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Sustainable Urban Development

Challenges and Good Practices in Europe and China

Joint Report

China-EU Sustainable Development Research Group

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Preface

For supporting urban transitions globally, partnerships with strong commitments and cooperation on all scales, from local to global are required. Bi-lateral and multilateral partnerships between organisations, cities, programmes and initiatives can enhance international support for effective and targeted capacity-building to support national plans. Exchange and co-creation of knowledge, technologies and experiences regarding sustainable city services and infrastructures offers promising prospects for addressing issues of urban planning, environment, health, water, transport, ICT, hazards, resilience and disaster risk reduction, and improving the well-being of citizens.

In this sense, JPI Urban Europe and the Chinese Center for Urban Development (CCUD) cooperate and collaborate with a focus on exchanging knowledge, establishing a dialogue on strategic level and bundling expertise of European and Chinese experts since 2016.

JPI Urban Europe is a challenge driven research and innovation initiative of 20 countries. Since 2012, the programme has funded 67 projects in the area of sustainable and liveable urban areas. The Chinese Center for Urban Development is a specialised agency directly under the National Development and Reform Commission (NDRC). CCUD is a specialist agency dedicated in policy research and consulting service on urbanization and urban development, which is engaged in providing policy research and consulting services in urbanization for NDRC and other relevant departments, participating in major researches at department and local levels, offering integrated services for urbanization and carrying out international cooperation. Given the fields of action and work of JPI Urban Europe and CCUD, the established and successful partnership between both agencies contribute to localizing and implementing the Sustainable Development Goals and New Urban Agenda in Europe and in China by exchanging knowledge, stimulating discussions and underlining the importance.



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Executive Summary

In recent years, the global perception of urban areas has changed. An urban area was often described as a place where societal challenges were manifested in space in terms of pollution, congestion, health risks, etc. It is now described as a place where the concentration of economic and social activity is perceived as an asset for transformative change. The rapid and unprecedented scale of urbanisation, despite challenges that it brought about can mainly be understood as a process of opportunities to facilitate urban transitions.

SDGs – A Global Reference for Sustainable Urban Development

On a global scale, the transformative power of urbanisation for tackling global societal challenges has been recognised and expressed intensively in current global policies, agendas and guidelines. In *the 2030 Agenda for Sustainable Development*, the United Nations outlines 17 Sustainable Development Goals (SDGs) which “will stimulate action over the next 15 years in areas of critical importance for humanity and the planet”¹. The importance of urban areas for achieving the SDGs becomes evident when looking at the roles they are assigned in the document - *the SDG 11 Sustainable Cities and Communities* is entirely dedicated to urbanisation but also the remaining 16 SDGs have an urban dimension. The 17 SDGs and their targets clearly underline the importance of sustainable urban development for the future of humanity and the planet, and 90 out of the 169 indicators encompass urban areas.

The SDG 11 expresses the need to discuss sustainable urbanisation and urban development in politics, policy and practice for the first time at global level. Connected to the SDG 11, UN-Habitat published *the New Urban Agenda* which was signed by almost all member states. *The New Urban Agenda* illustrates a shared vision of urbanisation that can contribute to a sustainable future offering benefits and opportunities for all. It marks a paradigm shift identifying sustainable urban development as part of the solution to societal challenges. The SDG 11 and *the New Urban Agenda* provide a global reference framework for goals and visions of sustainable pathways with global consensus of importance.

The visions and pathways mentioned above represent a paradigm shift from understanding urbanization as an undesirable dynamic resulting in environmental and social challenges to a process with transformative power². However, approaches towards such sustainable transformation are manifold and diverse, which include a broad range of initiatives, activities, programs, projects, methodologies and stakeholders. To realise the above-mentioned urban

¹ United Nations (2015:3) Transforming our world: The 2030 Agenda for Sustainable Development.

² Foreword by Joan Clos in: UN-Habitat (2015) National Urban Policy: A Guiding Framework.

transitions, the multiplicity of approaches in urban policy as well as research and innovation require navigation across sectoral silos, approaches, and technologies³. At the same time awareness is needed on where and how they add up and increase the transformative potential and where conflicting strategies, approaches and implementations cause dilemmas and might limit the transformative power.

Benefitting from International Exchange

For supporting urban transitions globally, partnerships with strong commitments and cooperation on all scales are required, from local to global. Bilateral and multilateral partnerships between organisations, cities, programmes and initiatives can enhance international support for effective and targeted capacity building. The exchange and co-creation of knowledge, technologies and experiences regarding sustainable city services and infrastructures offer promising prospects for addressing issues in urban planning, environment, health, water, transport, ICT, hazards, resilience and disaster risk reduction, and improving the well-being of citizens.

In this sense, JPI Urban Europe (hereinafter referred to as the “JPI UE”) and the China Center for Urban Development (hereinafter referred to as the “CCUD”) have collaborated since 2016, with a focus on exchanging knowledge, establishing a dialogue on strategic level and bundling expertise of European and Chinese experts. JPI UE is a European challenge-driven research and innovation initiative. Since 2012, it has funded more than 70 projects in the area of sustainable and liveable urban areas with strong emphasis on Urban Living Labs, experimentation and science-policy cooperation. CCUD is a public institution under the National Development and Reform Commission (NDRC). CCUD is specialized in policy research and consultancy on urbanization and urban development. Since its establishment in 1998, it has been conducting policy research and providing consulting services at ministerial and local levels and offering integrated services for urbanization and carrying out international cooperation. Given the fields of action and work of JPI UE and CCUD, the established and successful partnership between the two organisations contribute to localizing and implementing the SDGs and *the New Urban Agenda* in Europe and China by exchanging knowledge, stimulating discussions and raising awareness of good practices concerning urban transitions.

³ Bylund, J. (2016) Connecting the dots by obstacles? Friction and traction ahead for the SRIA urban transitions pathway

Innovative Approaches and Case Studies from Europe and China

Five thematic areas of sustainable urban development have been selected to present European and Chinese cases. For each thematic area, a research and innovation project funded by JPI UE and innovative projects in Chinese cities are used as cases to underline good practices and highlight innovative approaches conducive to achieving SDGs. The following are overviews of the good practices by thematic area in this report.

Sustainable Urban Planning and Urban Renewal

People centred urban planning and the renewal of the existing housing stock towards energy efficiency and for enhancing the quality of life of the residents are key to sustainable urban development. To this end, the example of the project **SubUrbanLab** showcases how co-design in urban living labs and participatory planning can modernize and socially uplift underprivileged neighbourhoods. In Chinese cities, the development of superblocks has hindered the walkability in urban areas and contributed to urban sprawl. The large-scale renewal project in **Nanchong Prefecture (Sichuan Province)** illustrates how urban planning and renewal can contribute to the human scale developments by promoting a multi-centric urban structure and thus enhance walkability, access to public parks and thus contribute to sustainable and liveable urban areas.

Energy Efficiency and Low-carbon Development

Urban areas have great potential to reduce greenhouse gas emissions and increase energy efficiency, thus contributing to actions of climate change mitigation. This does not only require renewable energy technologies or innovative energy management but also changing user behaviours. In this sense, the project **me²** aims at creating a community platform to increase awareness of the energy consumption among citizens and investigate ways to change user behaviours towards greater energy efficiency. The me² concept was tested in two Urban Living Labs in Amsterdam (the Netherlands) and Lisbon (Portugal). In China, efforts have been made at the strategic level and/or on the city scale. Several Chinese ministries have promoted sustainable urban development by launching eco-cities policies, standards and pilot programmes for low carbon development. A large number of cities in China have made efforts to achieve low carbon development. One of the best cases in China, **Hangzhou City**, followed an ambitious plan to become a low-carbon city and a role model for sustainable development in the country.

Transport and Mobility

Efforts are made worldwide to improve mobility systems with the aim to provide safe access for all people to public places, goods, services and economic opportunities, while at the same time reducing the environmental footprint of transportation. Tackling the transport and mobility issue has a significant impact on other (socio-)economic and environmental aspects as well as on the quality of life and the wellbeing of the urban populations. For this thematic area, multi-modal mobility systems and new mobility services were investigated to deal with problems of commuting and congestion. The European case study, the JPI UE project **Smart Commuting** analysed mobility behaviours of commuters in three countries to identify the need for and potential of new mobility services. Results of this project have not only been reflected in policies but are also translated into business solutions with transportation companies. The case of **Shanghai** in China illustrates how different smart services can enhance the multimodal transport behaviour where busses, cars, trains and bikes play an essential role. Through an innovative app solution, different transport modes are connected, and door-to-door travel planning is offered in a multi-modal way.

Sharing Economy

With the development of digital technologies, the sharing economy has become a reality. Combined with an upcoming tendency among urban populations towards sharing instead of owning, sharing services are influencing urban life socially, environmentally and economically. Sharing economy provides potential to challenge established routines. In Europe and China, new sharing schemes are significantly influencing urban life, consumption patterns and have the potential to significantly contribute to sustainable urban development. The JPI UE project **E4-share** developed models for flexible, efficient and economic viable electric car-sharing systems. In the project, different car-sharing models were compared, user incentives determined, and supporting policy frameworks investigated using the case of the City of Vienna. In China, the sharing economy has seen significant growth recently. As part of sharing economy, the **Public Bicycle** program was first launched in Hangzhou in 2008 as a seamless feeder service to public transit throughout the city in light of growing traffic congestion and environmental concerns. With the development of innovative technologies, the dock-less bike sharing in China has seen a rapid expansion since 2015. New sharing schemes and business models have created a boom of **Bike Sharing** in China ever since. Today, bike sharing is especially relevant for solving the issue of “the last mile”, the distance between public transportation and people’s final destination and contributes to the reduction of car dependency and greenhouse gas emissions.

Smart Urban Governance

To effectively implement and design strategies for sustainable urban development, new collaborative governance processes involving private and public stakeholders are called for. Enabling technologies, big data and ‘real time’ action offer new ways for innovative and smart urban governance and management. Multiple information sources are nowadays easily available for urban decision making, while appropriate tools and methods are required to consolidate and synthesise them. The JPI UE project **UrbanData2Decide** processed information from public social media and open data libraries to develop a decision support system for urban governance. At the same time digital technologies and social media support participatory planning and governance. Another JPI UE project **Incubators for Public Space** embedded such new technologies in participatory planning processes to allow all stakeholders to contribute to urban planning. The project implemented Urban Living Labs in London, Brussels and Turin. In China, progress and institutional breakthroughs have been made in smart urban governance in the past few years, with the application of more advanced information and network technology. ‘Internet+’ has transformed urban management model and service provision and delivery models in a profound way. Smarter ways to manage population and monitor urban road networks and the smart emergency response system are among the typical examples of smart urban governance. So far, 80 cities have carried out the ‘Information-for-the Public’ pilot projects. The e-governance has increased government efficiency. The online service platforms introduced in Shandong, Zhejiang and Guangdong provinces have helped innovate and improve government services, transparency and law enforcement supervision. The Smart Urban Governance approach of **Weihai City (Shandong Province)** aimed at tapping the potential of smart technologies by fostering institutional change, capacity building in public administration and socio-technological innovations.

Conclusions

The Conclusions section is intended to identify potential areas and ways of collaboration between Europe and China in sustainable urban development by analysing similarities and differences based on the good practices that are presented in this report. The good practices are selective rather than exhaustive, which represent, to some extent, related projects that have been funded by JPI UE and represent the sustainable urban development landscape in China.

The similarities in sustainable urban development between Europe and China are largely due to common urban challenges that both sides are facing. The differences are caused by different levels of urbanization, stages of socio-economic development as well as different approaches

to governance and sustainable urban development between the two sides in general. The following two main differences can be determined from the cases investigated:

- ***Different Scales and Ways to Scale up.*** In general, the European side has implemented more sustainable urban development projects in European cities on the project scale, which focuses on testing frameworks, approaches and /or innovative technologies and on the rollout of the already tested and approved demonstration projects. While the Chinese side has made more efforts on the city scale, which puts more emphasis on implementing projects concerning sustainable urban development in pilot cities and selecting and involving more eligible cities to start related projects.
- ***Different Ways to Engage the Public.*** Different ways have been witnessed on both sides in public engagement. According to the cases reflected in the report participatory approaches and co-creation methods are more strongly applied in European projects than the projects in Chinese cities. This may be due to the different governance approaches, a more top-down approach in Chinese cities, compared to a mixed model of top-down and bottom-up approaches in European cities.

Besides those differences in scale and policy and governance approaches the cases very well demonstrate that urban transitions requires integrated approaches and the involvement of different actors and stakeholders. In principle the following three main elements are key for driving sustainable urban development:

- Availability of new technological solutions or social innovations that help to tackle a specific urban challenge
- New governance models as well as capacities and expertise in public administration fit to take highest advantage of such new technological and social opportunities and to create frameworks for urban transitions
- Mobilisation of citizens to create awareness of new approaches and solutions, drive behaviour change and support uptake of new solutions through early involvement in urban planning and local development

According to this, efforts are needed on all scales and of all stakeholder groups to achieve sustainable urban development and research and innovation can strongly support these. To deal with this complexity, experimental settings on local or city level can help addressing specific challenges, through local pilot projects or living labs, allowing all stakeholders to cooperate, co-create, engage in urban development actions. Through this evidence can be created for good practice and conclusions can be drawn for wider implementation, including new policies, partnerships or business models. The examples given in the report highlight the potential of

such multi-stakeholder approaches and create interesting references for further exchange between European and Chinese actors.

As sustainable urban development is a complex, long-term process, no single stakeholder can achieve the goal alone. Rather, it requires the collaboration between various stakeholders, such as cities, businesses, universities/research institutes and financial institutions. As the two sides are different in the above-mentioned aspects, it could be worth exploring each other's market by better understanding local knowledge and needs. In general, the Europe side could provide Chinese cities with sustainable urban development framework and experiences (in related areas such as open data and urban living labs) by sharing its already tested and approved demonstration projects in collaboration with Chinese key stakeholders. China has a huge market with enabling environment for innovation and could provide information and network technologies and physical infrastructure construction in European cities where needed in collaboration with European key stakeholders. Partnerships may be needed to mobilize and integrate resources from the key stakeholders on both sides. Given the fields of action and work of JPI UE and CCUD in Europe and China mentioned earlier, it could be helpful for the two organisations to play a facilitator role on each side. Suggested ways of cooperation may include, but not limited to the following: conducting cooperative projects involving key stakeholders from both sides, with European and Chinese cities as demonstrator and/or observer cities; and organising events to gather expertise of European and Chinese experts and key stakeholders to better understand local knowledge as well as exchange ideas and experiences that could be transferable and adapt to other local contexts.

Chapter One: Introduction

1.1 Background

In recent years, the global perception of the urban area has changed. An urban area was often described as a place where societal challenges were manifested in space in terms of pollution, congestion, health risks, etc., while it is now described as a place where the concentration of socio-economic activities is perceived as an asset for transformational change.

