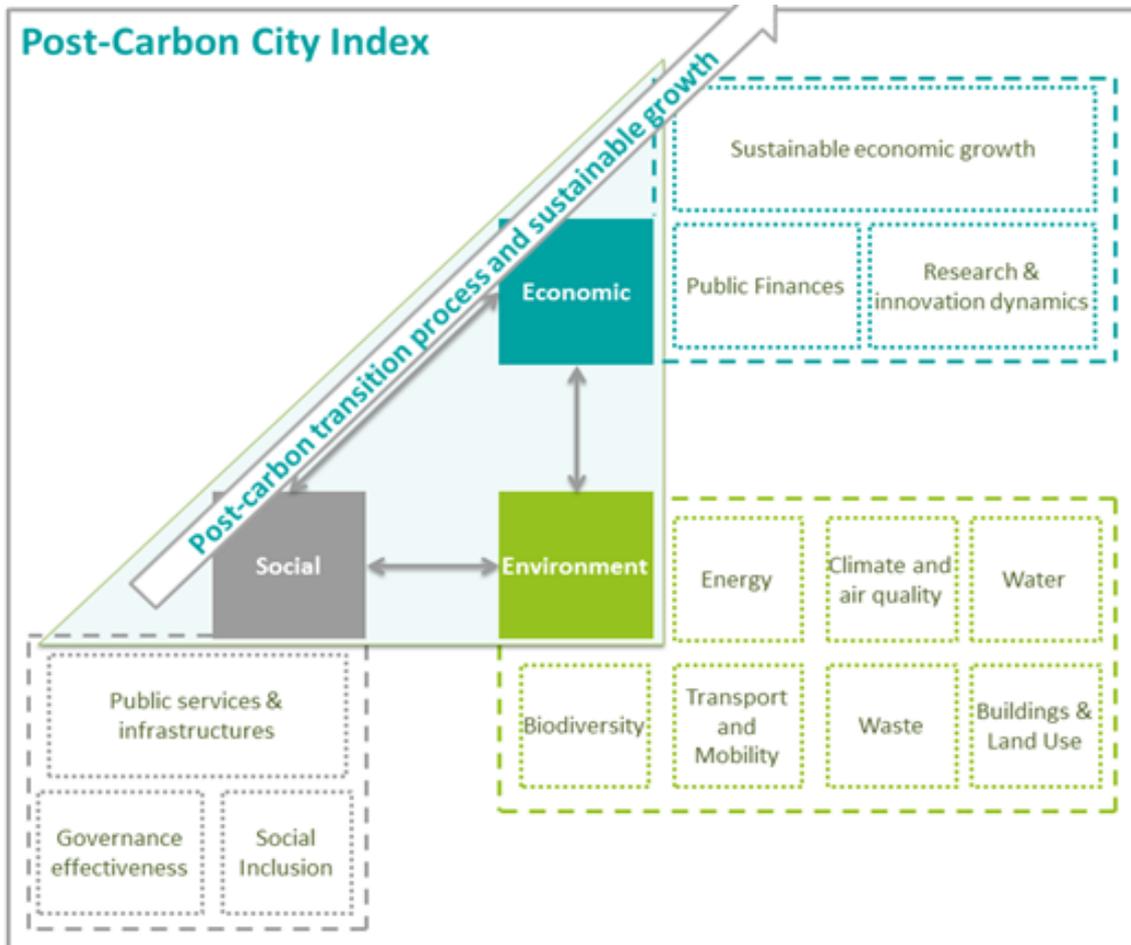
1. General data on city size and population
2. Key strategies and projects
3. Key performance indicators

General data: This includes the parameters city area (km<sup>2</sup>), population density (inhabitans/km<sup>2</sup>), total number of inhabitants, share of foreign population, and population

structure by age group. These parameters served to give a general idea on potentially common situations to be addressed.

Key strategies and projects: This refers to major strategies that are of relevance for a sustainable city development. The presence of important projects related to sustainable city development in the areas of energy, mobility, biodiversity, climate, waste water, and buildings, as well as “smartness of the city” was identified. This served to identify overlaps or complementarities in the activities taking place in each city which gives an idea on potential areas of exchange.

Post-Carbon City Key performance indicators: These indicators were defined along the dimensions social, environmental, and economic and a division into sub-dimensions as shown in Figure 1 below. The application of these indicators allows for a standardized comparison of cities. The full list of key performance indicators can be found in Annex II. For Xiamen, not all indicators could be provided. More background information on these indicators can be found in the POACITO Deliverable D1.2: Report on Key Performance Indicators.



**Figure 1: Dimensions and sub-dimensions of the Post-Carbon City Index**

Source: POACITO Deliverable D1.2: Report on Key Performance Indicators

## III.II STAKEHOLDER WORKSHOPS AND ENGAGEMENT: SCENARIO ESTABLISHMENT AND VISION BUILDING

At the core of the project was a series of participatory stakeholder workshops held in the case study cities Barcelona, Malmö, Istanbul, Lisbon, Litoměřice, Milan/Turin, Rostock, and Zagreb. The purpose of these workshops was to bring together local stakeholders to define a common post-carbon vision for 2050 for Europe, and to outline an action plan guiding the path towards achieving this vision. Comparable workshop was held in Xiamen.

For these stakeholder meetings, the Chinese Academy of Social Sciences hosted two meetings, one for Xiamen Municipal officials, and another for energy conservation and low carbon development experts in Xiamen.

The meeting with governmental officials was proceeded in the Chinese way, i.e. the participants speak one by one.

The following key questions were put forth for discussions:

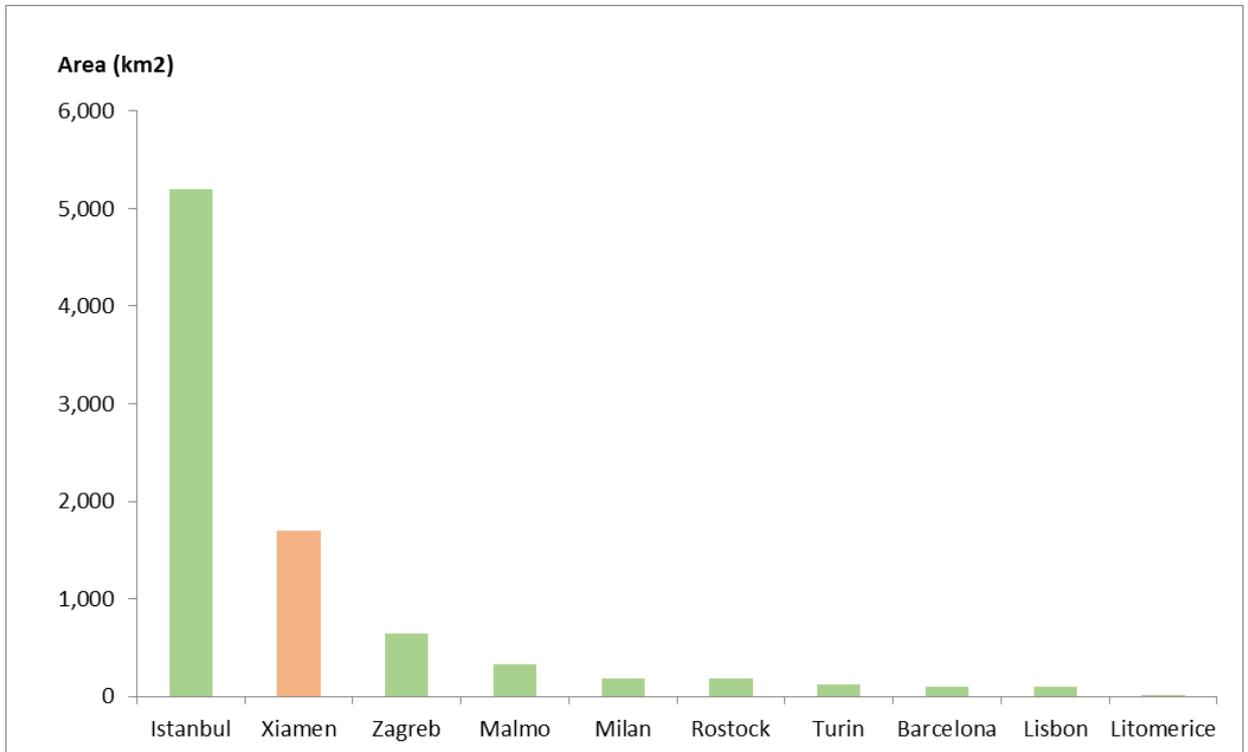
- How would you like Xiamen to look like and to function in 2050?
- What are the main problems or challenges for Xiamen low carbon development?
- Can we establish a common vision for a post Carbon future of Xiamen in 2050?
- What are the key elements for the Xiamen's bright future?
- How to overcome the difficulties to reach the long-term targets in Xiamen?
- What are the milestones of a low carbon development road map for Xiamen?
- How can you or your division contribute to build Xiamen as a pioneer low carbon city in China?