Among others, urbanisation is an important driver for such transformational change. In 2014, 54% of the world population lived in urban areas; the figure is estimated to be about 67% in 2050^{4 5}. According to projections by the United Nations the global urban population will increase from 3,6 billion in 2011 to 5,3 billion in 2050^{6 7}. That is the most substantial change of human settlement in history.

There are differences in urbanization processes and patterns as well as the level of urbanization between the developed and the developing world⁸. In the developed world, a balancing process can be observed with the population decreasing in large cities and increasing in smaller or medium-sized cities. The situation in developing countries is rather characterised by large cities attracting more people and maximizing the positive externalities and minimizing the negative impacts⁹, which imposes a challenge for national governments and municipal authorities. In developing countries, urbanization is an ongoing important phenomenon and it is expected that more than 90% of future urban growth will happen in developing countries^{10 11}. Developing countries are expected to accommodate over 80% of the world urban population by 2050 since rural-urban migrants seek a better life for themselves and their families in urban areas¹².

Substantial differences also have been observed by continent, region and country. Such differences can be seen from Figure 1 and 2. In Europe and North America, urbanization has

⁴ World urbanisation prospects – United Nations Department of Economic and Social Affairs, Population Division (2014)

⁵ J. Clos: A 21st Century vision for urbanisation. OECD development Matters, 8 June 2016

⁶ O. Courtard, G. Finnveden, S. Kabitsch, R. Kitchin, R. Matos, P. Nijkamp, C. Pronello, D. Robinson: Urban Megatrends. Towards a European Research Agenda; A Report by the Scientific Advisory Board of the Joint Programming Initiative Urban Europe, 2014, page 3

⁷ World urbanisation prospects – United Nations Department of Economic and Social Affairs, Population Division (2014)

⁸ Urban Europe – Statistics on Cities, Towns and Suburbs. Statistical Books, Eurostat. 2016 Edition, page 8

⁹ UN-Habitat, The Economic Role of Cities. United Nations Settlements Programme. Nairobi 2011, p. 41

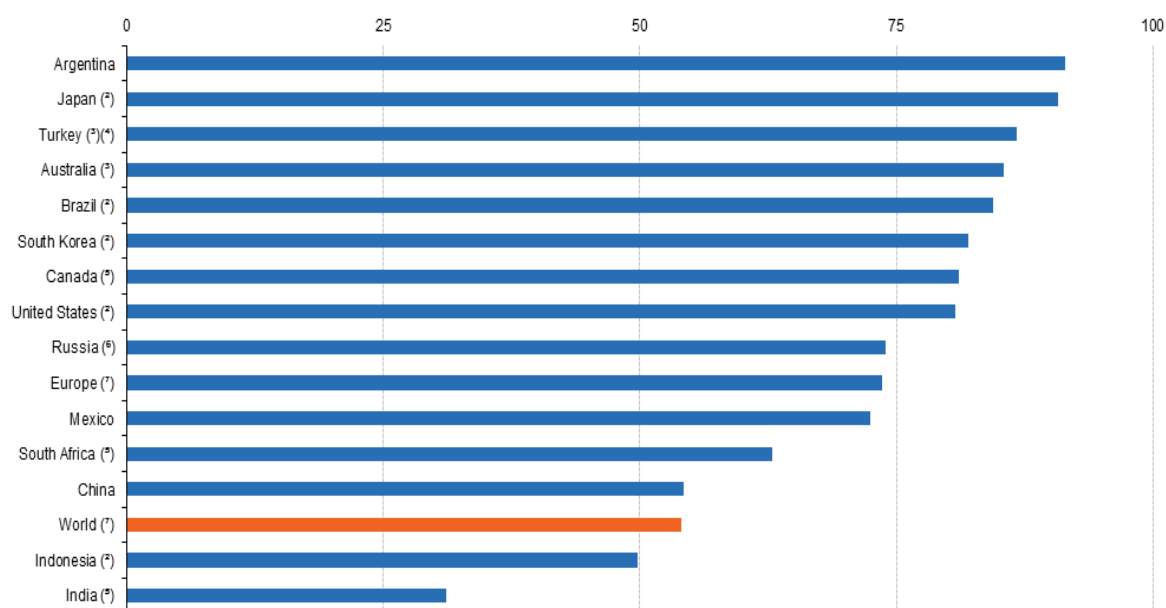
¹⁰ Q.Z. Zhang, The trends, promises and challenges of urbanisation in the world. Habitat International 54 (2016), p. 242

¹¹ O. Courtard, G. Finnveden, S. Kabitsch, R. Kitchin, R. Matos, P. Nijkamp, C. Pronello, D. Robinson: Urban Megatrends. Towards a European Research Agenda; A Report by the Scientific Advisory Board of the Joint Programming Initiative Urban Europe, 2014, page 3

¹² Ibid.

been closely linked with industrialization in the 19th century and the first half of the 20th century¹³. The process slowed down after that because suburbanisation leads to the reduction in population in urban areas. There are different reasons or drivers for suburbanisation, such as lower costs of housing, increasing private car ownership, better connections between the center and the periphery due to the development of the public transport, green and more pleasant and liveable environment, clean air, tranquillity, closeness to nature, alternative employment opportunities, better level of safety compared to city centers, and demographic change.

Figure 1 Share of urban population, 2014 (% of total population living in cities)



(*) United Nations data are based on national definitions; as such there may be a discrepancy with respect to the Eurostat data used elsewhere in this publication.

(*) 2010.

(*) 2013.

(*) Estimate.

(*) 2011.

(*) 2012.

(*) 2015.

Source: Urban Europe – Statistics on Cities, Towns and Suburbs. 2016 edition, page 8

According to most recent data¹⁴, there are currently 31 cities with the population of 10 million or more in the world - 17 in Asia, 5 in Latin America, 4 in Europe, 3 in Africa, and 2 in North America. There are 6 cities with the population of more than 10 million in China, 5 in India, 2 in Brazil and Japan, and 16 in other countries. By 2030, it is expected that the number of mega-cities with 10 million or more inhabitants will increase to 41 in the world¹⁵. Such rapid and unprecedented scale of urbanisation and the concentration of population in large or mega-cities

¹³ Q.Z. Zhang: The trends, promises and challenges of urbanisation in the world. Habitat International 54 (2016), pp. 241-252

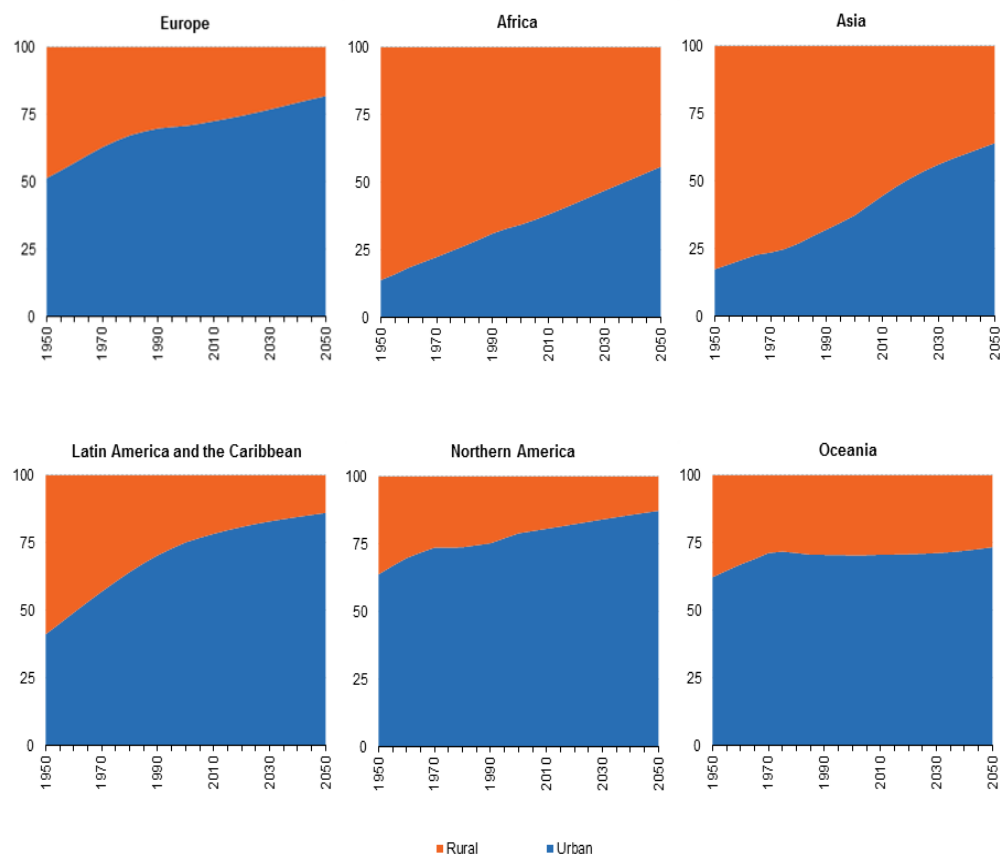
¹⁴ World City Population 2018; see: <http://worldpopulationreview.com/world-cities>

¹⁵ World Urbanisation Prospects, United Nations Department of Economic and Social Affairs, Population Division (2014)., page 1

in the world have caused continuous challenges but meanwhile provides opportunities to facilitate such urban transformation.

For instance, the large number of rural-urban migrants in the process of rapid urbanization leads to growth of urban agglomerations. This causes substantial challenges in urban areas and meanwhile offers competitive advantages and opportunities for a better life. The relationship between urbanization and socio-economic development in urban areas is complex. Thus, many pre-conditions for urban development, such as job opportunities, infrastructure, public services as well as possible impacts regarding CO₂ emissions, climate change, water resources, biodiversity, social inclusion and human health, need to be re-assessed in order to enforce positive aspects of sustainable urbanization^{16 17}.

Figure 2 The Estimated and Projected Urban and Rural Populations in the World from 1950 to 2050



(*) United Nations data are based on national definitions; as such there may be a discrepancy with respect to the Eurostat data used elsewhere in this publication.

Source: World urbanization prospects – United Nations, Department of Economic and Social Affairs, Publication Division (2014)

There is no commonly agreed-upon definition of sustainable urbanization. However, it is useful to reflect on related definitions in order to see the spectrum of perspectives that are necessary

¹⁶ UN-Habitat: The Economic Role of Cities. United Nations Human Settlements Programme, Nairobi 2011

¹⁷ M. Chen, H. Zhang, W. Liu, W. Zhang: The Global Pattern of Urbanization and Economic growth. Evidence from the Last Three Decades. PLOS ONE, August 2014, Volume 9, Issue 8, p.14

to comprehend the holistic nature of sustainable urban development. Sustainable urbanization requires multidisciplinary approaches addressing water, air, soil, energy, food, transportation, land, biodiversity, chemicals, construction, climate change (both adaptation and mitigation) economic development and social change in integrative and interactive ways rather than by ‘silo thinking’ in separated disciplines¹⁸.

This report adopts the following definition given by ICLEI Local Governments for Sustainability 2016¹⁹: “Sustainable cities work towards an environmentally, socially, and economically healthy and resilient habitat for existing populations, without compromising the ability of future generations to experience the same”.

1.2 Global Trends, Opportunities and Challenges of Sustainable Urban Development

JPI Urban Europe’s Scientific Advisory Board in its 2014 report²⁰ identified a number of global trends:

- International trade, the creation of multinational companies, increased export-orientation, the development institutions like the World Trade organisation (WTO) and agreements that make trade and investment easier, are elements of the globalised economy. Developments in information and communication technologies as well as in the transport sector supported a steep increase in global interaction and cooperation. Economic relations are bound into different kinds of global chains of connectedness. Economic globalisation was and is a key driver of urbanization and cities and city clusters are focal sites for production and consumption attracting people at all levels of competences, capabilities and skills, they act as local-global nodes of interconnection.
- At the same time, modernization of agriculture leads to decreasing job opportunities on the country side and is another driver causing people moving to cities.
- Geopolitics and conflict influence urbanization and urban development. Since the Second World War, with the formation of the United Nations and other intergovernmental bodies a complex system of multi-level consultation, management, and governance has been established that influences also urban governance and management. Although, international bodies were founded in order to support peace, conflicts are still the reason for transnational

¹⁸ Sustainable Urbanization Policy Brief. Proliferation of Urban Centres, their Impact on the World’s environment and the Potential Role of Global Environment Facility (GERF). Scientific and Technical Advisory Panel. May 2014, page 4

¹⁹ <http://www.iclei.org/activities/agendas/sustainable-city.html>

²⁰ O. Courtard, G. Finnveden, S. Kabitsch, R. Kitchin, R. Matos, P. Nijkamp, C. Pronello, D. Robinson: Urban Megatrends. Towards a European Research Agenda; A Report by the Scientific Advisory Board of the Joint Programming Initiative Urban Europe, 2014,

migration. In addition, climate change causes people to leave their region or country where they do not find adequate living conditions anymore.

- At international level, emerging countries (E7: China, India, Brazil, Mexico, Russia, Indonesia, and Turkey) gained political power and influence on the global stage and a multi-polar global political system has developed. At local level, in many countries cities achieved more and more autonomy and urban governance and management plays an important role with city mayors as key agents of change.
- “Demographic change results from a combination of migration, both rural-urban and cross-border, as well as due to gradual changes in life-expectancy and birth rate.”²¹ The global population is increasing and for 2050 is expected to peak at 9.3 billion with growth concentrating mainly in developing countries.
- Improved living conditions will lead to decreasing mortality rates and ageing of the population. These developments will have important consequences for the labour market, housing, services, consumption patterns and adequate provisions of care for the elderly.

As “cities are agents of social, cultural, economic, technological and political changes and advancement” there are many possible positive effects and opportunities of urbanization, such as²²: economic development and employment opportunities, developments of new markets, gains of higher productivity, benefitting from proximity and low transport costs, cities as centers offering different services, education and health care, innovation, culture and creativity, as well as local-global linkages.

The opportunities and challenges of urbanisation and urban development need to be addressed by policies, plans, and programmes of action designed for specific situations following the requirements of sustainable development as defined and agreed upon on international level.

Although cities across all continents face in principle the same challenges the pathways towards sustainable urban development need to correspond to the cities’ specific urban situation, anticipate its cultural, infrastructure, economic, social characteristics and dynamics. In addition, size matters and there are significant differences between megacities and small and medium sized towns. On the other side, the challenges that cities are facing put cities in a position to

²¹ *ibid.* page 5

²² Q.Z. Zhang, The trends, promises and challenges of urbanisation in the world. *Habitat International* 54 (2016), p. 243 f.

become vanguards of change towards sustainability and cities “are emerging as privileged grounds for effective environmental action”²³.

In general, in the frame of adequate national strategies that follow global agreements and goals urban leadership and authorities need to develop new strategies and apply new management approaches fit to cope with the complexities of the problems and creating new opportunities.

Urbanization created substantial environmental challenges due to industrial activities, transportation, construction activities, heating, increasing energy demands, different kinds of waste, sanitation, pollution of air, water and soil, land use and urban sprawl, and lack or degradation of green areas.

There is wide spectrum of challenges and problems that may arise and that need to be considered in systematic planning and managing urban development as far as possible, such as²⁴:

- Urban sprawl, problems of land management, land use, urban agriculture, degradation of land and ecosystems,
- Center-periphery differences, commuting time, unequal distribution of services,
- Lack of adequate investment in housing leading to shortages of affordable housing and formation of slums,
- Higher costs of living, risks of unemployment, risk of poverty and social exclusion
- Urban inequalities and gender inequality, disparity between rich and poor, social segregation, inequalities hitting girls and women more severely than boys and women,
- Shortage of infrastructure investment, deficits regarding safe water supply, problems of waste management and treatment (private and industrial), sewage treatment, lack of adequate sanitation services,
- Traffic congestions and emissions from cars, industry, and heating with coal,
- Environmental degradation, especially contamination of water, air, and soils, noise light stress, greenhouse gas emissions, problems of waste management and treatment -,

²³ UN-Habitat: Urbanization and Development. Emerging Future. Key Findings and messages. World Cities Report 2016. United Nations Human Settlements Programme (UN-Habitat), 2016; page 18

²⁴ See e.g.: Q.Z. Zhang, The trends, promises and challenges of urbanisation in the world. Habitat International 54 (2016), pp. 245 ff.

- Crime and insecurity, areas becoming ungovernable, increase of gated communities and operations of private security operators leading to segregation and increased distrust between different societal communities and groupings,

It is necessary to emphasize that these challenges are interdependent and need to be addressed taking systems-oriented approaches.

Cities may lack sufficient resources for fulfilling the necessary tasks and coping with the multitude of challenges. In developing countries, urbanization is an ongoing important phenomenon and it is expected that future urban growth will happen to more than 90% in developing countries²⁵. However, also there will be substantial differences between regions and countries. In the developed world, a balancing process can be observed with the population decreasing in large cities and increasing in smaller or medium-sized cities. The situation in developing countries is rather characterised by large cities attracting more people and maximizing the positive externalities and minimizing the negative impacts”²⁶ is a challenge for national governments and municipal authorities.

1.3 The Global Framework for Sustainable Urban Development and Latest Achievements

On a global scale, the transformative power of urbanisation for tackling global societal challenges has been recognised and expressed intensively in recent global policies, agendas and guidelines. The **United Nations**, in its **2030 Agenda for Sustainable Development**, formulated 17 Sustainable Development Goals (SDGs) which “*will stimulate action over the next 15 years in areas of critical importance for humanity and the planet*”²⁷. The importance of urban areas for achieving the SDGs becomes evident when looking at the prominent roles they are given in the document: SDG 11 is entirely dedicated to Sustainable Cities and Communities, while all 17 SDGs have an urban dimension. Furthermore, 90 out of the 169 indicators encompass urban areas. The 17 SDGs and its targets clearly underline the importance of sustainable urbanisation for the future of humanity and the planet.

SDG 11 expresses the need to discuss sustainable urbanisation and urban development in politics, policy and practice for the first time on global level. Connected to the SDG 11, **UN-Habitat** published the **New Urban Agenda** which was signed by almost all member states. The New Urban Agenda illustrates a shared vision of urbanisation that can contribute to a

²⁵ Q.Z. Zhang, , The trends, promises and challenges of urbanisation in the world. Habitat International 54 (2016), p. 242

²⁶ UN-Habitat, Urbanization and Development. Emerging Future. Key Findings and messages. World Cities Report 2016. United Nations Human Settlements Programme (UN-Habitat), 2016; p.41

²⁷ United Nations (2015:3) Transforming our world: The 2030 Agenda for Sustainable Development. See: <https://sustainabledevelopment.un.org/post2015/transformingourworld>

sustainable future offering benefits and opportunities for all. Foremost the New Urban Agenda marks a paradigm shift identifying sustainable urban development as part of the solution to societal challenges. SDG 11 and the New Urban Agenda are providing a global reference framework for goals and visions for sustainable pathways with significant global consensus²⁸.

“(In SDG11 and the New Urban Agenda) It is acknowledged that cities are drivers of progress and not solely a source of problems and risks, which can be seen as paradigm shift. Urban development is crucial for reaching the sustainable development goals, because more than half of the global population is living in urban areas nowadays and this number continues to grow.”²⁹

The visions and pathways expressed in SDG11 and the New Urban Agenda are related to the paradigm shift in understanding urbanization rather as a process with transformative power³⁰ than an undesirable dynamic resulting in environmental and social challenges and problems. However, approaches towards sustainable transformation are manifold, diverse and include a broad range of activities, methodologies, programs, projects, stakeholders and initiatives. This multiplicity of approaches in urban policy as well as research and innovation call for urban transitions³¹ that navigate between sectoral silos, approaches, technologies³², and analyse where they add up and increase the transformative potential. At the same time, conflicting targets, strategies and need to be identified as they might hinder the transformative power and therewith, limit urban transitions.

There are different possible approaches towards pursuing sustainable urban development by focussing on specific targets as appropriate to the specific situation of a particular urban area. In the same year of the publication of the SDGs, Hassan & Lee (2015)³³ investigated in an in-depth literature study issues that were identified as highly relevant to sustainable urban development in scientific papers published world-wide over five years, grouped as:

- Balanced approach to SUD and socio-cultural awareness,

²⁸ JPI Urban Europe Scientific Advisory Board (2018) New Urban Transitions towards Sustainability. Manuscript in preparation.

²⁹ JPI Urban Europe Scientific Advisory Board (2018) New Urban Transitions towards Sustainability. Manuscript in preparation.

³⁰ Foreword by Joan Clos in: UN-Habitat (2015) National Urban Policy: A Guiding Framework. See: <https://unhabitat.org/books/national-urban-policy-a-guiding-framework/>

³¹ Urban Transitions are defined as “fundamental and multi-dimensional alterations of urban development to reach the ambitious targets concerning ensuring livelihoods of citizens by avoiding greater stress on environment and fair distribution of economic and natural resources”; in JPI UE (2015) SRIA Strategic Research and Innovation Agenda. See: https://jpi-urbaneurope.eu/documents_library/

³² Bylund, J. (2016) Connecting the dots by obstacles? Friction and traction ahead for the SRIA urban transitions pathway. Joint Programming Initiative Urban Europe.

³³ A.M. Hassan & H. Lee: Toward the sustainable development of urban areas: An overview of global trends in trials and policies. Land use Policy 48 (2015), pages 199-212

- Economic sustainability and mitigating GHG,
- City structure, land use, urban sprawl and sustainable transportation,
- Economic urban development,
- Urban renewal, urban vegetation and sustainable assessment systems, and
- Assessing urban sustainability and applying urban experiments to different locations

The study underlines that transportation and fostering educational awareness are top concerns in both quantitative and qualitative terms in the reviewed publications. Researchers agree that transportation policies can make important contributions to creating urban sustainability by measures such as promoting electrical cars or imposing tolls on specific areas and investing in expanding public transport networks. There is not enough research on the connections between home and work and the possibilities of residents optimizing their living space in relation to commuting and job.

The study concludes that Europe was first in promoting sustainable urban development and reached an acceptable level of sustainable urban development before Asia. In Asian countries sustainable urban development is high on the agenda now, and China ranks first with regard to attention paid to sustainable urban development, while India ranks second.

In Europe, quantitative and qualitative issues center on restoring historic buildings e.g. by improving their energy efficiency. Social participation and educational awareness are deemed important in scientific publications. In Asia, the following issues are most important in the scientific literature in quantitative terms: Land use, assessment of sustainability, urban sprawl, transportation, educational awareness, development of urban vegetation, and the need for establishing a balanced approach linking economic, social and ecological issues in a comprehensive way. In qualitative terms, the most relevant issues are educational awareness, social participation and urban land use. Out of USA, Latin America and Australia, awareness regarding sustainable urban development is highest in USA. USA, and also Canada and Australia try to reduce greenhouse gas emissions by lowering the number of cars. In USA, urban agriculture is on the agenda as a measure contributing towards achieving the goal of self-sufficient cities. In Africa, there are only few research activities regarding sustainable urban development due to the poor economic and political conditions of most African countries.

It is interesting to note that in the results of the analysis of scientific literature many important aspects are missing such as buildings, socio-economic aspects as well as the role of governance - to name just a few.

About three years after the SDGs were agreed upon, the UN reports about the state of play of the implementation of SDG11 are as follows:³⁴:

SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable

The pace of urban growth has been unprecedented. More than half the world's population, or nearly 4 billion people, lived in cities in 2015. However, while cities are incubators of innovation and help foster increased employment and economic growth, rapid urbanization has brought with it enormous challenges, including inadequate housing, increased air pollution, and lack of access to basic services and infrastructure.

- The proportion of the urban population living in slums worldwide fell from 28 per cent in 2000 to 23 per cent in 2014. However, in sub-Saharan Africa, more than half (56 per cent) of urban dwellers lived in slum conditions.
- From 2000 to 2015, in all regions of the world, the expansion of urban land outpaced the growth of urban populations, resulting in urban sprawl.
- According to data from cities in 101 countries from 2009 to 2013, approximately 65 per cent of the population was served by municipal waste collection.
- In 2014, 9 in 10 people living in urban areas breathed air that did not meet the World Health Organization's air quality guidelines value for particulate matter (PM 2.5).
- As of May 2017, 149 countries had fully or partially implemented national-level urban policies, most of which are aligned with priority areas identified in the SDGs.

1.4 Aim of the Report

The report aims to provide an outlook for further needs and priorities concerning sustainable urban development in Europe and China by analysing main challenges and illustrating selected good practices from cities on both sides.

1.5 Structure of the Report

The report contains five chapters. Chapter One sets the scene for the research by putting sustainable urban development in the context of urbanization, SDGs and the New Urban Agenda. Chapter Two illustrates global trends, main challenges and key achievements in relation to sustainable urban development. Chapter Three analyses main challenges and strategies/approaches concerning sustainable urban development in Europe and China. Chapter

³⁴ United Nations. The Sustainable Development Goals Report 2017. New York 2017, page 8

Four presents selected good practices from cities on both sides, with a special focus on five themes. Chapter Five concludes the report by summarizing existing cooperative projects on sustainable urban development between both sides and providing an outlook for further needs and priorities.

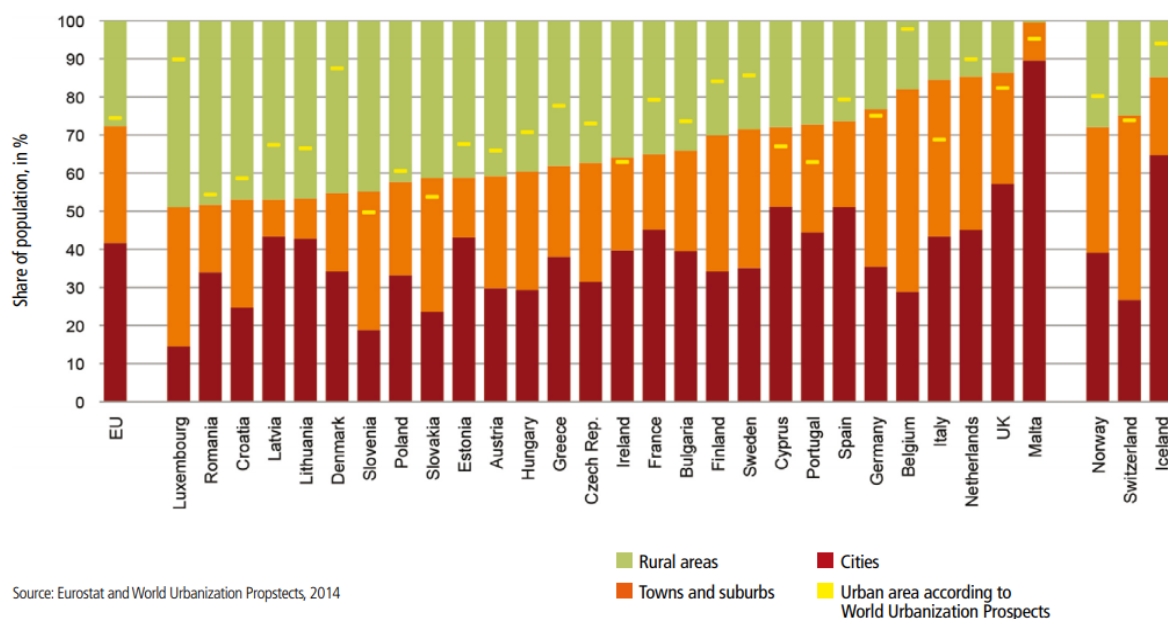
Chapter Two: Main Challenges and Strategies/Approaches Concerning Sustainable Urban Development in Europe and China

2.1 Main Challenges and Strategies/Approaches in Europe

The European policy and programme context

The pattern of urbanisation in Europe differs significantly from other parts of the world. Europe is highly urbanised with around 73% of the population living in urban areas. The distinct characteristic of urbanisation in Europe is that in contrast to Asia and South and North America, Europe has a high number of small and medium sized cities and relatively few urban areas above 1M inhabitants³⁵. Only four out of 79 cities world-wide with a population over 5M are located in Europe. 16% of the European population live in cities with over 5M people compared to 30% in Asia and 28% in North America³⁶.

Figure 3 Population by Degree of Urbanisation per EU Country in 2014



Source: European Commission and UN-Habitat (2016): The State of the European Cities

Europe's urban areas are diverse in their forms, organisation, spatial dynamic, socio-economic structure and governance system. These different characteristics are historically grown, determined by trajectories and political form of organisation at a national and local level and resulted in contrasting forms of urban developments in south-eastern and north-western European countries. However, continental and global influences will “ultimately need to be

³⁵ JPI Urban Europe (2015) Strategic Research and Innovation Agenda; see: https://jpi-urbaneurope.eu/documents_library/

³⁶ European Commission and UN-HABITAT (2016) The state of the European Cities; see: http://ec.europa.eu/regional_policy/en/policy/themes/urban-development/cities-report/

integrated in complex local conditions and requirements so that responses (strategies to bring about performance improvements) fit to their contexts.”³⁷

The performance of European Cities³⁸ combined with the new policy framework of the 2030 Sustainable Development Goals have led to priority areas which are seen as key for the further development of European Urban Areas. These themes haven been taken up by the work of the Urban Agenda for the EU. The Urban Agenda for the EU (Pact of Amsterdam) is a coordinated and integrated approach to deal with the urban dimension of the EU and national policies and legislation. Therefore, 12 thematic partnerships have been implemented where public authority, Member States, the European Commission and stakeholders such as NGOs or businesses are involved. The themes of the partnerships are among others Smart Land Use, Climate Adaptation, Circular Economy, Inclusion of Migrants and Refugees, Urban Mobility, Housing, Air Quality, Urban Poverty, Jobs and Skills in the Local Economy, Digital Transition and Public Procurement. The Urban Agenda for the EU is one commitment by the European Commission to localize and implement UN-Habitat’s New Urban Agenda.