## IV GENERAL CITY DESCRIPTION

### IV.I TERRITORY

Xiamen is a sub-provincial city in south-eastern Fujian, beside the Taiwan Strait. It is divided into six districts: Huli, Siming, Jimei, Tong'an, Haicang, and Xiang'an. Its urban core grew up from the port of Xiamen on southern Xiamen Island, now located within the Siming District. It now also includes the Gulangyu Island and the rugged coast of the mainland from the northeast bank of the Jiulong River in the west to the islands of Xiang'an in the east. Xiamen is divided between Huli District in the north and Siming District in the south. Siming also includes Gulangyu.

Altogether, these cover an area of 1,699.39 square kilometres. The urbanized area of the city has spread from its original island to include parts of all six of its districts. This area connects to Quanzhou in the north and Zhangzhou in the west, making up a metropolis of more than five million people.



**Figure 2: Area of Xiamen as compared to European case study cities**

The Xiamen Island was considered to possess one of the world's greatest natural harbours in Yundang Bay, but Fujian's international trade was long restricted to Quanzhou or to Guangzhou in Guangdong. Due to the siltification of Quanzhou's harbour, Britain insisted that Xiamen be opened to foreign trade in the treaty that ended the First Opium War in 1842. Under the Qing Dynasty (the last Dynasty before the founding of the PR China), both before and after the war, there was large-scale emigration of Chinese from southern Fujian spread Hokkien-speaking communities to Singapore, Malaysia, and Indonesia. The overseas Chinese continue to support Xiamen's educational and cultural institutions. As part of China's Opening up policy under Deng Xiaoping, Xiamen became one of the original four special economic zones (SEZ) opened to foreign investment and trade in the early 1980s. SEZs in China can utilize an economic management system that is more attractive for foreign and domestic firms to do business than in the rest of mainland China. In SEZs foreign and domestic trade and investment are conducted without the authorization of the Chinese central government in Beijing. This includes promotion of co-operation between domestic enterprises and imports of advanced foreign equipment and technology. In fact, the Chinese SEZs are not

only “windows” to promote exchange between China and the rest of the world but also testing laboratories to experiment with economic, social, and political reform (Mohiuddin et al 2014)<sup>3</sup>.

Its former harbour was enclosed using land excavated during the city's expansion. The city is known for its mild climate, Hoklo (Hokkien-speaking communities’) influence and colonial architecture, as well as its relatively low pollution.



Figure 3: Overview map of Xiamen

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<sup>3</sup> Mohiuddin et al, 2014: The Special Economic Zone as a Locomotive for Green Development in China. Asian Social Science 10(18):109-121 · August 2014

## IV.II CLIMATE AND POPULATION

Xiamen has a monsoonal humid subtropical climate, characterized by long, hot and humid summers (but moderate compared to much of the rest of the province) and short, mild and dry winters. According to the detailed 2010 national Census that is carried out every ten years, Xiamen had a population of 3,531,347 inhabitants, almost 1.8 times the population counted for the last census in 2000 (which consisted of 2,053,070 inhabitants). The annual average population growth was of 5.57% for the period 2000–2010, however this includes the population explosion in the Jimei district, which quadrupled since the prior census while the Huli district's population more than doubled. According to the less detailed but most current 2015 statistics, the permanently resident population was 1,967,800 at the end of 2015, and the population residing at least half a year was 3.86 million inhabitants. This leads to a population density of 1,158 inhab/km<sup>2</sup> for permanent residents and 2,272 inhab/km<sup>2</sup> including half year residents.

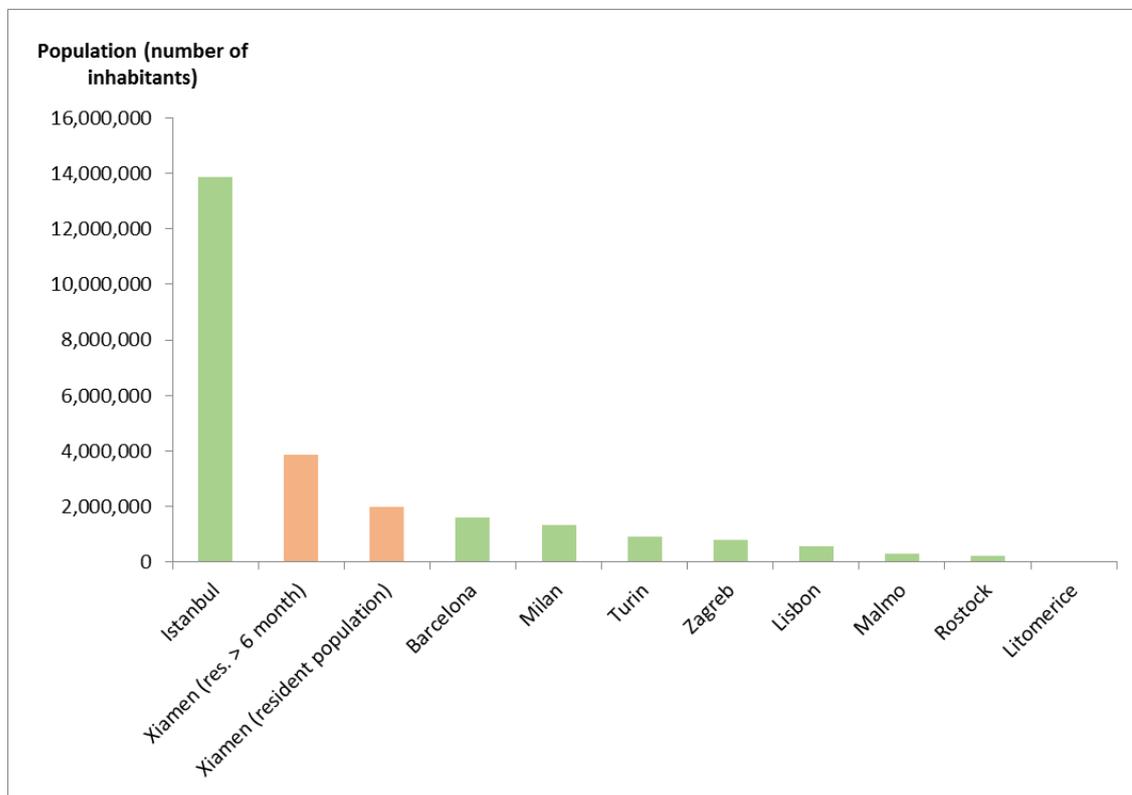
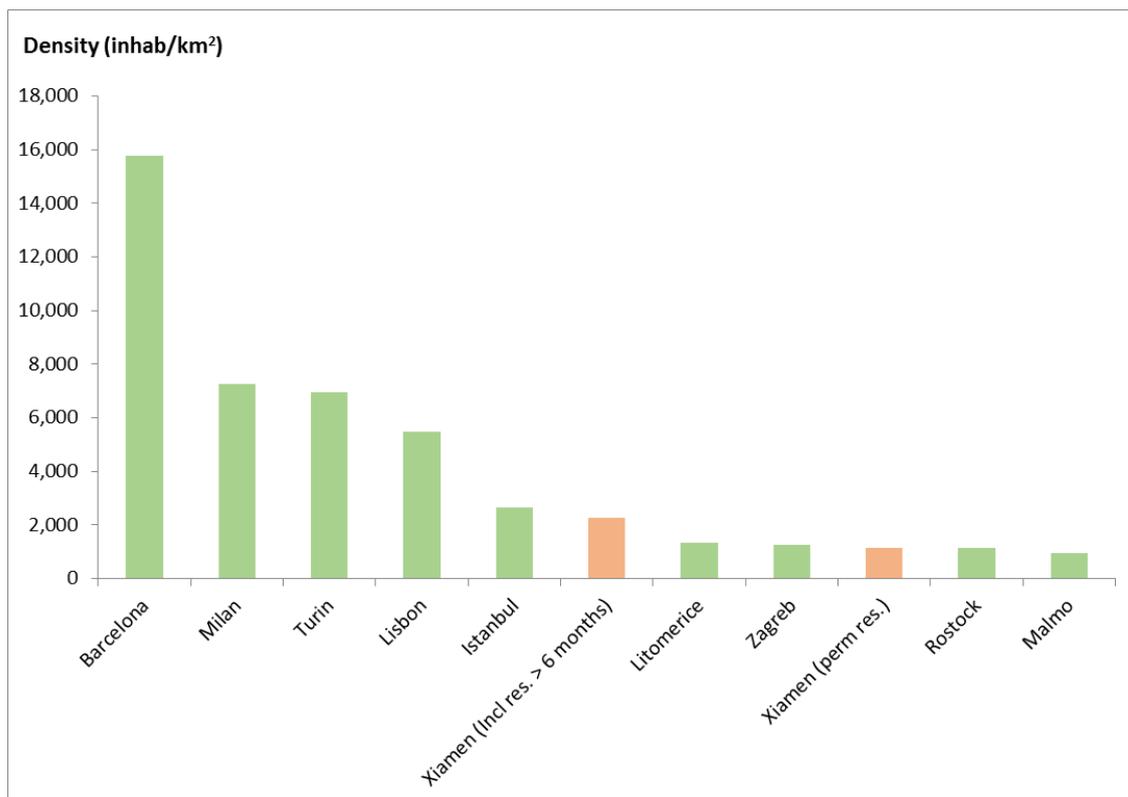