Important approaches, thematic areas and challenges in which big efforts are being made in Europe are among others smart cities and communities, climate change and the integration of refugees and migrants. **Smart Cities and Communities** refer to urban areas which make increasing use of ICT and in which **(social) innovation** plays a significant role. In this concept, ICT can be a main enabler for tackling societal challenges and to enhance the participation of society in urban development processed. Technological approaches which take particular respect to and include social processes, in short the link between innovation and society, makes Smart Cities and Communities an important concept for urbanisation. Furthermore, in European cities great efforts for reducing **greenhouse gas emissions**, including increasing the energy efficiency of the existing building stock, have been made. Strategies and approaches to mitigate **climate change** are a common feature. In terms of adaptation to climate change, **nature-based solution** such as natural wetland, networks of green areas and greening of neighbourhoods and buildings have recently gained much attention.³⁹ Since the summer of 2015, in which many European countries and in particular urban areas were the destinations of big numbers of refugees, the **integration and active involvement** of the newly arrived gained in importance. The integration includes efforts and requires innovation in the education system, the housing sector and the labour market.

³⁷ JPI Urban Europe (2015) Strategic Research and Innovation Agenda.

³⁸ As described extensively in: European Commission and UN-HABITAT (2016): The state of the European Cities; see:

³⁹ European Commission and UN-HABITAT (2016): The state of the European Cities.

Besides the initiatives funded and supported by the European Commission and its Member States there are a number of relevant players and networks for sustainable urbanisation in Europe: **ICLEI**⁴⁰ (Local Governments for Sustainability); **EUROCITIES**⁴¹ (a network of elected local and municipal governments of major European cities); **ERRIN**⁴² (European Regions Research and Innovation Network), **CEMR**⁴³ (Council of European Municipalities and Regions) and **UN-Habitat Europe**⁴⁴.

JPI Urban Europe – A research and Innovation Programme supporting Urban Transitions

Urban development has gained increased attention in Europe over the recent years. Urban areas are hubs for regional – even national and continental – development and innovation. Harbours for refugees and migration and zones for climate change adaptation and sustainability, cities are key actors for addressing many of the societal challenges. As highlighted in the introduction already, urban areas play an essential role in achieving all of UN's 17 sustainable development goals in the *2030 Agenda for Sustainable Development*, not merely goal number 11 – *Sustainable Cities and Communities*.

JPI Urban Europe is thus committed to address the complexity of urban transitions by funding strategic research and innovation, improving and **aligning R&I instruments, moderating science-policy processes** and supporting transnational collaboration for local capacity building. JPI Urban Europe connects public authorities, civil society, scientists, innovators, business and industry to provide an environment for urban research and innovation. The mission is to develop tools, knowledge and platforms for dialogue on urban transitions.

Complementary to the central concern of supporting transitions to urban sustainable and liveable futures, the JPI Urban Europe Strategic Research and Innovation Agenda published in 2015 sets out five thematic priorities to be tackled:

- Vibrancy in changing urban economies
- Welfare and finance
- Environmental sustainability and resilience
- Accessibility and connectivity
- Urban governance and participation

⁴⁰ <http://iclei-europe.org/home/>

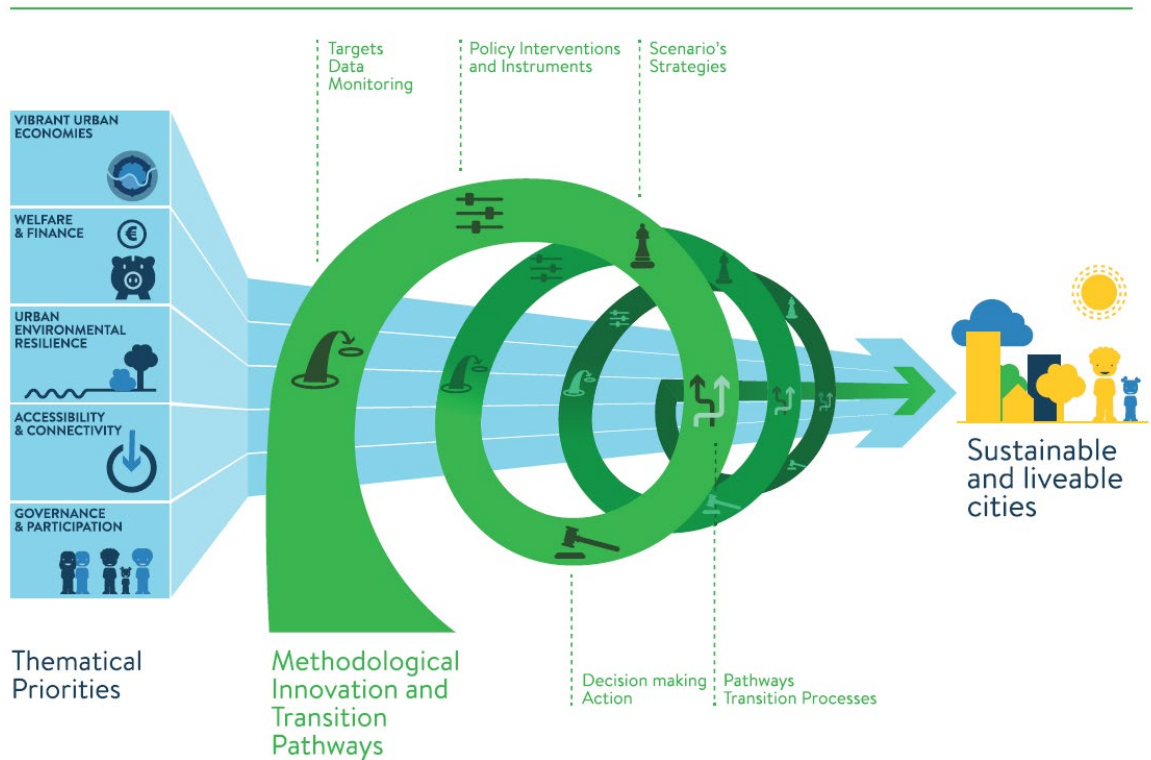
⁴¹ <http://www.euocities.eu/>

⁴² <https://www.errin.eu/>

⁴³ <http://www.ccre.org/>

⁴⁴ <https://unhabitat.org/tag/europe/>

Figure 4 Framework of JPI Urban Europe's Strategic Research and Innovation Agenda



For its implementation members from governments and funding organisations from 20 European countries are joining forces in several joint actions based on the portfolio of urban-related programmes and activities of each of the countries. In this sense the JPI Urban Europe functions as a platform for connecting and building upon these various programmes, benefitting from experiences and competences across borders. Our ambition is to provide an innovation eco system by engaging public and societal actors in the co-creation of missions and solutions, creating new kinds of partnerships to tackle the urban challenges.

2.2 Main Challenges and Strategies/Approaches in China

China has witnessed accelerated urbanization of unprecedented scale in the past four decades since the country adopted the reform and opening-up policy in 1978. Its urbanization rate increased from only 18.96% in 1979⁴⁵ to 51.27% in 2010 and to 58.52% in 2017, with the total urban population of 813.47 million⁴⁶. In the process, China has avoided some common negative impacts of rapid urbanization such as urban poverty and unemployment, with 260 million migrant workers⁴⁷ finding jobs in the secondary and tertiary industries in urban areas to contribute to its rapid economic growth, which, in turn, pulls 500 million people out of poverty

⁴⁵ UN-Habitat (2010) State of China's Cities 2010/2011: Better City, Better Life. Beijing: Foreign Languages Press.

⁴⁶ National Bureau of Statistics of China.

⁴⁷ The term *Migrant Worker* refers to people who were registered in rural areas or are holding rural *hukou* but living and working in urban areas. In general, migrant workers cannot have access to urban public services in the same way as residents who were registered in urban areas or are holding urban *hukou*.

in the country⁴⁸. Urbanization in China has yet to be completed because the share of its urban population is still below expectations based on its current per capita income. China's urbanization rate is expected to be 65% in 2030 on current trends, with additional 20 million people living in urban areas each year⁴⁹⁵⁰.

Such rural-urban migration of unprecedented scale in China is largely due to its rapid industrialization, with which its urban development pattern is featuring accelerated urban expansion and large energy consumption⁵¹. In the process of accelerated urbanization, cities are expanding significantly with rapid growing urban population, which has served as an important driver for economic growth and brought tremendous benefit to their stakeholders⁵². But meanwhile, the rapid pace of urban expansion and population growth have resulted in various challenges for sustainable urban development, such as urban sprawl, traffic congestion, excessive consumption of energy and environmental degradation⁵³.

These challenges are complex and intertwined largely because China's rapid economic growth has been driven by investment and its urbanization has relied excessively on land conversion and land financing over the past decades⁵⁴. This, to some extent, is reflected in its typical urban development pattern over the last thirty years that is the single-use areas of urban blocks at large scales⁵⁵. Many traditional residential communities in city centers have been demolished, resulting in their residents being relocated to suburban areas where suburban clusters or new towns have been planned with the intention of relocating both jobs and housing from city centers. However, the population density in city centers has been not decreased in reality. Instead, those suburban areas with inadequate mixed-used development have gradually been connected to cities centers, leading to urban sprawl. This is compounded by wide roads but inadequate multimodal transport and local roads and insufficient proper public transit connections. As a result, traffic has become concentrated on arterial roads and expressways that

⁴⁸ World Bank and DRC (2014) Urban China: Toward Efficient, Inclusive, and Sustainable Urbanization.

⁴⁹ World Bank and DRC (2014) Urban China: Toward Efficient, Inclusive, and Sustainable Urbanization.

⁵⁰ Wang, J. and He, D. (2015) Sustainable urban development in China: challenges and achievements, *Mitig Adapt Strateg Glob Change*, 20, pp.665–682.

⁵¹ Wei, H. (2014) The Strategy for China's Urban Transformation in the New Era. In: *China Economic Forum on Urban Transformation and Green Development (2012)*. Beijing: China Social Sciences Press.

⁵² Tan, Y., Xu, H. and Zhang, X. (2016) Sustainable urbanization in China: A comprehensive literature review, *Cities*, 55, pp.82-93.

⁵³ Qiu B. (2016) On the New of the New Type of Urbanization. Available at:

<http://kns.cnki.net/KCMS/detail/detail.aspx?dbcode=CFJD&dbname=CJFDTEMN&filename=ZFGP201600007&v=MjY1NTBoMVQzcVRyV00xRnJDVVJMS2ZaT1JyRnllblVMelBQeXZNZnJHNEg5Zk1yNDIGWTRSOQVYMUxleFITN0Q=>

⁵⁴ UN-Habitat (2010) State of China's Cities 2010/2011: Better City, Better Life. Beijing: Foreign Languages Press.

⁵⁵ Wang, J. and He, D. (2015) Sustainable urban development in China: challenges and achievements, *Mitig Adapt Strateg Glob Change*, 20, pp.665-682.

link city centers and their suburban areas, thus causing higher levels of car dependency, traffic congestion, excessive consumption of energy and other urban challenges.

Policy and decision makers in China have increasingly recognized and paid great attention to the challenges and their negative implications. Various strategies/approaches have been adopted to tackle the challenges, which are reflected in major events that have been taken place and policies on environmental protection and sustainable development that have been issued to tackle the challenges caused by the rapid urbanization process in the country. For instance, environmental protection was identified by the State Council as a national strategy at the Second National Environmental Protection Working Meeting in 1983. The State Council issued the *Ten Major Measures for China's Environmental Protection and Development* in 1992, which are specific approaches related to sustainable development in China. Sustainable development was set as a national strategy for modernization at the Fifteenth National Congress of the CPC in 1997. The concept of *Ecological Civilization* was proposed at the Seventeenth National Congress of the CPC in 2007, which is related to both environmental protection and sustainable development. In 2015, the amendments to the *Environmental Protection Law of the People's Republic of China* was come into force in 2015, which assigns more responsibilities to enterprises for pollution prevention, imposes harsher penalties for environmental pollution and establishes the environmental public interest litigation system. The following is a summary of major events and policies on environmental protection and sustainable development in China since 1970s.

Table 1 Major Events and Policies on Environmental Protection and Sustainable Development in China since 1970s

Year	Policy/Policies	Event/Issuing Authority	Main Points/ Significance
1973	<i>Decisions of the State Council on Issues Concerning Environmental Protection and Improvement</i>	First National Environmental Protection Working Meeting held by the SPC entrusted by the State Council	The <i>Decisions</i> identifies principles related to planning, utilization of resources and public participation in environment protection, which marks the beginning of environment protection in contemporary China.
1979	<i>Environmental Protection Law of the People's Republic of China (on trial)</i>	SCNPC	It is the first law on environmental protection in the People's Republic of China, which was formulated based on the <i>Constitution of the People's Republic of China</i> (Amended in 1978).

1982	<i>Constitution of the People's Republic of China (Amended in 1982)</i>	NPC	It is the first time that environmental protection, pollution prevention and control as well as natural resources conservation were written in the <i>Constitution</i> , the most fundamental law in the People's Republic of China.
1982	<i>Sixth Five-Year Plan for National Economic and Social Development</i>	State Council	The <i>Plan</i> has a separate chapter on environmental protection, which identifies environmental protection as one of the ten major tasks facing the government.
1983		Second National Environmental Protection Working Meeting held by the State Council	The Meeting identifies environmental protection as national strategy, which greatly raises public awareness of environmental protection, and formulates general guidelines on environmental protection in China that suits the country.
1989	<i>Environmental Protection Objectives and Tasks (1989-1992); and Outline of the National Environmental Protection Plan Towards 2000</i>	Third National Environmental Protection Working Meeting held by the State Council	The Meeting evaluates current situations of environmental protection in China, summarizes the successful experience gained from the three environmental management systems; and proposes additional five systems and measures, which constitute the 'Eight Environmental Management Systems' in China.
1989	<i>Environmental Protection Law of the People's Republic of China (Amended in 1989)</i>	SCNPC	The amended Law includes the above-mentioned systems, which strengthens legal basis for environmental protection.
1992	<i>Ten Major Measures for China's Environmental Protection and Development</i>	State Council	These are specific measures related to sustainable development in China. It is a guiding document on China's environmental protection and development.
1994	<i>China's Agenda 21: White Paper on Population, Environment and Development in the 21st Century</i>	State Council	The <i>China's Agenda 21</i> proposes that the objectives and contents mentioned in this policy should be integrated into the national economic and social development plans and long-term plans. It is a significant starting point to integrate the concept and objectives of sustainable development into policy-making process at the national level in China.