Figure 4: Population size of Xiamen as compared to European case study cities in 2015



**Figure 5: Population density of Xiamen as compared to European case study cities**

### IV.III CITY DEVELOPMENT AND ECONOMY

Known in the West as Amoy, Xiamen has a long history as a port city, and later became a center of British trade in the 19th century and Xiamen retains a strong international flavour.

Xiamen was part of the first batch of low- carbon pilot projects announced in 2010, that involved five provinces (Guangdong, Liaoning, Hubei, Shaanxi and Yunnan) and eight cities (Tianjin, Chongqing, Shenzhen, Xiamen, Hangzhou, Nanchang, Guiyang and Baoding), and the first one in Fujian Province.<sup>4</sup> Xiamen’s Municipal Development Reform Commission (DRC) takes lead to promote low carbon development. An inter-division steering group was established to enhance coordination among governmental divisions in 2011. The GDP per capita in 2015 was about \$14000. The development level in Xiamen, especially of the Xiamen Island, the core area of Xiamen, is relatively high in eastern China, and obviously higher than other cities in middle and western China. Xiamen is already well known for liveability with good conditions of natural resources and environment.

In 2015, the energy consumption and carbon emission per unit of GDP were 0.437 tce/10000 yuan RMB and 0.776 tCO<sub>2</sub>/10000 yuan RMB, relatively low for large and medium size cities in

<sup>4</sup>Official source of the National Development and Reform Commission in Chinese: [http://www.gov.cn/zwggk/2010-08/10/content\\_1675733.htm](http://www.gov.cn/zwggk/2010-08/10/content_1675733.htm)

China<sup>5</sup>. The share of coal in the energy mix is only 24%. The service sector in the economic structure has a share of already 55.8%.

## V KEY STRATEGIES AND PROJECTS

Xiamen’s basic development principle is “To lay equal stress on economic development and ecological protection, and to seek to achieve economic and environmental win-win results”. Xiamen’s government target is to construct an ecological and cultivated city in China. Green development is the most important guideline for Xiamen. Xiamen takes many concrete measures to realize low-carbon transformation, including the enhancement of top-level urban design, to strictly implement the scientific planning, or design an ecological construction mechanisms. Xiamen is implementing several low-carbon pilot community projects and requires key companies to release GHG emission reports. Xiamen has also set a specific emission peak target and determined to achieve its CO<sub>2</sub> emission peak during the period 2020-2022 with the amount around 40.14 million tons of CO<sub>2</sub>. With the estimated population of 5.5 million people at that time, Xiamen’s per capita emission should be around 7.2 tons of CO<sub>2</sub>.

As examples for relevant projects in Xiamen the fields of emission inventories, mobility, and buildings can be mentioned as briefly described below.

PROJECT FACTSHEET	
Title	<b>Carbon emission inventory</b>
Area of implementation (city, neighbourhood, etc)	City of Xiamen
<b>Project description</b>	
Aims	To make clear the main sources of Xiamen’s carbon emission and set specific low-carbon development planning and policies.
Content	<ul style="list-style-type: none"> <li>• To finish the 2005-2010 Xiamen’s carbon emission inventory compilation task</li> <li>• Start the 2011-2014 carbon emission inventory compilation work.</li> </ul>

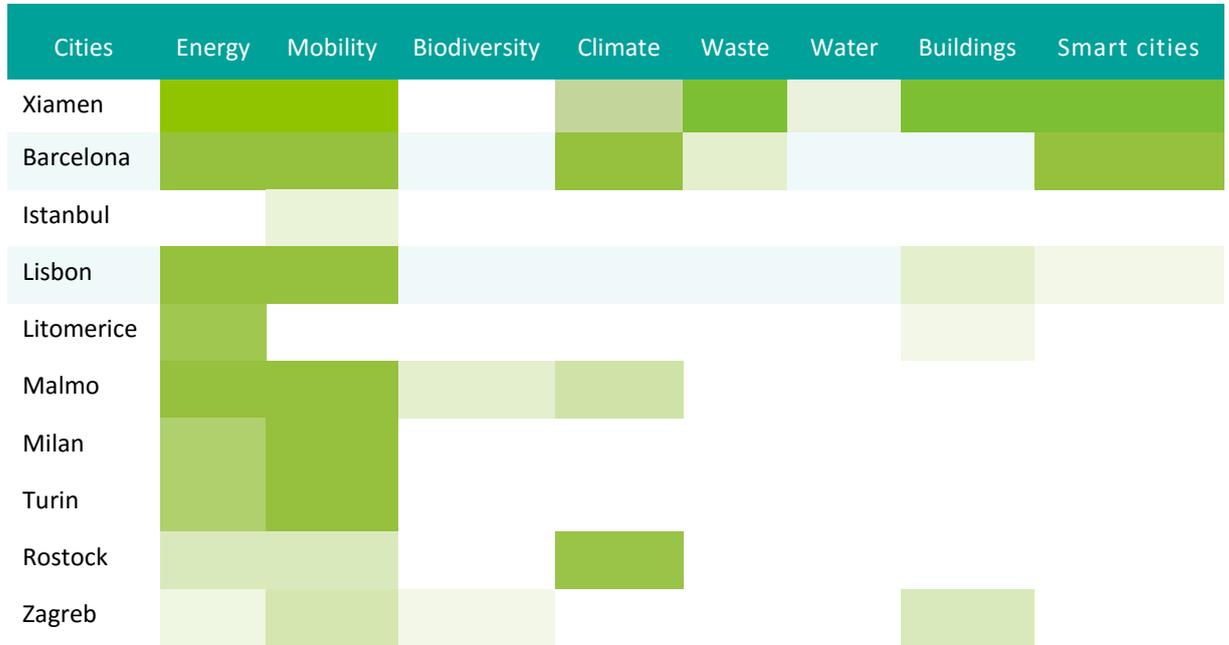
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<sup>5</sup> Source: City of Xiamen

PROJECT FACTSHEET	
Title	<b>Policies to promote the application of new energy vehicles</b>
Area of implementation (city, neighbourhood, etc.)	City of Xiamen
<b>Project description</b>	
Aims	To promote the wide application of clean and low-carbon transportation systems
Content	By 2015, Xiamen's new buses were aimed to be all new energy vehicles with several routes using pure electric buses. This aim was almost achieved with in the share now being over 90%.

PROJECT FACTSHEET	
Title	<b>Low-carbon pilot city construction projects of Xiamen</b>
Area of implementation (city, neighbourhood, etc.)	City of Xiamen
<b>Project description</b>	
Aims	Xiamen is chosen as one of China's low-carbon pilot cities and explores new measures and actions in constructing low-carbon cities.
Content	Include a series of concrete measures in low-carbon technology innovation, promote low-carbon buildings, low-carbon transportation and an increase of carbon sinks and forest coverage.