1996	<i>Decisions of the State Council on Issues Concerning Environmental Protection</i>	Fourth National Environmental Protection Working Meeting held by the State Council	The <i>Decisions</i> identifies environmental protection as the most important task in the sustainable development strategy. It starts a new chapter for environmental protection in China.
1996	<i>National Environmental Protection Plan during the Ninth Five-year Plan Period; and Vision 2010</i>	SEPA	They are guiding documents on environment protection for the five-year plan period from 1996 to 2000 and the following fifteen years up to 2010.
1997		Fifteenth National Congress of the CPC	Sustainable development was set as a national strategy for modernization.
2001	<i>National Environmental Protection Plan during the Tenth Five-year Plan Period</i>	SEPA	The policy contains the <i>Plan for Controlling the Total Emission of Major Pollutants</i> and <i>Plan for Green Engineering Program (Phase II)</i> . It is the guiding document on environmental protection for the five-year plan period from 2001 to 2005.
2002		Fifth National Environmental Protection Working Meeting held by the State Council	The <i>Meeting</i> makes arrangements for the implementation of the <i>National Environmental Protection Plan during the Tenth Five-year Plan Period</i> . It points out that environmental protection is a significant function of the government who intends to mobilize the whole country to protect the environment.
2003	<i>Environmental Impact Assessment Law of the People's Republic of China</i>	SCNPC	The <i>Law</i> intends to prevent negative impacts on the environment due to the implementation of various plans and construction projects to achieve sustainable development. It is a significant legal basis for implementing the sustainable development strategy.
2005	<i>National Environmental Protection Plan during the Eleventh Five-year Plan Period</i>	SEPA and NDRC	The policy is the guiding document on environmental protection for the five-year plan period from 2006 to 2010.
2006	<i>Methods on Punishment for Violations of Environmental Protection Laws and Regulations (on trial)</i>	MoS; and SEPA	The <i>Methods</i> intends to promote the implementation of environmental protection laws and regulations by penalizing violations.

			It is a significant policy to strengthen environmental protection and management.
2006		Sixth National Environmental Protection Working Meeting held by the State Council	<p>The Meeting proposes ‘Three Shifts’ in the attitudes towards environmental protection and management by shifting the previous attitudes to: the same emphasis placed on environmental protection and economic growth; the same pace of environmental protection and economic development; and utilizing a comprehensive method, such as legal, economic, technological and administrative means (only when necessary) to deal with environmental issues.</p> <p>The ‘Three Shifts’ is significant to achieve environmental objectives in the new era of environmental protection.</p>
2007	<i>Report to the Seventeenth National Congress of the Communist Party of China</i>	Seventeenth National Congress of the CPC	<p>The <i>Report</i> officially proposes the concept of ‘Ecological Civilization’.</p> <p>The Concept relates to both environmental protection and sustainable development.</p>
2007	<i>Methods on Public Release of Environmental Information (on trial)</i>	SEPA	<p>The <i>Methods</i> intends to standardize the disclosure of environmental information to the public.</p> <p>It is an important policy to encourage public participation in environmental protection.</p>
2011	<i>Suggestions of the State Council on Promoting Environmental Protection</i>	Seventh National Environmental Protection Working Meeting held by the State Council	The Meeting emphasizes effective implementation by ways such as improving environmental protection management, strengthening supervision over environmental law enforcement, etc.
2011	<i>Twelfth Five-year Plan for National Environmental Protection</i>	MEP	It is a guiding document on environmental protection for the five-year plan period from 2011 to 2015.
2014	<i>Environmental Protection Law of the People’s Republic of China (Amended in 2014)</i>	SCNPC	It is the most updated law on environmental protection, which was enforced on 1 January 2015.

2016	<i>Thirteenth Five-Year Plan for National Eco-environmental Conservation</i>	MEP	It is a guiding document on eco-environmental conservation for the five-year plan period from 2016 to 2020.
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Source: Own analysis and summary

In line with sustainable development, *sustainable urbanization* was suggested by UN-Habitat/DFID as an important component in 2002, which is characterized by the urbanization process that fulfills the principles of sustainable development⁵⁶. Sustainable urbanization is an effective way to achieve sustainable urban development in China, which is conducive to tackling the above-mentioned urban challenges caused by rapid urbanization process^{57 58}. A joint research conducted by World Bank and DRC in 2014 suggested that China needs to transform from its traditional model to the *New Model of Urbanization* that is more efficient, inclusive and sustainable. Here, “*Efficient Urbanization* makes the best possible use of China’s productive resources: its people, land, and capital; *Inclusive Urbanization* provides all people access to equal opportunity to benefit from urbanization -- to use their labor where they are most productive, to accumulate assets and savings, and to use public services of similar quality across China; and *Sustainable Urbanization* means urbanization that can be supported by China’s environment (land, air, water) and natural resources, while providing an urban quality of life commensurate with the desires of China’s people”⁵⁹.

The concept of the *New-Type Urbanization with Chinese Characteristics* (hereinafter referred to as the “*New-Type Urbanization*”) was proposed in the *Decision of the CCCPC on Some Major Issues Concerning Comprehensively Deepening the Reform* (hereinafter referred to as the “*Decision*”) adopted at the Third Plenary Session of the 18th Central Committee of the Communist Party of China in 2013⁶⁰. The *Decision* advocates the improvement of institutions and mechanisms for a sound process of urbanization in China, which emphasizes people-entered urbanization; the coordinated development between large, median-sized and small cities as well as towns; the industry-and-city integration; and the coordinated development between urban and new rural areas in the process of urbanization. The *Decision* also advocates the optimization of urban spatial structure and urban management and the expansion of urban carrying capacity. The *New-Type Urbanization* takes into full consideration China’s national

⁵⁶ UN-Habitat/DFID (2002) Sustainable urbanization: achieving Agenda 21. Nairobi: United Nations Human Settlement Programme/Department for International Development.

⁵⁷ Tan, Y., Xu, H. and Zhang, X. (2016) Sustainable urbanization in China: A comprehensive literature review, *Cities*, 55, pp.82-93.

⁵⁸ Zhao, P. (2010) Sustainable urban expansion and transportation in a growing megacity: Consequences of urban sprawl for mobility on the urban fringe of Beijing, *Habitat International*, 34(2), pp.236-243.

⁵⁹ World Bank and DRC (2014) Urban China: Toward Efficient, Inclusive, and Sustainable Urbanization.

⁶⁰ Available at: http://www.china.org.cn/chinese/2014-01/17/content_31226494.htm

circumstances and the necessity of its transformation from the traditional to a more scientific way of development in the process of rapid urbanization⁶¹, which reflects the concepts of *sustainable urbanization* and *New Model of Urbanization*.

Numerous pilot projects have been implemented in areas in relation to the *New-Type Urbanization*, such as more compact and mixed-use development, more efficient energy use and waste management, etc. A few pilot projects that have become good practices are being scaled up, which can help tackle the urban challenges across the country. In the following chapter, selected good practices in China will be illustrated according to the six themes, Sustainable Urban Planning and Management, Energy Efficiency and Low-carbon Development, Transport and Mobility, Urban Renewal and Municipal Solid Waste Management, Sharing Economy and the Contribution of Private Sectors and Smart Urban Governance.

⁶¹ Qiu B, Q. (2016) On the New of the New Type of Urbanization. Available at: <http://kns.cnki.net/KCMS/detail/detail.aspx?dbcode=CFJD&dbname=CJFDTEMN&filename=ZFGP201600007&v=MjY1NTBoMVQzcVRyV00xRnJDVVJMS2ZaT1JyRnlIb1VMelBQeXZNZnJHNEg5Zk1yNDIGWTRSOGVYMUx1eFITN0Q=>

Chapter Three: Good Practices in Europe and China

3.1 Sustainable Urban Planning and Urban Renewal

3.1.1 Overview

People centred urban planning and the renewal of the existing housing stock towards energy efficiency and for enhancing the quality of life of the residents are key to sustainable urban development. To this end, the example of the project **SubUrbanLab** showcases how co-design in urban living labs and participatory planning can modernize and socially uplift underprivileged neighbourhoods. In Chinese cities, the development of superblocks has hindered the walkability in urban areas and contributed to urban sprawl. The large-scale renewal project in **Nanchong Prefecture (Sichuan Province)** illustrates how urban planning and renewal can contribute to the human scale developments by promoting a multi-centric urban structure and thus enhance walkability, access to public parks and thus contribute to sustainable and liveable urban areas.

3.1.2 Case Studies in Europe

JPI UE Project SubUrbanLab

Suburban Lab aims to examine how municipal authorities can engage with local residents and other stakeholders, and how they can work together to modernize and socially uplift underprivileged neighbourhoods and suburbs and turn these suburbs into more attractive, sustainable and economically viable urban areas. The project sets up urban living labs in two suburbs in Sweden and Finland as a mean to develop new forms of actively involving residents and stakeholders in shaping their own urban contexts.

Stakeholder involvement in upgrading of local areas

Across Europe, some 200 million people live in suburbs containing large scale housing areas in great need of modernization and social uplifting. These areas are less valued in the sense that they usually have large-scale architecture and the local environments are commonly seen as less attractive and amongst the residents, the majority is socially and economically underprivileged. In Sweden and Finland these types of areas have been the subject of recurrent governmental initiatives and reform programs aimed at improving public spaces, improving the energy efficiency of buildings, improving waste management and to support social cohesion and trust in the local public authorities by way of engaging local residents in local processes. Piloting and testing solutions is becoming a more common feature in selected approaches.

Urban living labs

The Suburban Lab project, was carried out between 2014-2016, by VTT Technical Research Centre of Finland and IVL Swedish Environmental Research institute in cooperation with Botkyrka Municipality in Sweden and the City of Riihimäki, Finland. The project developed and set up in total six Urban Living Labs (ULLs) in Sweden and Finland.

Urban living labs (ULLs) utilize various co-design methods for understanding stakeholders needs, generating and presenting ideas and evaluating the solutions in practice. It is a forum for innovation which develops new products, systems, services, and processes for urban areas. Urban living labs employ methods which puts people at the heart of the entire development process as both users and co-creators. They allow people to test, explore, examine, experiment with and evaluate new ideas to come up with creative solutions in complex every day contexts. Nearly half of the 67 projects financed in JPI Urban Europe calls since 2012 includes elements of ULLs and there is now a substantial portfolio of projects that test urban living labs in different settings and contexts.

This project examined how the urban living lab approach could be used to actively involve the residents and other stakeholders in two suburbs, Alby in Sweden and Riihimäki in Finland, in the modernization and social uplifting of their suburbs and local neighbourhoods, co-developing and testing new services or solutions in their daily life. Users of the new services or solutions were active partners in the whole development process which took place in their real urban contexts. The descriptions below of two of the urban living labs illustrates how the project focused on relatively modest and small-scale projects that provides opportunities for collaboration.

Figure 5: Poster from the urban living lab “New light on Alby Hill”



“New light on Alby Hill” focused on how to transform a walkway so that it was both more attractive and safer. Ambient lighting and light installations along the walkway were planned, designed and implemented together with researchers, public organizations, companies, non-governmental organizations and residents, who also suggested images for the light installations under the theme of “Our Alby”. The winning images were chosen through open voting. Contributions to social and environmental sustainability increased the sense of security, laying the foundation for continued participation among residents, whilst achieving aims such as decreasing the energy use of the street lightning.

“Together more” in Peltosaari, provided residents with accessible opportunities to participate in the planning and development of their environment and arranging local activities. The goal was to improve the appreciation of the area and to increase communal feelings among the residents. Several types of activities were piloted and residents were engaged in discussions about plans concerning the area. The project piloted new kinds of events which also managed

to reach young people in the area and enhanced collaboration between various groups. The area gained a lot of positive press coverage.

Key success factors, main experiences and lessons learnt from six Urban Living Labs

The key success factors for Urban Living Labs are the early and continuous involvement of the people affected by them, having clear goals and expectations, and acting instead of simply discussing. The methods must be adapted to the goals and to the participants. At its best, people can participate in the Urban Living Lab activities as a part of their other activities and see the effects of their participation shortly afterwards.

Experiences from the six urban living labs stress amongst other things that each Urban Living Lab was shaped and changed along the way as a consequence of the context of where it was set, and by unexpected events and the impact from different stakeholders. Processes were not linear - they took unexpected turns as researchers, decision-makers and public organizations, residents and companies took part in the co-creation of each Urban Living Lab.

Lessons learnt from the project include insights on how to best encourage engagement from local residents on the one hand and the municipality on the other hand. The project also showed how user-driven urban living labs, primarily run by the residents, may further strengthen residents' feelings of inclusion and participation in the local society, while an enabler-driven urban living lab, run by the municipality, may increase the chances of sufficient resources if the working methods of living labs are fully embraced and integrated into existing organizational routines.

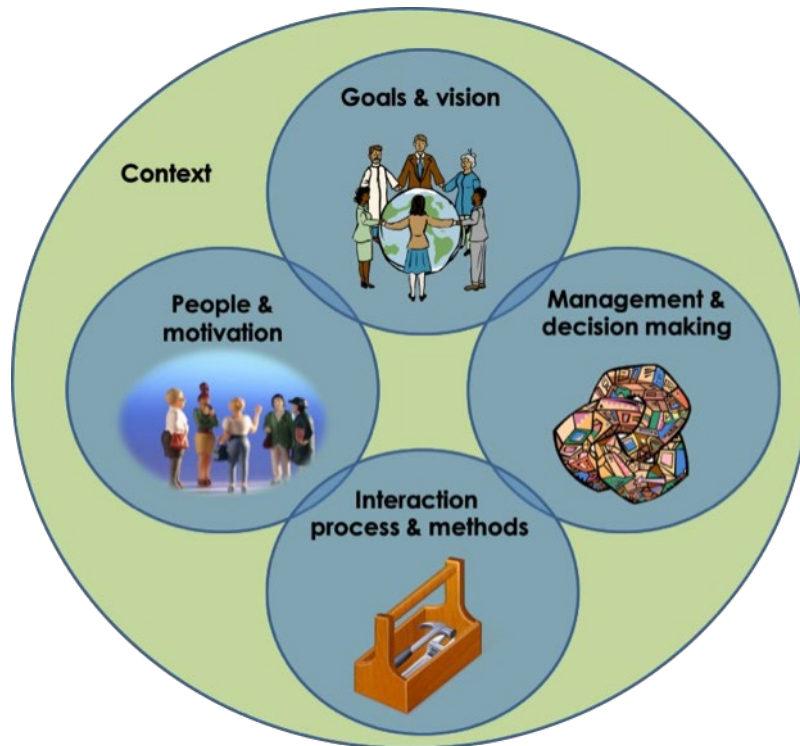
Boundary conditions and guidance to cities

Elements and boundary conditions that need to be taken into consideration when setting up urban living labs have been identified through literature reviews and interviews with residents on their past experiences of stakeholder involvement. Boundary conditions for Urban Living Labs are presented as checklists with questions for each of the five elements (see Figure 6), that should be answered before starting ULL activities and practical examples and recommendations for answering the questions.

“The most important outcome from the project Suburban Lab was the fact that we could identify (generally applicable) boundary conditions and key success factors for Urban Living Labs, that can be used to give clear guidance to other cities on how to set up similar living labs. The methods are replicable in other cities but the themes for the Urban Living Labs have to be defined based on the city-specific needs”, says Riikka Holopainen, research Team Leader, D.Sc. (Tech) at VTT Technical Research Centre of Finland. Riikka Holopainen continues by saying

“The local stakeholders involved in the project in Alby and Riihimäki benefitted from the project in terms of more sustainability in their local environments and everyday life”.

Figure 6: Five elements of planning an Urban Living Lab: Context; Goals and vision; People and motivation; Management and decision making; Interaction process and methods. (Bäck et al. 2012).



Booklets and guidelines⁶²

The booklet “Urban Living Labs as arenas for co-creation in urban areas” describing success factors together and lessons learned and the report “Boundary conditions for successful Urban Living Labs”⁶³ are targeting organizations who want to start and lead urban living labs in connection to modernization and uplifting actions.

SubUrbanLab – Social uplifting and modernization of suburban areas with Urban Living Lab approach

Duration: 2013–2016 Internet: www.jpi-urbaneurope.eu/suburbanlab

Contact: Riikka Holopainen, VTT Technical Research Centre of Finland Ltd.

E-mail: riikka.holopainen@vtt.fi

Partners: IVL Swedish Environmental Research institute, Botkyrka Municipality, City of Riihimäki, VTT Technical Research Centre of Finland Ltd.

⁶² http://suburbanlab.eu/wp-content/uploads/2016/05/SubUrbanLab_booklet_screen.pdf .

⁶³ <http://suburbanlab.eu/tulokset/?lang=en> .

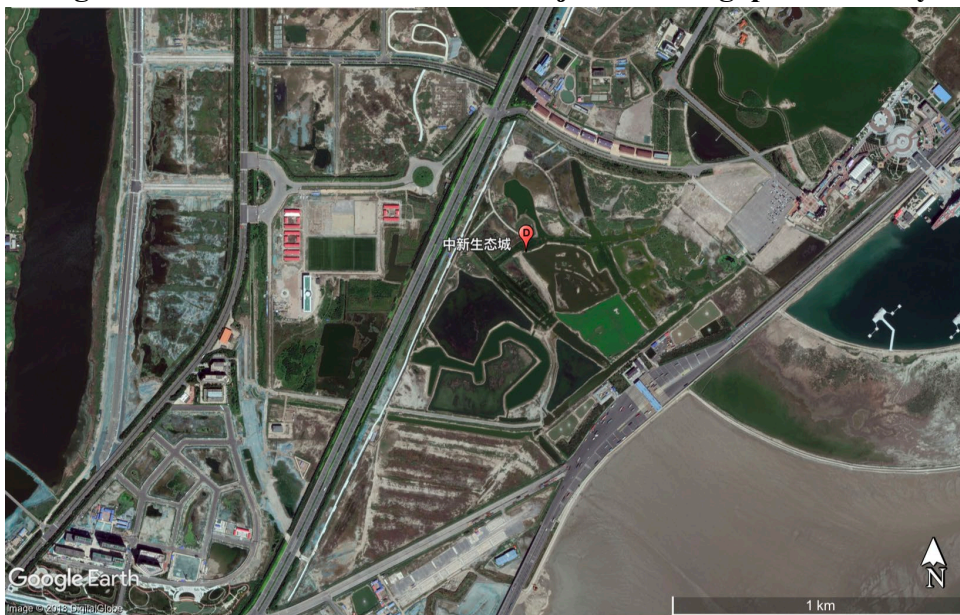
3.1.3 Case Studies in China

Introduction

The development of superblocks in Chinese cities mentioned in the previous chapter has contributed greatly to pedestrian-unfriendly built environments and traffic congestion. More compact and mixed-use development could help reduce urban sprawl and car dependency as well as increase walkability and efficiency in infrastructure and services distribution and delivery.

Several pilot projects are making efforts to develop smaller-grid street networks, such as the Caofeidian International Eco-City and the Tianjin Sino-Singapore Eco-city (see Figure 7). The main features of the latter include “transit-oriented development, mixed land use, eco-recovery, large eco land use and zero wetland lose, renewable energy, intelligent grid, untraditional water treatment and reuse, cleaning and utilization of garbage, green transportation and fuel, green building and eco-industry park”⁶⁴.

Figure 7 The Street Networks in Tianjin Sino-Singapore Eco-city

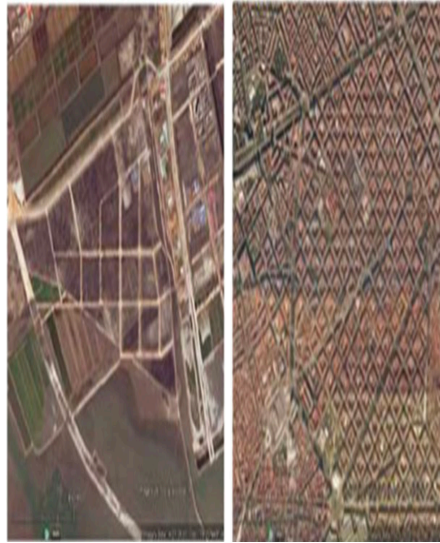


Source: Google Earth

However, the grids are still large in Chinese eco-cities compared to those in Europe, such as the eco-city in Barcelona, Spain. Figure 8 compares the proposed human-scale street networks between the eco-city of Caofeidian in China and that of Barcelona in Spain.

⁶⁴ Wang, J. and He, D. (2015) Sustainable urban development in China: challenges and achievements, *Mitig Adapt Strateg Glob Change*, 20, pp.665-682.

Figure 8 A Comparison of the Proposed Human-scale Street Networks between the Eco-City of Caofeidian in China (Left) and that of Barcelona in Spain (Right)

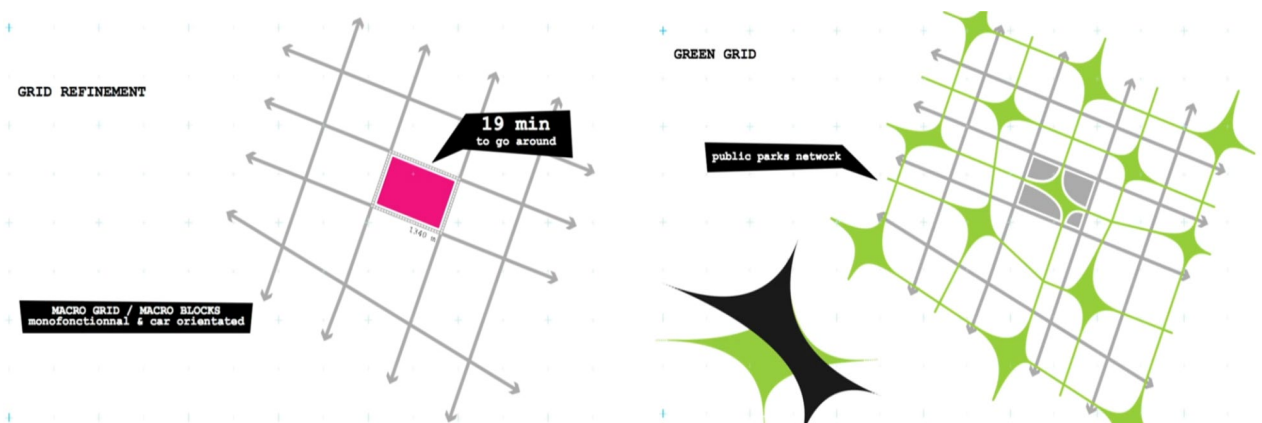


Source: Wang, J. and He, D. (2015) Sustainable urban development in China: challenges and achievements, *Mitig Adapt Strateg Glob Change*, 20, pp.665-682.

One approach to reducing the grid is to incorporate the micro-scale into the existing macro-scale development by redeveloping brownfields for mixed-use development and increasing accessibility and greenspaces. Figure 9 are conceptual diagrams showing how coarse grids can be refined by applying the above-mentioned approach. In the diagram on the left, the pink polygon represents one of the mono-functional and car-oriented grids that are pedestrian-unfriendly. The coarse grids are refined by adding public transport networks and green corridors to the existing coarse grids (see the diagram on the right). These can be refined further with networks for bikes and pedestrians.

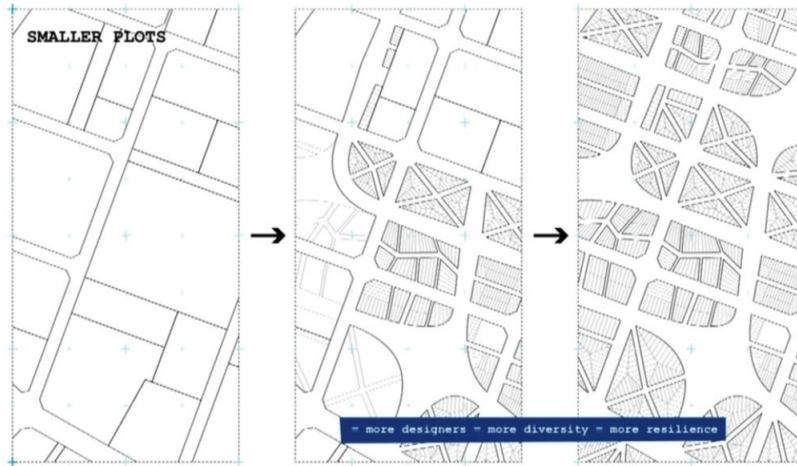
Figure 9 Conceptual Diagrams of the Approach: Incorporating the Micro-scale into the Existing Macro-scale Development

Source: <http://www.inktalks.com/discover/691/neville-mars-urban-renewal-of-mumbai-and-china>



Consequently, the massive plots of the coarse grids can be refined to human scale from the perspective of land use (see Figure 10), which may increase diversity and enhance resilience overtime, thus conducive to sustainable urban development. These refined grids can feed into the existing urban areas, which contributes to the solving of the urban challenges caused by the development of superblocks and urban sprawls. The following is a case study of Nanchong prefecture in China.

Figure 10 Potential Effects of Applying the Approach: More Diversity and Resilience



Source: <http://www.inktalks.com/discover/691/neville-mars-urban-renewal-of-mumbai-and-china>

Case Study – Nanchong Prefecture, Sichuan Province

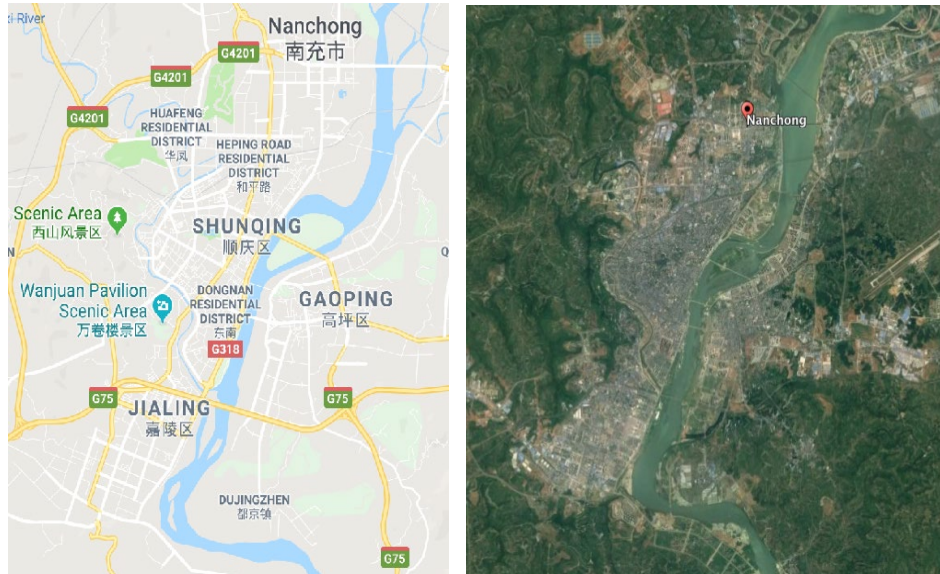
Nanchong is a prefecture-level city located in the middle reaches of Jialing River and the northeast of Sichuan Province, China. The prefecture governs three urban districts, one city and five counties⁶⁵ within its jurisdiction, with an area of 12,500 square kilometres and population of 7.6 million⁶⁶. There are 126 square kilometres and 1.25 million population in its three urban districts, i.e. Shunqing District, Gaoping District and Jialing District (see Figure 11) in 2017⁶⁷.

⁶⁵ Shunqing District, Gaoping District, Jialing District, Langzhong City (a county-level city), Nanbu County, Yingshan County, Peng'an County, Yilong County and Xichong County.

⁶⁶ Available at: <http://www.nanchong.gov.cn/10000/10004/10007/10030/2016/03/08/10127357.shtml>

⁶⁷ Ibid.

Figure 11 The Location and Current Situation of Nanchong's Three Urban Districts



Source: Google Maps and Google Earth

A large-scale urban renewal project was launched in Nanchong in 2009, which involves 1.65 million square meters, with 3,000 households being relocated. The project retrofitted historic buildings, leaving a nostalgic legacy to its residents⁶⁸. The prefecture's built environment and ecological environment have been changed dramatically with its economic and transportation development in recent years (see Figure 12 and Figure 13).

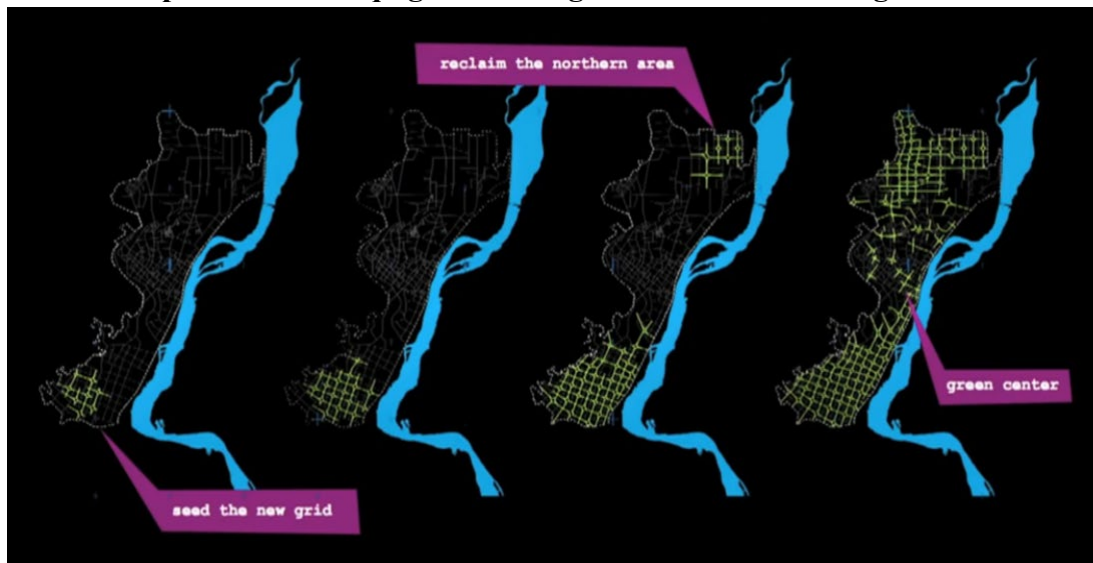
Figure 12 The Road, Bus Lane and Pedestrian Networks in the Transport Plan for Upgrading the Networks in the Urban Districts of Nanchong Prefecture



Source: <http://www.nanchong.gov.cn/10000/10003/10211/2015/03/06/10118318.shtml>

⁶⁸ Available at: http://nc.newssc.org/system/20161116/002057336_2.html

Figure 13 The Gradual Incorporation of the Micro-scale into the Existing Macro-scale Development in Shunqing and Jialing Districts in Nanchong Prefecture



Source: <http://www.inktalks.com/discover/691/neville-mars-urban-renewal-of-mumbai-and-china>

The development of individual business centers in Gaoping and Jialing Districts in addition to their higher population density and the development of road networks and industries give rise to a multi-centric urban structure of the prefecture. This is conducive to its sustainable socio-economic development, with statistics for Gross Regional Product, disposable income of urban residents and urban population pointing to steady increase in the decade from 2006 to 2015.