The table below shows a comparative overview of the sectors in which major city development projects relating to low carbon development are carried out. The importance of energy and mobility is comparable to most European cities, while the importance of buildings and smart city projects seems to be higher than in most EU cities. This is caused by the large population growth in Xiamen. Also waste has a high importance while this became a lower issue in EU cities over the last decade.



**Figure 6: The relative importance of sustainability key projects types – Xiamen and EU**

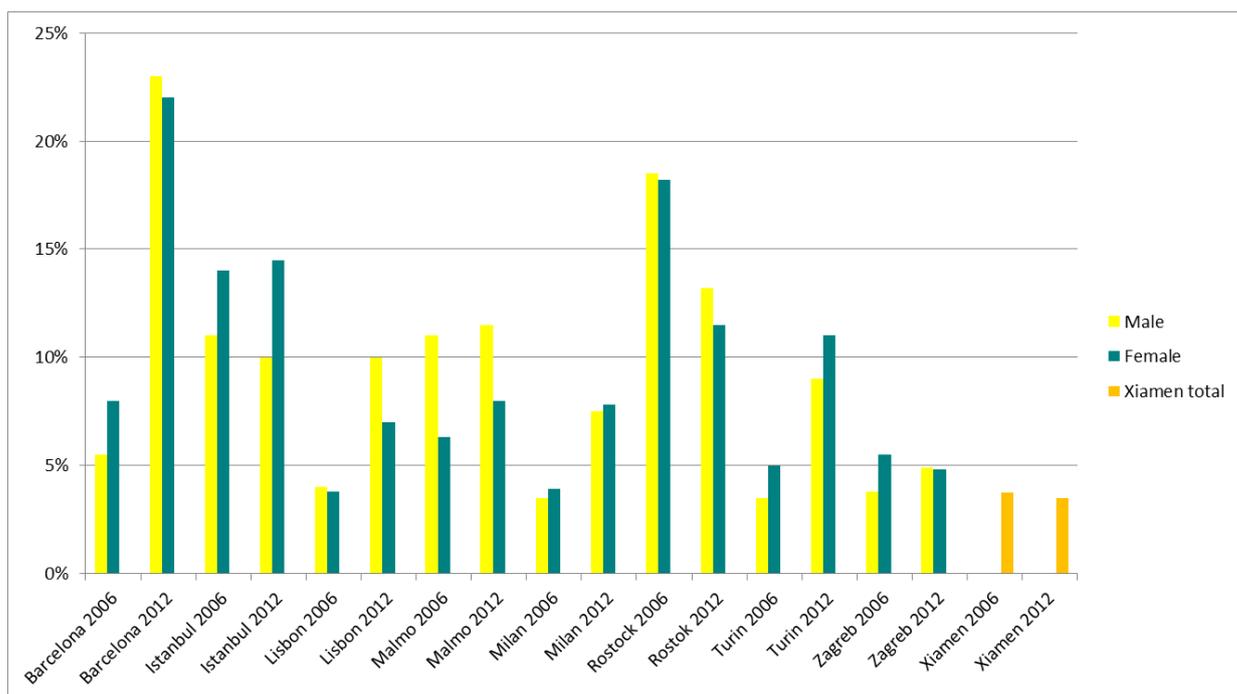
Source: Own estimation for Xiamen, EU overview from POCACITO Deliverable D3.3

## VI KEY PERFORMANCE INDICATORS (KPI)

### VI.I SOCIAL PERFORMANCE

#### UNEMPLOYMENT LEVEL

The level of registered unemployed in Xiamen is at the low end as compared to EU cities. As opposed to most European cities which showed an increased unemployment level between 2006 and 2012 (economic crisis), the rate in Xiamen showed a slight decrease.



**Figure 7: Evolution of unemployment rate by gender (2006 and 2012)**

Source for EU cities: POCACITO Deliverable D3.3

## POVERTY LEVEL

The poverty level could only be provided in terms of the share of the population receiving governmental support rather than using a poverty threshold. Therefore, the data provided is not comparable to European statistics. The share of the population receiving governmental support is about 2% and slightly decreased by 2015. In the EU poverty levels were between 14 and 18% in 2005 but rise to a range of 16-22% in 2012. The increasing poverty levels in the EU were particularly visible during the timeframe of the economic crisis (2011).

## AVERAGE LIFE EXPECTANCY

Life expectancy was not available for the city of Xiamen, however data for Fujian Province is shown in the graph below. Life expectancy is below all European values, at least until 2010, but showed an important increase between 2000 and 2010.

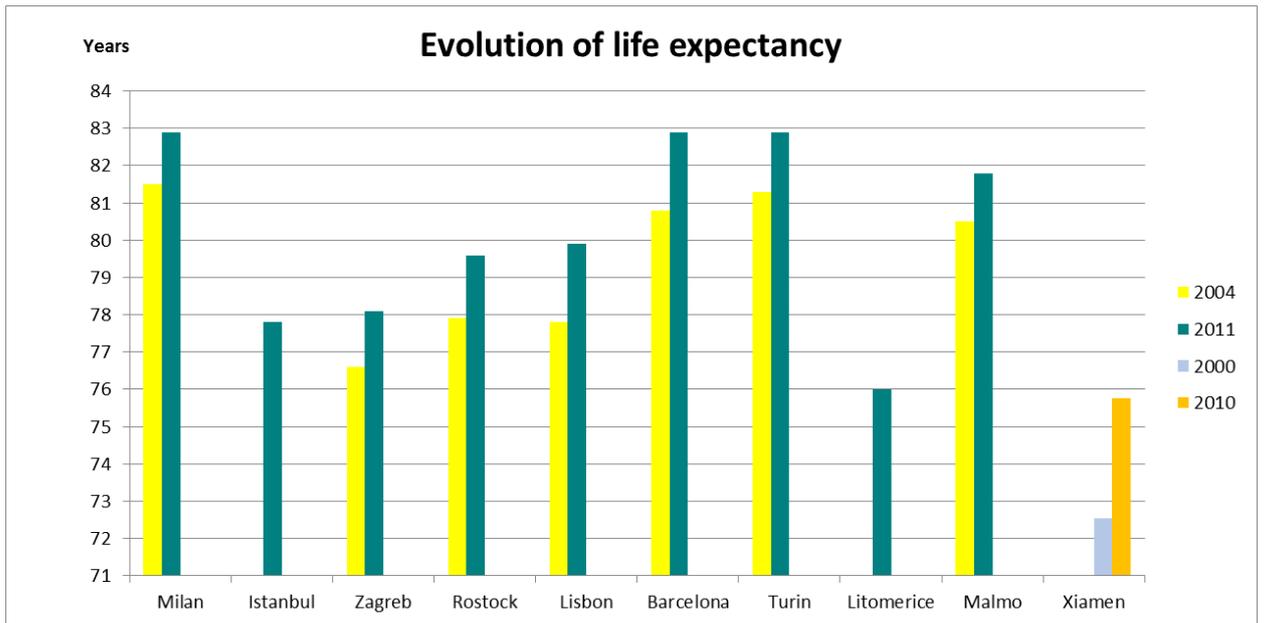


Figure 8: Evolution of life expectancy (2004 and 2011, resp. 2000 and 2010 for Xiamen)

Source for EU cities: POCACITO Deliverable D3.3

#### GREEN SPACE AVAILABILITY

The green space availability is relative high in Xiamen and ranks after Malmö and Rostock in the EU cities.