With the development of the multi-centric structure, urban recreation centers have been expanded to develop and include more public parks (e.g. Xihe Sports Park, Nanmenba Ecological Park and Baita Park) and pedestrian networks in Nanchong. This has gradually incorporated the micro-scale into the existing macro-scale development, which increases walkability and access to public parks, thus beneficial for residents and sustainable urban development of Nanchong.

3.2 Energy Efficiency and Low-carbon Development

3.2.1 Overview

Urban areas have great potential to reduce greenhouse gas emissions and increase energy efficiency, thus contributing to actions of climate change mitigation. This does not only require renewable energy technologies or innovative energy management but also changing user behaviours. In this sense, the project **me²** aims at creating a community platform to increase awareness of the energy consumption among citizens and investigate ways to change user behaviours towards greater energy efficiency. The **me²** concept was tested in two Urban Living Labs in Amsterdam (the Netherlands) and Lisbon (Portugal). In China, efforts have been made on policy level. Several Chinese ministries have promoted sustainable urban development by

launching eco-cities policies, standards and pilot programmes for low carbon development. One of the best cases in China, **Hangzhou City**, followed an ambitious plan to become a low-carbon city and a role model for sustainable development countrywide.

3.2.2 Case Study in Europe

JPI UE Project me²

The project highlights include the pilots in Amsterdam and Lisbon, the policy analysis and survey results as well as the me² platform. The project applies smart grids, electric mobility, business models and policy incentives to the development of an innovative service concept.

The goal of me² is to make citizens more aware of energy consumption, incentivise changes in their individual and collective behaviour to save on electricity costs, while being connected with a local community. The concept has been validated and optimized in two practical pilots in urban communities in Amsterdam and Lisbon. Me² affects consumers, utility companies, grid operators, electricity suppliers, municipalities, and car sharing companies.

- “Throughout me² there has been continuous development and we have been adjusting things and fine-tuning it the whole time” says Halldora Thorsdottir, me² project manager and researcher at the Urban Technology research programme of the Amsterdam University of Applied Sciences.

The combination of data technologies in a community allows the integration of mobility with electricity, to balance the grid, to reduce electricity costs, and to enable a feeling of local belonging. me² enables urban demand-side management, i.e. aims to modify consumer demand for energy such as using less energy during peak hours in an urban community.

- “One of the motivations was to bring together the increasing significance of electric vehicles and smart grids. All of the project’s pilot participants got a smart meter, but we were particularly interested in the role that EVs (electric vehicles) play. The participants have a house but, especially in the Netherlands, also an EV and charging point, and some have solar panels”, says Halldora Thorsdottir.

One of the developments that me² is based on is the fact that homes and small-scale businesses are becoming small energy producers with the potential to provide a solution to managing peak demand and grid balancing. 75% of the Dutch participants own a private charging point and a little over half of the households produce renewable electricity using PV installations. This is important as such initiatives and ventures are expected to be an integral part of the future EU energy system management.

- “The project creates a new market place for urban actors in which a local community of electric vehicle (EV) users and local smart meter (SM) owners are brought together in an urban online community”, says Wolfgang Prügler, CEO of Moosmoar Energies OG (MME), one of the project partners.

Pilots in Lisbon and Amsterdam

The target of the pilots has been to test the quality and experience of the me² integrated energy monitoring platform. The first pilot was in Lisbon with 50 people taking part in a closed community system. The project used several devices in order to track energy consumption: smart plugs for home consumption and charging and MOBI-E plugs for public charging. The Dutch pilot involved 50 households in an open system with private electric vehicles. This pilot differs from the Lisbon pilot as the number of EV users was higher. This is due to the Netherlands having one of the highest percentages of electric vehicles in Europe. The participants in both countries installed smart meters and opened me² accounts, so that their energy usage could be collected and they could see it on a personal dashboard.

Figure 14 Via me² accounts and personal dashboards consumers have access directly to their energy information laying the base for mechanisms to influence behavior



Gamification

Gamification was key to our success. Before the pilot it became clear in a cross-cultural analysis that the social aspect and gamification is more important in the Netherlands, whilst in Portugal the participants were not motivated by competition but instead very motivated by self-improvement and helping the environment.

- “In both pilots we gave incentives to the users on how to reduce energy usage and how to handle peak hour consumption. In Portugal these were mainly focused on financial and

environmental arguments. In the Netherlands we focused on social comparison and gamification. Our user community consisted of people trying to do their best, they were highly interested in technological and efficiency related details, and they wanted to play the game against themselves to see how they could perform. They are perhaps less interested in the savings they make in return, it is more the case that they want to do good”, says Halldora Thorsdottir.

In Portugal the users would get points every week for reducing energy usage. In the Dutch pilot a similar algorithm was introduced and used at peak hours, between 5:00 and 9:00 in the evening, with users getting additional points and getting a message about it which stated “You have reduced your consumption!” and a ranking where they could see how they were doing with the winner getting a prize. The first phase resulted in a white book report in which recommendations for the different phases of user interaction are given, along with an evaluation of the effects of the incentives in the two project pilot cities along with practical findings. One of the lessons learned from having a technical pilot is that even though the devices are “plug and play” people are not used to them and tend to say they will do it tomorrow.

– It’s a complex project with many different facets, the technical part is quite important and complicated and then there’s the social part in setting up a pilot, “it took a long time to get it altogether, to realize the most important components for success” explains Halldora when reflecting on the two year project period.

Platform and App

The me² integrated energy monitoring platform is the front end of the project’s Smart City Aggregator (SCA) system. The SCA connects use of EV batteries and households’ equipment with smart meters, to achieve greater efficiency and flexibility at an electricity grid level or the back end. The front end includes a community website, an app and an intelligent back end. The consumers have access directly to their energy information laying the base for mechanisms to influence behavior. The app is available for iOS and Android and serves to increase the accessibility of the platform. Users can share their results, if for example they have acquired green points and other users can “like” what they are doing.

Figure 15 The web-based platform shows consumption by appliance, locality or categories like heating or cooling on a dashboard.



- At the back-end of the smart city aggregator we can have utilities or different companies that gather all the profiles of the consumers on the front end. The front end has been tested in the pilots which gave us feedback for further development. This can also become an interesting product for an energy provider or for a company that is allowed to trade on the energy market. Halldora Thorsdottir argues “You can optimize the management and use of energy”.
- The data from the smart meters was sent to the me² platform. The web-based platform shows consumption by appliance, locality or categories like heating or cooling. The collected data have been compared with results from a pre-pilot survey asking the participants about their consumption. A user scenario has also been developed. The technical partner, MediaPrimer, has been engaged from the beginning and has put a lot of effort in making the front-end: the website, the app and the platform. The aggregator can communicate directly with the users through the platform and has the means to send messages to consumers such as “the peak hour is costly for you to load your car, it’s better to do it later” or “if you charge it at different time you get more points”.

In addition, the market square, an online market place of me² and connected to the platform, was developed by our other technical partner, VPS. The idea is that companies that have energy efficiency service, for example solar panels or other smart tools or services that facilitate smart charging of electric vehicles as affiliated partners will be on the market square. The users can go there and see if the products are enticing. There are now several ideas on how to take the outcomes to the next step.

– Our commercial partners are now focusing on exactly what the next step should be. Halldora says “in principal they want to take the product further, they are participating in an active discussion on research, testing and development before finding the best way to take it to the market.”

When will smart solutions like the smart meter be standard?

- It’s already happening. I think in the Netherlands more and more people want to know if they can save energy, our users for example really want to see all of their production and consumption in one place and in the platform you see everything. This is something that we are offering in me², and this is also what other smart home solutions will offer, and some are already doing it Halldora Thorsdottir concludes the future prospects.

me² – Integrated smart city mobility and energy platform

Duration: 2016–2018 Internet: www.jpi-urbaneurope.eu/me2

Contact: Dr. Robert van den Hoed, Amsterdam University of Applied Sciences

E-mail: r.van.den.hoed@hva.nl

Partners: Amsterdam University of Applied Sciences, UCP Católica Lisbon School of Business & Economics, Lisboa E-NOVA, Agência Municipal De Energia-Ambiente De Lisboa, MOOSMOAR Energies, Virtual Power Solutions, MediaPrimer

Acknowledgement: This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 646453.

3.2.3 Case Study in China

Introduction

Cities around the world generate 80% of GDP, according to recent estimates⁶⁹. Meanwhile, they are responsible for approximately 70% of global energy-related GHG emissions, which imposes an additional challenge for Chinese cities, given that China has been the largest contributor of carbon emissions in recent years⁷⁰.

Figure 16 shows CO₂ emissions by Sector from 1990 to 2009 in China. Based on an estimate by the International Energy Agency (IEA), emissions by the electricity and heat generation sector had increased significantly since 1990, accounting for approximately 50% of all emissions in 2007⁷¹. In 2013, China remitted about 25% of carbon dioxide in the world, i.e. 9.2 Gt CO₂; 73% of the increase in global carbon emissions between 2010 and 2012 occurred in

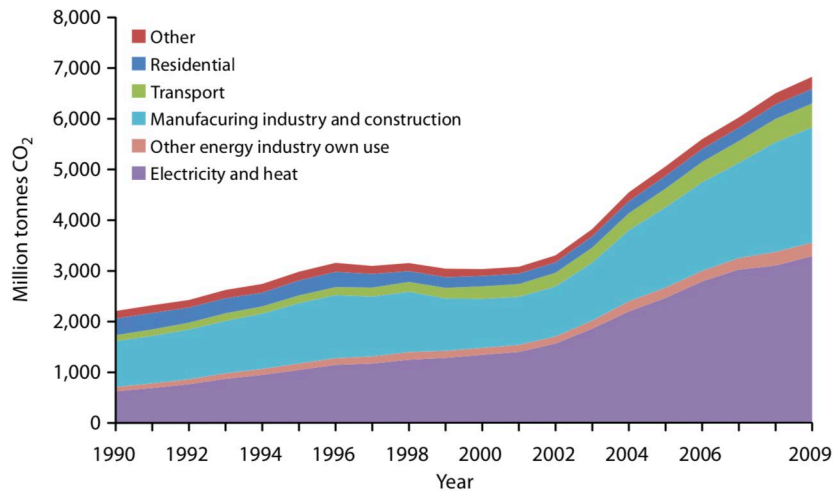
⁶⁹ Dobbs, R. et al. (2011) Urban world/Mapping the Economic Power of Cities.

⁷⁰ World Bank (2012) Sustainable Low-Carbon City Development in China.

⁷¹ OECD/IEA (2009) CO₂ Emissions from Fuel Combustion 2011, Paris, France: OECD/IEA.

China; without mitigation, the emissions in the country could rise by over 50% in the next 15 years⁷². CO₂ emissions would continue to grow quickly across all key sectors unless effective measures were implemented to lower carbon intensity.

Figure 16 CO₂ Emissions by Sector in China (1990-2009)



Source: OECD/IEA (2011)

Fortunately, policy makers, over the last decades, have recognized the need for reducing carbon emissions and energy use while maintaining robust economic growth to create more employment opportunities and improve people's quality of life. Since early 1990s, The Ministry of Environmental Protection (MEP) and the Ministry of Housing and Urban-Rural Development (MoHURD) have attempted to guide cities towards more sustainable development by ways including releasing various eco-city policies and standards. Figure 17 shows cities and counties that have been awarded an Eco-City status by MEP and MoHURD. By 2012, MEP had designated 11 counties, districts, and cities as eco-cities, i.e. Miyun county and Yanqing county in Beijing; Taicang city, Zhangjiagang city, Changshu city and Jiangyin city in Jiangsu province; Rongcheng city in Shandong province; Yantian district in Shenzhen; Minhang district in Shanghai; and Anji county in Zhejiang province. MoHURD's National Eco-Garden Cities include Shenzhen, Qingdao, Nanjing, Hangzhou, Weihai, Yangzhou, Suzhou, Shaoxing, Guilin, Changshu, Kunshan and Zhangjiagang.

Figure 17 Map of MEP and MoHURD Eco-Cities

⁷² Zhu, L. (2016) China's Carbon Emissions Report: 2016 -- Regional Carbon Emissions and the Implication for China's Low Carbon Development.



Source: World Bank (2012) Sustainable Low-Carbon City Development in China.

Apart from MEP and MoHURD, the National Development and Reform Commission (NDRC) launched a pilot program for national low-carbon province and city development in 2010. The program has been implemented in five provinces (i.e. Guangdong, Liaoning, Hubei, Shaanxi, and Yunnan) and eight cities or municipalities (i.e. Tianjin, Chongqing, Shenzhen, Xiamen, Hangzhou, Nanchang, Guiyang and Baoding) across the country.

Although some local governments may still have inadequate capacity to transform themselves to low-carbon cities, the pilot programs mentioned above have positive impacts on the determination of local governments' striving for low-carbon development. One positive side in practice is that the increase in energy efficiency and the achievement of low-carbon development in Chinese cities are in line with sustainable urban development in the context of the rapid urbanization process. Cities that engage in low-carbon transformation will become more livable, efficient, resilient, and ultimately more sustainable.

There are emerging Low-Carbon City Initiatives in cities such as Shenzhen, Wuxi, Guiyang, Baoding and Hangzhou. Some of these initiatives appear similar in nature to the previous generation of eco-cities, thus sharing similar achievements and shortcomings. Low-carbon development in Hangzhou represents a good practice among them.