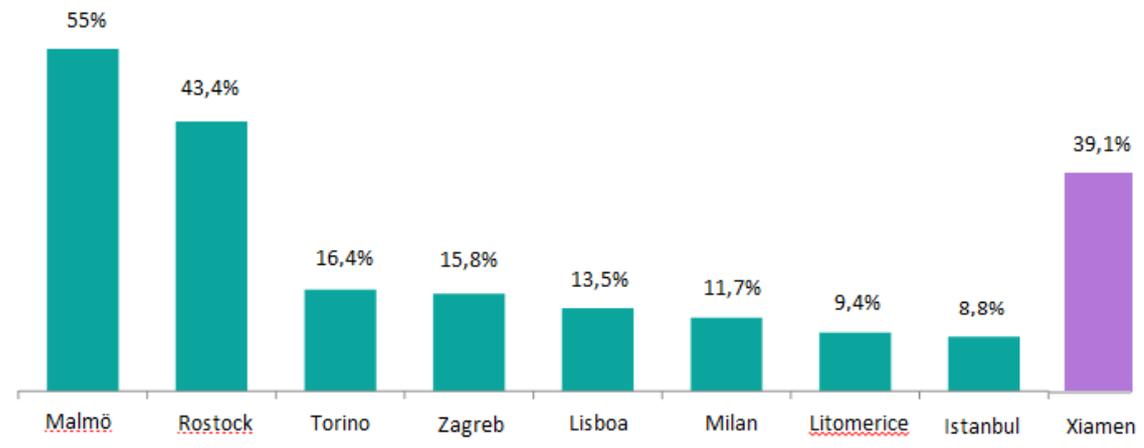
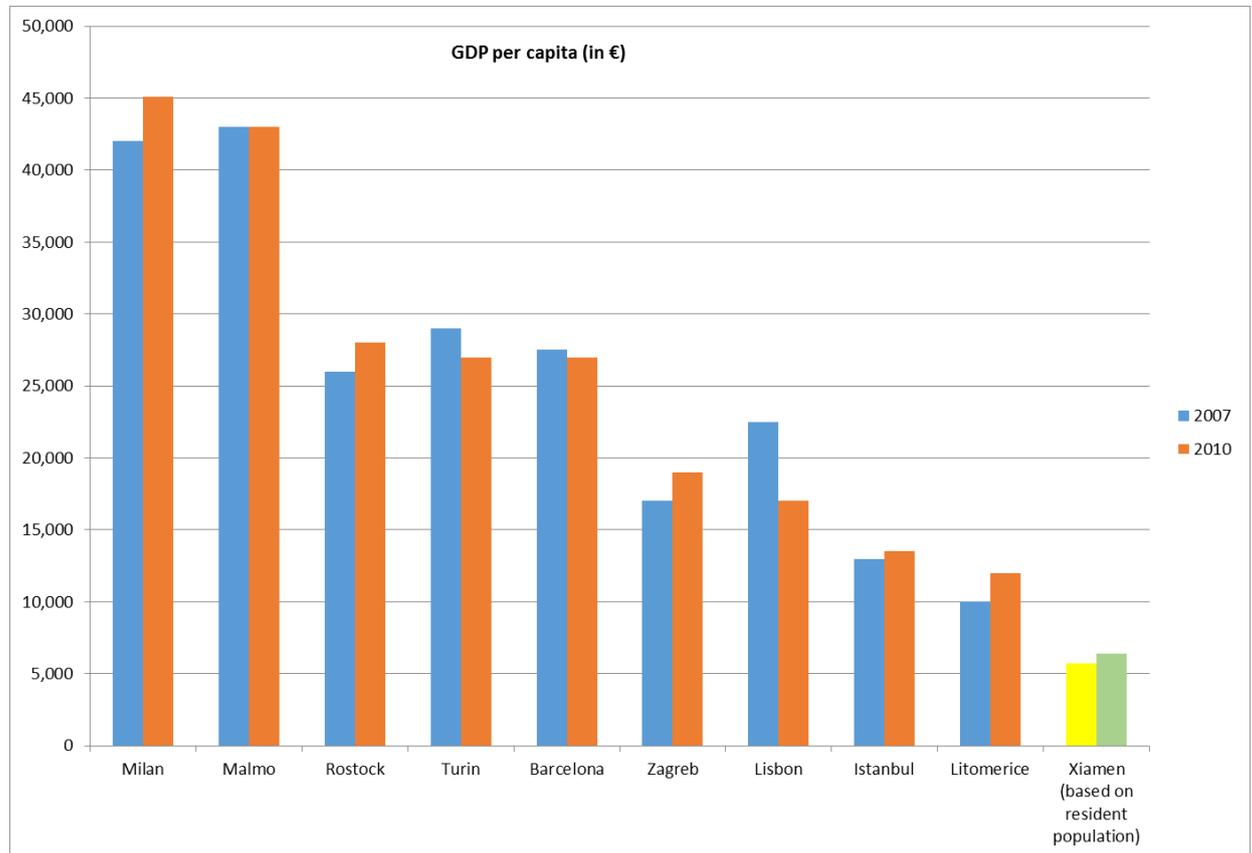


Figure 9: Percentage of green space over total urban area, EU cities and Xiamen

## VI.II ECONOMIC PERFORMANCE

### LEVEL OF WEALTH – GDP PER CAPITA

In terms of GDP per capita, Xiamen is still below all European cities but given its economic growth it may reach some of the European case study cities in the coming years.

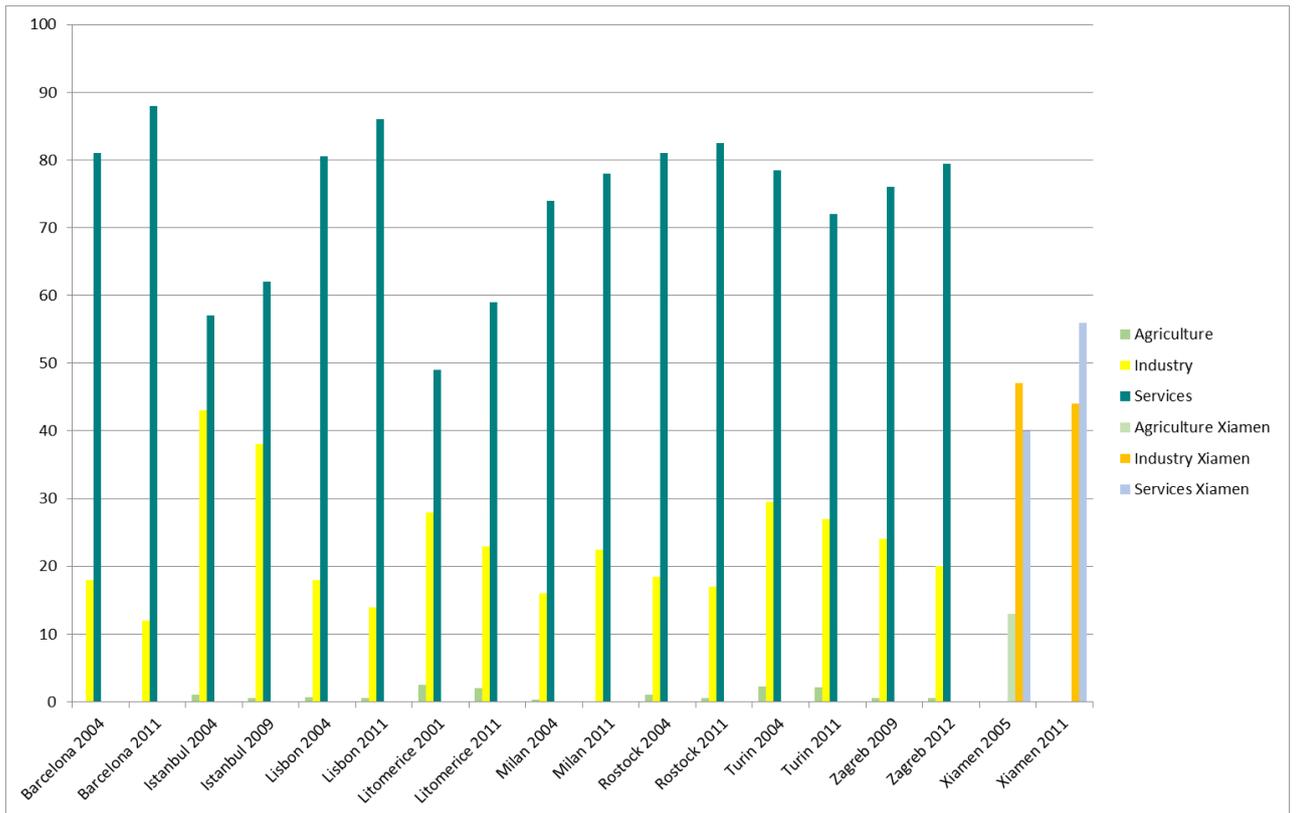


**Figure 10: GDP per capita: EU cities and Xiamen**

Source for EU cities: POCACITO Deliverable D3.3

### EMPLOYMENT BY SECTORS

As opposed to European cities Xiamen showed a relatively important share of agriculture in 2005 and had a more balanced distribution between the service sector and industry. All European cities showed a higher service sector share already in 2004 as compared to employment in industry and in most cases this share increased. This shift towards the service sector is much more apparent in Xiamen where the highest share was industry in 2005 and became the service sector in 2011 while agriculture has completely lost importance.



**Figure 11: GDP per capita: EU cities and Xiamen**

## BUDGET DEFICIT

A GDP-related annual debt was not available for Xiamen. Between 2005 and 2015 the budget deficit, i.e. the share of the fiscal expenditures that could not be covered by the local fiscal revenues, varied between 1% in 2014 and 18% in 2005 with no clear tendency over time.

## R&D INTENSITY

For the R&D intensity, no GDP-related data was available for Xiamen. The share of R&D expenditures was available as share of the public budget and varied between 3,9% and 3,1% since 2005. This is comparable to the highest GDP-related expenditures for Europe which had the highest value in Malmö while all other EU cities stayed below 3% in 2011 with the lowest value of below 1% being the share in Litomerice.

## VI.III ENVIRONMENTAL PERFORMANCE

### ENERGY CONSUMPTION BY SECTORS

Xiamen shows an important increase of industrial (53%) and household (98%) electricity consumption between 2005 and 2010 (67% combined). This is way above the values for European cities and to be seen in connection to the increasing economic performance (doubled GDP during that period) while Europe importantly suffered from the economic crisis.

### CARBON EMISSIONS INTENSITY

The carbon emission intensity could be gathered for industrial enterprises whose total annual energy consumption corresponds to more than 10000 tons of coal equivalent (tce). Xiamen's carbon intensity has strongly dropped between 2014 and 2015 while slowly being reduced in the years before. The strong rise of the service sector may have contributed, but still Xiamen has important industrial activities. The carbon intensity has developed from the higher range to one of the lowest intensities as compared to European cities (note that the shown years deviate). It has to be noted however that the CO<sub>2</sub> emissions of Xiamen may not have the same level of accuracy than in the EU.

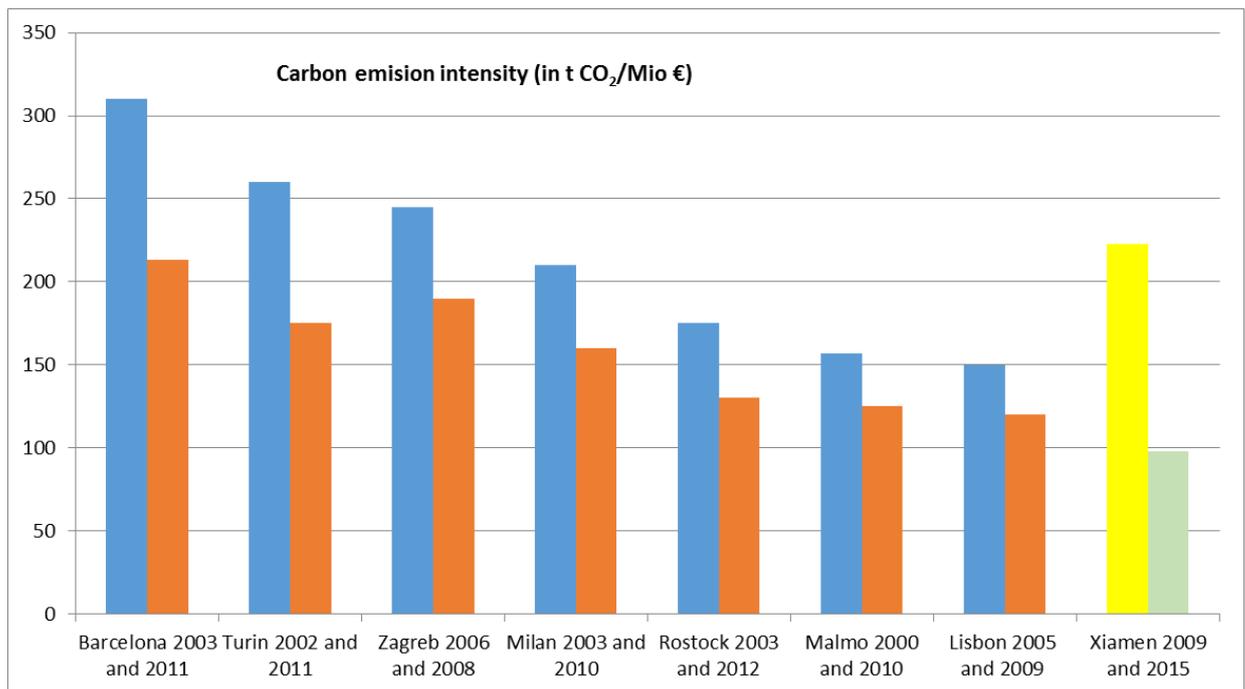


Figure 12: Carbon intensity in EU cities and Xiamen

## VII PARTICIPATORY ASSESSMENT – ESTABLISHMENT OF VISIONS AND BACKCASTING SCENARIOS

### VII.I RESULTS OF THE VISION BUILDING

Although all stakeholders had own opinions and priorities, the common vision for 2050 can be described as “Beautiful Xiamen Strategy”, which refers to not only the beautiful environment but also economic prosperity and social advancement.

The great challenge for Xiamen is how to achieve green and low carbon development to improve life quality for all residents while reaching an emission peak as soon as possible.

Overall in the stakeholder meetings there were discussions on potentials and costs: some participants were worried Xiamen’s performance in energy efficiency and low carbon emission is already better than other large and medium size cities. There will be less “low hanging fruits” left (opportunities to reduce emissions with low costs). Xiamen has to make more efforts to find innovative approaches for low carbon development. Some important sectors and areas were frequently mentioned:

- **Transportation:** Consisting of the core Xiamen island and several districts outside, Xiamen has bridges to connect them. Transportation is a big problem for many young commuters who may work on the Xiamen island but live outside due to high prices of housing. The first subway line is under construction. A new express bicycle road of 7.6 kilometres will be built soon.
- **Ports:** Xiamen has 4 port areas close to the urban area. Ports are an important cause of energy intensive activities and high pollution, which need more attention regarding energy conservation and emission reduction.
- **Tourism:** Xiamen has a beautiful beach as well as historical and cultural heritages such as the Gulangyu Island. Tourism has a great potential for growth. The local community is actively advocating environmental protection, especially a waste sorting and treatment system. The conception of low carbon tourism needs to be developed and put into operation.

Other important issues that stakeholder discusses included:

- **Governance:** Government representatives fully recognized their responsibilities in leading to a low carbon development. NGOs are active in advocating environmental protection. The government can cooperate with NGOs to raise public awareness and promote low carbon development. Although there are many NGOs now in China, the role of NGOs is not as important than in western countries.
- **International cooperation:** Being one of the earliest Special Economic Zones, Xiamen is quite open and actively engaging in international cooperation.

- Xiamen has more socioeconomic similarities to European cities because Xiamen's economy is more developed and the economic structure is highly dependent on the tertiary sector. It would therefore like to learn from European low carbon city experiences. Xiamen asked for specific examples and concrete information of policies and best practices of post carbon cities in the EU.

Xiamen is already applying IT in smart city construction in Xiamen, such as smart transportation and security systems. Xiamen has a great potential to develop an IT industry and apply IT to improve energy efficiency and reduction of emissions in cities.

## VII.II RESULTS FOR BACKCASTING SCENARIOS

China is developing fast since its opening and reforming in 1980s. Stakeholders had difficulties to imagine a long-term vision for 2050. They are more comfortable to discuss the reality, short term targets for the 13th Five Year Plan (2016-2020) and medium term targets for 2030 and set up these targets as milestones for the vision for 2050.

The outline of Xiamen's Social and Economic Development in the 13th Five Year Plan was adopted by Xiamen People's Congress in January 2016. The average economic growth was envisioned to be 8.5%, higher than the national target of around 7%. Participants highlighted that besides GDP, Xiamen is the first city in China to set up an HDI as an important target for social and economic development, and it has the aim to increase the HDI from 0.856 in 2015 to 0.89 in 2020, reaching the medium level of developed countries. Based on the development level in 2015, about 30 targets were set up for 2020 in the 13th Five Year Plan including economic development, innovation driven welfare and ecological civilization. For example, Xiamen plans to increase the urbanization rate from 44% to 52%, keep the annual growth of import and export trade by 6%, increase R&D expenditure from 3% to 4%, internet access at 85%, etc.

The most important milestone of low carbon development is the emission peak. China submitted an INDC and declared to reach the emission peak around 2030 and make efforts to achieve it as early as possible. Following the national target of the emission peak, up to now 23 Chinese cities and provinces have agreed to peak their emissions by or before 2030, and 8 by or before 2020. For example, Beijing and Guangzhou have agreed to peak by 2020. But up to now, Xiamen as one of the first batch low carbon pilot cities, has not set up a target year for its emission peak. The Xiamen municipal DRC has the position that more research is needed to decide Xiamen's target year of emissions peak and make a concrete road map to achieve the target although the period 2020-2022 is envisaged. The Xiamen government has invited experts to do research work on it. Other participants also hesitated to project Xiamen's peak year. Several experts said that emission curve will stay relatively flat after the peak for some time.

## VII.III OVERVIEW EVALUATION

The city representatives imagine Xiamen will be one of pioneer city to achieve the “Dream of China” in 2050. At that time, not only GDP per capita but also carbon emissions per unit of GDP will reach a similar level as in developed countries. Definitely low carbon development is one of the important targets. Xiamen was imagined to be a liveable, sustainable, beautiful city with the charm of history and culture. Thus, a new model of development was emphasized to achieve the targets, which means an innovative, harmonious, green, open and inclusive development. The milestones were set for the 13th Five Year Plan (2016-2020) and are basis for 2030.

## VII.IV PARTICIPATORY PROCESS IN EU CITIES

### VII.IV.1 POST-CARBON VISIONS FOR EUROPEAN CITIES

Table 1 provides an overview of the sectors covered during the Vision Workshop in Xiamen and in the EU case study cities. In the following some explanation is provided on the sectors of major interest for Xiamen, these explanations are based on the POCACITO deliverable 4.4. Even though these sectors were not all addressed in the Xiamen workshops, it becomes evident from the other sources that they are partly equally on the agenda of city development in Xiamen.

As far as energy is concerned, local visions in the EU touch on energy efficient development, self-production and consumption of energy, alternative energy sources, increased use of and investment in clean energy, regulation of energy policies at city level, energy and the carbon market, and calculations of emissions from buildings. Visions on energy covered 4 categories for urban action, namely reform of energy generation and distribution; concepts, plans, and performance; reducing energy consumption; and energy efficient or energy generating buildings.

Regarding transport, visions contain a range of qualitative ideas such as efficient, clean, and accessible public transport to management and form of transport means, like sharing and smart logistics. Issues covered in the transport and mobility sector can be divided into five main categories: quality of transport; carbon-free transport; public over private transport; integration, connection, and multimodality; and reduced impact from traffic.

With regards to land use, visions focused mainly on the quality of the urban environment and efficient management of natural resources, as well as buildings and the re-use of urban areas. With regards to urban economics, visions are focused on improving competitiveness or on the transition of the urban economy to a sustainable low-carbon economy.

Related to social issues, visions aim at social inclusion, increase safety, and enhance cultural identity. In this context, also the planning of city development, transportation, and infrastructure were discussed as they positively affect quality of life in the city.

Related to waste and consumption, visions see cities under a metabolism approach, where inputs and outputs of matter become relevant and allow for addressing the phenomena of

carbon leakage. Consumption and waste visions can be categorised into 3 main areas: waste reduction, efficient use of resource, and closed cycle.

For tourism, visions seek a balance between tourism and quality of life for the local population, where the city is attractive for tourism and tourism contributes significantly to the local economy.

As far as food production is concerned, visions focus on self-sufficiency through local production of food, and in turn reduced transport of food, as well as healthy eating and enjoying a high quality of food.

Finally, for the technological sector, visions see technology and technological innovation as tools for the post-carbon transition, which will help drive economic development. Visions on technology and innovation include ideas such as smart technology and integrated systems and networks.

	Transport and mobility	Energy	Land use and infrastructure	Social issues	Economy	Biodiversity and conservation	Technology and innovation	Education	Tourism	Governance	Food production	Consumption and waste
Xiamen	x		x		x		x		x			
Barcelona	x	x	x	x	x		x	x	x	x		
Istanbul	x	x	x	x	x	x	x			x		x
Litoměřice	x	x	x	x	x		x	x	x	x	x	x
Lisbon	x	x	x	x	x		x		x	x	x	
Malmö	x	x	x	x	x		x				x	x
Milan	x	x	x	x	x	x	x	x		x		x
Rostock	x	x	x	x	x				x		x	x
Turin	x		x	x	x				x			
Zagreb	x	x	x		x	x		x		x	x	x

**Table 1: Sectors covered during the Vision Workshops in EU cities and Xiamen**

Source for the EU cities: POCACITO deliverable 4.4

## VII.IV.II BACKCASTING EXERCISE

The following list provides some examples for actions that were detailed for the different sectors in the local scenarios (POCACITO Deliverable 4.4) and which correspond to key issues, projects and interests in Xiamen:

- Stakeholders from Milan identified the development of informatics infrastructure, including smart stops and smart times for public transportation on buses, trains, and trams, as a possible action in the sector of urban planning measures to achieve the post-carbon vision of Milan as a city that is more accessible and usable without a car.
- Stakeholders from Istanbul identified waterfront planning and easy accessibility to parks and green areas as possible actions to achieve the vision of integrated water and green lands.
- Stakeholders from Turin identified enhancing social housing, innovating tools and resources for welfare, and improving welfare through information and communications technology as possible actions to achieve the vision of a city with high birth rates, strong resilience, high quality of life and strong identity.
- Stakeholders from Milan identified increased waste sorting, with the separation of waste and recyclables more user-friendly and more efficient, and increased efficiency of energy recovery of residual waste as possible actions to achieve the vision of reuse and recycling of materials.
- Stakeholders from Malmö identified large-scale cultivation of shrimp, algae, and vegetables using residual heat, and introduction of government subsidy of fossil-free and sustainable agriculture as possible actions to achieve the vision of city gardening and farming, and optimising the use of arable land by producing food in a resource efficient and large scale manner outside the city and in small scale inside the city.
- Stakeholders from Istanbul identified the introduction of new approaches to R&D and the use of renewable technology for natural resource usage, transportation, buildings and industry as possible actions to achieve the vision of a city which uses innovative R&D approaches for development and innovative activities.

## VII.V COMPARATIVE DISCUSSION ON MAJOR CITY DEVELOPMENT ELEMENTS

Based on the above, the following areas can be identified as major sectoral elements identified for Xiamen's city development. As shown above for the sectors addressed during the vision workshops, transport, energy and economic development are of high importance for most EU cities as well. The technological focus and the importance of tourism distinguish Xiamen from a number of EU cities. Barcelona, Lithuania, and Lisbon are the EU cities that covered both of these sectors as well. Also resource efficient food production is not an issue yet in Xiamen.

**Energy:** Energy generation is, besides transport, most important in EU cities. Xiamen is active in improving energy efficiency, see also technology below. Regarding energy generation most of Xiamen's energy generation is from outside of Xiamen itself. Xiamen is poor in fossil fuel energy reserves. There is only one power generation plant, but the coal is also from other parts of China. There are however two waste incineration power plants.

**Transport:** Besides energy generation, transport is most important in EU cities. This is comparable to Xiamen with the particularity that transport in Xiamen is characterized by a great amount of daily business transport from and to the main Island.

**Economic growth and trade:** Xiamen's target is above the national average and use of the HDI was introduced with a 2020 target corresponding to the medium level of developed countries. In Europe, economic development was discussed to be a prime issue in Milan, Turin and Istanbul.

**Tourism:** Mediterranean cities may show comparable patterns and dependency on tourism as well as impacts from climate change and tourism was considered for these a relevant factor for local, post-carbon visions (see report D4.1).

**Technological solutions and innovation:** An important characteristic of Xiamen is the development of IT solutions with are, for instance, applied in the areas of energy efficiency and construction in general, contributing to the development of **low-carbon buildings and smart city development**. This generates an important potential for low-carbon city development based on local know-how and technologies.

**Quality of life** and the attractiveness of Xiamen can also be highlighted as important elements of the city as it was imagined in the future. This is comparable to EU cities, even though the focus on tourism is not present in all EU cities.

**Land use:** increased carbon sink and forest coverage are targeted by Xiamen's activities as low-carbon pilot city and can benefit from the high green space availability

**Waste:** Waste sorting and treatment were mentioned in the vision building workshops in connection with tourism and are of high importance in Xiamen.

## VIII KEY STRENGTH AND CHALLENGES

The strengths and challenges of low-carbon development in Xiamen are briefly summarized in the table below in comparison with results for the EU.

CITIES	STRENGTHS	CHALLENGES
<b>Xiamen</b>	<p>National framework defining a target year for the carbon peak is expected.</p> <p>Great touristic potential (beach, historical and cultural heritages). Community actively engaged in environmental protection. Open and actively engaging in international cooperation. Potential of IT and application in smart city construction (e.g. smart transportation and security system) may be expanded to energy efficiency and emission reduction. Being a special economic zone, this provides for more freedom, growth and cooperation as compared to other Chinese cities.</p>	<p>Soon achievement of the carbon peak but unclear when.,</p> <p>Low-cost options may already be largely exhausted (high degree of innovation needed). High transportation requirements due to high living costs in central areas. Emissions and pollution by port activities need to be addressed. Establishment of low carbon tourism.</p>
<b>Barcelona</b>	<p>At the forefront of smart cities movement</p> <p>Several strategies which are impacting carbon emissions</p> <p>Sustainability strategies are being implemented: transports, green space, waste and water management</p> <p>Strong role of Area Metropolitana de Barcelona as a coordinating body</p> <p>Influx of young immigrants</p>	<p>Increased share of the population at risk of exclusion and poverty</p> <p>Increased level of unemployment</p> <p>Need to find a balance between the need to maintain it as a tourist centre, while keeping its local character</p> <p>Growing level of municipal indebtedness</p>

CITIES	STRENGTHS	CHALLENGES
<b>Istanbul</b>	<p>Initial stage of development towards a post-carbon city</p> <p>Investments in public transportation</p> <p>Improvement of social performance</p> <p>Increase in level of wealth and economic attraction</p>	<p>Population increase and growing urbanisation</p> <p>Sprawl of the city towards peripheries caused by growing population</p> <p>Air and environmental pollution; stress on natural protection areas and forests</p> <p>Environmental performance as the weakest dimension and most underestimated by city</p>
<b>Lisbon</b>	<p>Several strategies and plans are being implemented in the area of mobility and energy, but still with medium impact</p> <p>Reduction of pollutants and carbon emissions</p> <p>Expressive reduction of water losses</p> <p>Improvement of public finances</p>	<p>Loss of population in the city centre and aging people</p> <p>Increase in unemployment and poverty levels</p> <p>Use of car as the privileged mode of transportation</p> <p>Need to improve performance in waste management and recovery</p> <p>Need to invest in buildings renovation</p>
<b>Litomerice</b>	<p>One of pioneer cities in Czech Republic aiming at energy efficiency and renewable energy production</p> <p>Ambition to become an energy self-sufficient city</p> <p>Emphasis on the geothermal power plant project</p>	<p>Small city that is from large extent influenced by the development of higher territorial units</p> <p>Dependence on the availability of external financial resources</p>
<b>Malmo</b>	<p>Ambitious energy strategy</p> <p>Sustainable transportation is on the right track</p> <p>Innovative city with a positive trend in GDP per capita</p> <p>Young and multicultural city</p>	<p>Economic inequity in the city</p> <p>Segregated city with evidence of social unrest (high immigration numbers)</p> <p>No protocol to calculate the carbon footprint of the city</p>
<b>Milan</b>	<p>Leading city in economic and social areas</p> <p>Innovative city</p>	<p>Advantage compared to Italian cities in terms of environmental standards, but behind European average standards</p> <p>Need to invest in the shift towards a zero-carbon paradigm and to increase civil awareness</p> <p>Poor air quality, high pollution</p> <p>Aged building stock</p>

CITIES	STRENGTHS	CHALLENGES
<b>Turin</b>	Innovative city Relevant share of green areas	Increase in unemployment and decrease in GDP (due to strong specialisation) High percentage of people in risk of poverty Poor air quality, high pollution Stock of debt is high
<b>Rostock</b>	Important measures to reduce environmental footprint Improvement of air quality, waste and water management and sustainable mobility	Weak infrastructure and social challenges regarding poverty and unemployment in the region Weak financial situation
<b>Zagreb</b>	Growing number of citizens and transition groups paving the way towards a post-carbon paradigm (bottom-up approach) Participation in major EU and global initiatives aiming at CO <sub>2</sub> reduction	Lack of strategic planning Need of social participation in the transition towards a post-carbon city Critical success factors: social – unemployment and poverty; environment – public transportation and municipal waste management; economic – GDP per capita, business survival and social entrepreneurship

**Figure 13: Key strengths and challenges**

Source for EU cities: POCACITO Deliverable 3.3

## IX CONCLUSIONS AND OUTLOOK FOR POTENTIAL COOPERATION BETWEEN XIAMEN AND EU CITIES

Xiamen is a particular case for a Chinese city given that it is one of the first batch of low carbon pilot cities in China. In addition, as special economic zone, Xiamen has opened up for international cooperation and learning to an over-average degree since 1979. Xiamen follows a typical development path with an important shift from agricultural and industrial activities to the tertiary sector and quickly catches up in terms of economic development with EU cities. Given the speed of development and a focus on specific sectors such as urban planning/buildings, cooperation may not be a one-way benefit but European cities might learn from Xiamen as well and jointly address common issues. During workshops in Xiamen, a high interest in international cooperation and learning was expressed. This provides a good ground for cooperation with European cities. Given the historical and economic development-related proximity to Europe and its specific situation as special economic zone and low carbon pilot city, Xiamen might thereby act as a “hot spot” for cooperation.

The comparably high economic development provides also opportunities for a locally created innovation on low-carbon city development including IT, logistics, energy efficiency and building technology. A major additional area of highest importance for further development is transport which is of particular relevance due to the high amount of commuting workers and employees as well as the island situation. Besides industry, tourism is an important economic factor which contributes to the Xiamen’s aim to develop as a liveable and attractive city. In addition to its touristic aspects, the coastal situation provides for a major harbour which at the same time is of high economic importance and challenging in terms of low-carbon development.

Overall, due to the relative high progress in the past, the reduced availability of low hanging fruits in city development will require a high degree of innovation. Xiamen shared the importance of technology and innovation as well as tourism with Litomerice, Barcelona, and Lisbon where the latter two also share the coastal situation and may thus be of prime interest for cooperation. Given that all EU case study cities equally share important challenges such as in transport, cooperation may equally be of interest but would require further analysis in order to identify more specific areas/projects in which a valuable exchange would be possible.

## ANNEX I: KEY PERFORMANCE INDICATORS USED IN THE POCACITO PROJECT

DIMENSION	SUB-DIMENSION	INDICATOR	UNIT	YEAR
SOCIAL	Social Inclusion	Variation rate of unemployment level by gender	Percentage	
		Variation rate of poverty level	Percentage	
		Variation rate of tertiary education level by gender	Percentage	
		Variation rate of average life expectancy	Average Nº	
	Public services and Infrastructures	Variation rate of green space availability	Percentage	
	Governance effectiveness	Existence of monitoring system for emissions reductions	Yes/No Description	
	ENVIRONMENT	Biodiversity	Variation rate of ecosystem protected areas	Percentage
Energy		Energy intensity variation rate	Toe/euro Toe	
		Variation rate of energy consumption by sectors	Percentage	
Climate and Air Quality		Variation rate of carbon emissions intensity	Ton CO2/euro Ton CO2	
		Variation rate of carbon emissions by sector	Ton CO2	
		Exceedance rate of air quality limit values	Nº	
Transport and mobility		Variation share of sustainable transportation	Percentage	
Waste		Variation rate of urban waste generation	Kg/person/year	
		Variation rate of urban waste recovery	Percentage	

DIMENSION	SUB-DIMENSION	INDICATOR	UNIT	YEAR
	Water	Water losses variation rate	m <sup>3</sup> /person/year	
	Buildings and Land Use	Energy-efficient buildings variation rate	Percentage	
		Urban building density variation rate	Nº/ km <sup>2</sup>	
ECONOMY	Sustainable economic growth	Level of wealth variation rate		
		Variation rate of GDP by sectors	Percentage	
		Employment by sectors variation rate	Percentage	
		Business survival variation rate	Percentage	
	Public Finances	Budget deficit variation rate	Percentage of city's GDP	
		Indebtedness level variation rate	Percentage of city's GDP	
	Research & Innovation dynamics	R&D intensity variation rate	Percentage	