Case Study - Low-carbon Development in Hangzhou City^{73 74 75}

Hangzhou, capital of Zhejiang province, is located in eastern coast of China, with the population 9.188 million, population density of 554 persons per square kilometer and an area of 16,596 square kilometers by the end of 2016⁷⁶. It is the first city in China who proposed the low-carbon city strategy (in 2008), aiming to reduce its carbon intensity by 35% by 2015 and 50% by 2020 against a 2005 baseline.

In 2009, Hangzhou released *the Decision on Low-Carbon City Development*, with an intension to transform itself to a low-carbon city and become a role model for low-carbon development in China. It proposed the development of a low-carbon demonstration city after it was identified by NDRC as one of the first Low-carbon Pilot Cities in the country, with a special focus on the following six themes, i.e. low-carbon economy, low-carbon transport, low-carbon buildings, low-carbon living, low-carbon energy and low-carbon society.

Since then, Hangzhou has adopted various initiatives. For the development of low-carbon economy, it has emphasized structural transformation and industrial upgrading by phasing out high-polluting and high-energy consumption businesses, and meanwhile, encouraging the development of cleaner production and circular economy. The city has established a comprehensive low-carbon public transport system, which consists of a public bicycle system, electric taxi services, a low-carbon bus scheme, water bus services and a metro system. By the end of 2015, there were 1,230 electric buses, 560 electric buses, 2,378 LNG buses and 3,866 CNG taxis in operation; the city became well known for its world largest public bicycle system, with 80,000 public bicycles and over 3,000 docking stations distributed in its city center and more than 400 million bike rides. Energy saving technologies have been applied to existing and new buildings to increase energy efficiency and reduce carbon emissions in the city. This includes, but is not limited to, encouraging the development of photovoltaic power generations, green rooftops and vertical greenery, and implementing the Green Building Rating System.

The above-mentioned initiatives and practices in Hangzhou have accomplished tremendous achievements. In 2015, the total coal consumption of the city was reduced by over 6% compared to that of 2012; clean coal utilization rate reached over 80%; renewable energy accounted for around 4% of total energy consumption. By the end of 2015, the unit GDP energy consumption

⁷³ Available at: http://district.ce.cn/zg/201508/25/t20150825_6311730.shtml

⁷⁴ Available at: http://hznews.hangzhou.com.cn/jingji/content/2016-10/28/content_6363947.htm

⁷⁵ World Bank (2012) Sustainable Low-Carbon City Development in China.

⁷⁶ Available at: <http://tjj.hangzhou.gov.cn/web/tjnj/nj2017/index.htm>

was reduced to 0.43 ton of standard coal/10,000 yuan, a drop by 23.25% against a 2010 baseline, which exceeded the goal of the reduction by 19.5% set for the Twelfth Five-year Plan period.

3.3 Transport and Mobility

3.3.1 Overview

Efforts are taken worldwide to improve mobility systems with the aim to provide safe access for all people to public places, goods, services and economic opportunities, while at the same time reducing the environmental footprint of transportation. Tackling the transport and mobility issue has a significant impact on other (socio-)economic and environmental aspects as well as on the quality of life and the wellbeing of the urban populations. In China and Europe alike multi-modal mobility systems and new mobility services are investigated to deal with problems of commuting and congestion. The European case study, the JPI UE project **Smart Commuting**, analysed mobility behaviour of commuters in three countries to identify the need for and potential of new mobility services. Results have not only been reflected with policy makers but are also translated into business solutions with transportation companies. The case of **Shanghai** illustrates how different smart services can enhance the multimodal transport behaviour where busses, cars, trains and bikes play an essential role. Through an innovative app solution, different transport modes are connected, and door-to-door travel planning is offered in a multi-modal way.

3.3.2 Case Study in Europe

JPI UE Smart Commuting

Smart Commuting started in 2016 to study new ways of combining work and life on the move with intelligent and sustainable transport system services. The project has studied commuter flows and contributed to the development of services for smarter traveling, striving to make commuting easier, more flexible and efficient, and lowering costs for travelers. In focus are three Travel-to-Work areas in Austria, Finland and Switzerland and how new types of mobility concepts could support people and cities.

The first objective was to identify the changing needs of mobile workers by collecting data by surveys, interviews and workshops. Smart Commuting has thereby been able to compare cultural and geographical contexts in three countries using an in-depth case study method. In this context, Smart Commuting examines how legislation, culture, and technology policies influence the adaptation of the chosen mobility solution. For example, cities have to address commuting when developing public services and assessing new infrastructure investments.

The second objective was to increase the sustainability of mobility with new mobility concepts

and services. This was done by having the on-demand shared taxi service partners Kyyti in Finland and ISTmobil in Austria as partners. The project helps to evaluate how these concepts meet the evolving needs of mobile workers and discover some common ground for service design and city planning policies. The Kyyti system for sharing taxis by the project partner Tuup Oy has partly been developed in the project.

- ‘The project was designed so that project’s research activities support implementations. The stakeholders did not have to wait for our final observations, and for example, we have been able to be agile and support our company partners already during the service development process’ says Prof. Matti Vartiainen from the Aalto University who has been the project leader with Teemu Surakka being project manager.

In Austria, ISTmobil GmbH, a provider of a shared taxi system, gave the project’s researchers access to the data about the use of their service to estimate the benefits of using such a system. Since different data sources exist with varying aggregation levels, accessibility and completeness, the identification of key aspects of mobility services was based on the incorporation of the mobility data from different sources. The analysis of the data provided possibilities to design more user-need-based services than before.

Figure 18 Commuting between population centers in Southern Finland. © YKR, 2014, used under CC BY 4.0

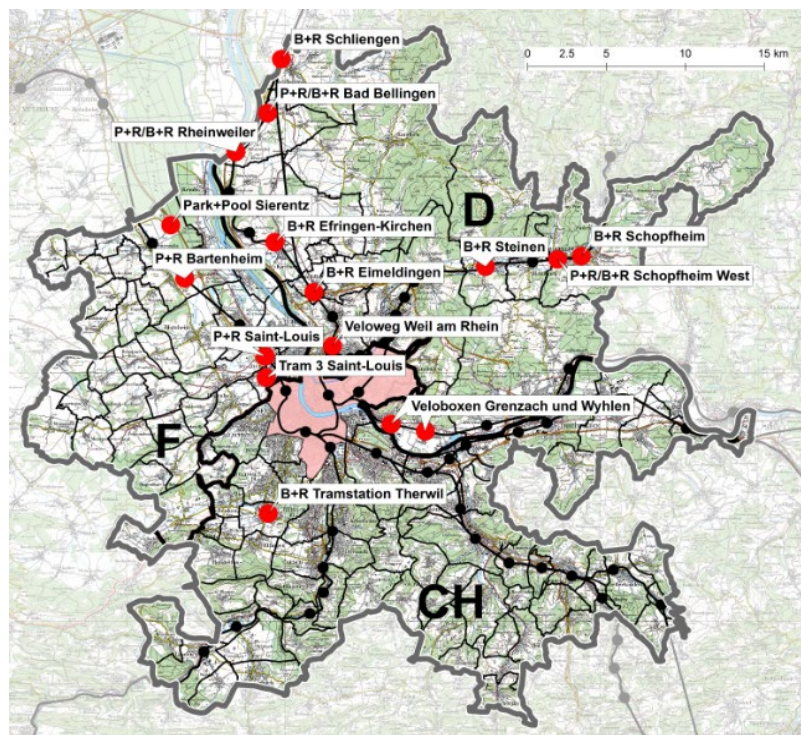


Over time the mobility of the workforce is increasing due to technology development,

commuting and the nature of work. However, looking at the current situation, there is much more potential for the ISTmobil services with only 0.06 % of commuters from the district of Korneuburg to Vienna utilising the service. From our other cases, the Growth Corridor in Finland is a similar Travel-to-Work area near the capital city Helsinki that could benefit from ISTmobil or similar mobility solutions. During the project, the service was expanded to the surrounding municipalities of Graz with the name GUSTmobil.

- “We took into account the institutional culture in each country. In Finland we are quite heavily focusing on enabling private companies to implement new services and to make technical innovations, whereas in the Swiss culture these new services are more strongly considered as only supplementing public transportation and the whole sector is pretty much in the hands of two federal companies”, says Vartiainen. He goes on to say “One of our findings concerns the policy issues, what are the necessary local policies in organizing these mobility services – to what extent are they scalable? The local context depends very much on the implementation of relevant policies.” The project has also pointed out differences between the countries concerning the governmental structure and the number of stakeholders involved in organizing transportation.

Figure 19 Mobility projects supported by the "Pendlerfonds" so far. © Canton of BaselStadt, 2016. Used with permission.



Findings and next steps

The Smart Commuting project has collected statistics on mobile workers and their needs; for

example, how many children they have, the number of cars they own, the number of motorcycles and e-bikes in the household, and they type of living environment they occupied. Results show, how much time the commuters spend travelling and the distance between the home and the workplace but also how they use the technical system and different applications, and what they are doing during their commute and what rationalities they have when choosing a certain mode of transport.

- “I think we have generated all kinds of findings, but the most important, to some extent, is the user survey in the three countries comparing the mobility profiles and the mobility needs in each country and how the users perceive the suitability of new mobility solutions to their needs”, says Vartiainen.

- “We have gained a lot of insights for the transportation actors about the differences between the countries concerning what services are emerging and how they are used. We have been invited to discuss our findings in Urban Agenda for the EU policy labs, which shows there is a need for these insights and policy guidelines”, says Teemu Surakka.

The project has generated new knowledge for the planning of commuter systems, services and city and region planning but also on what is important when setting up mobility systems and solutions. For the companies involved, this has meant not only the joint development of their services but also direct commercial effect as Tuup Oy has through the project started a co-operation with Swiss **PostBus**.

- “That was one of the drivers in joining the consortium. And now, we have been building a similar service to Kyyti in Switzerland. It has been in test use for a couple of months and will be launched in Brugg outside Zurich”, says Johanna Taskinen from Tuup/Kyyti. Tuup Oy is also going to start a new project with a company customer to test their solution in an organizational setting in the City of Oulu. Ms. Taskinen sees the project as one part of the continuous product development.

The study also gave answers to the market potential of new mobility modes, such as car sharing, on-demand services and bike sharing and what a commuter would like to see as enablers, such as more space for a laptop, a better internet connection, quiet working spaces and the permission to work while traveling from the employer. The findings lay the foundation for the next project that is based on Smart Commuting.

- “We have submitted a proposal for a Horizon 2020 call with more or less the same partners, but now adding city partners with their challenges in sustainable commuting. We have the evidence to step up to making the best possible policies and tools for cities to work, and this is

the main takeaway. I am happy with the collaboration in the project”, concludes Matti Vartiainen.

Smart Commuting – smart and mobile work in growth regions

Duration: 2016–2018 Internet: <https://smartcommuting.eu/>

Contact: Prof. Dr. Matti Vartiainen, Aalto University

E-mail: matti.vartiainen@aalto.fi

Partners: Aalto University, AIT Austrian Institute of Technology, tbw research GesmbH, ZHAW Zurich University of Applied Sciences, Virta Ltd. (Liikennevirta Oy), AC2SG Software Oy, Tuup Oy, ISTmobil GmbH, Growth Corridor Finland, Office for Mobility of the Canton of Basel-Stadt

Acknowledgement: This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 646453.

3.3.3 Case Study in China

Introduction

Urban public transport is a key component of sustainable urban development, as it offers a more energy efficient way for transport and mobility than the private automobile in general⁷⁷. Thus, the public transit-oriented development contributes to carbon emission reduction and thus sustainable development compared to automobile-oriented development. Figure 20 is an example showing that, within peak hours, the bus or metro system consumes less energy and emits less greenhouse gases than the private automobile per passenger kilometer from a life-cycle perspective accounts for all emissions⁷⁸.

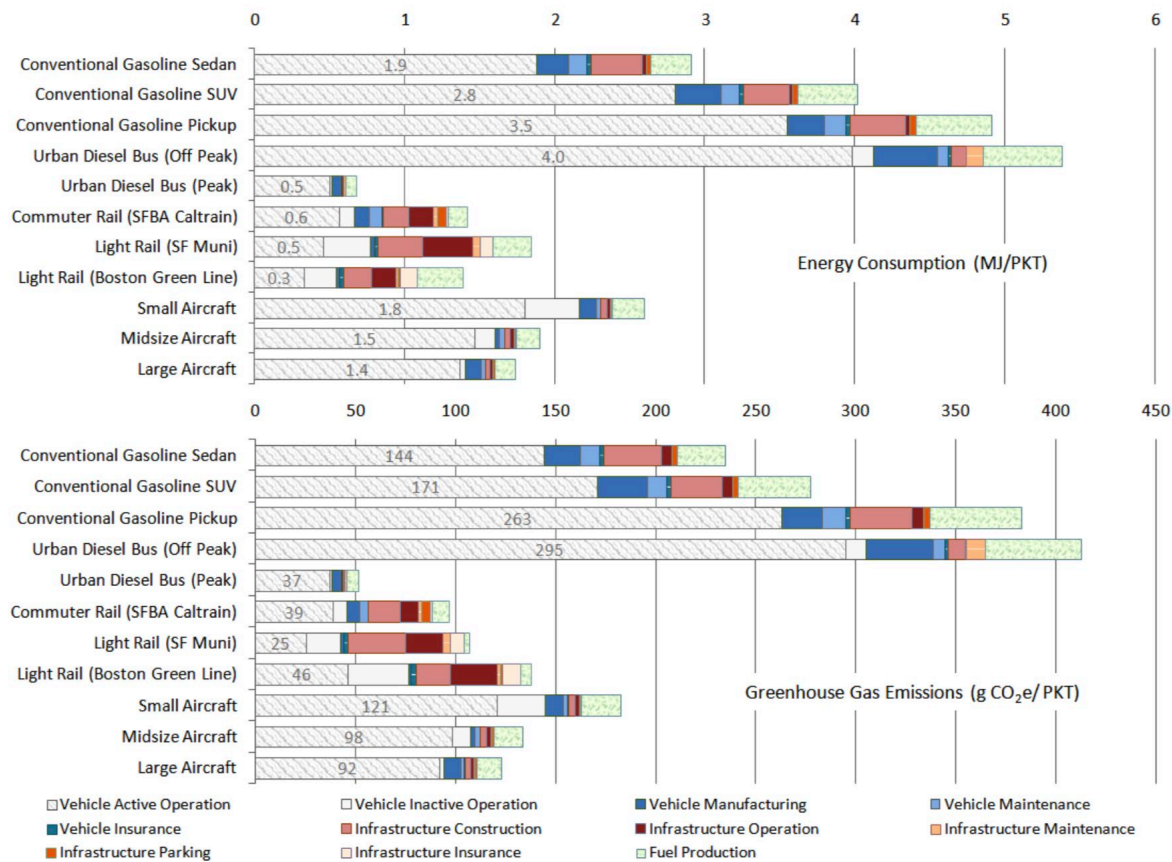
For traffic congestion alleviation, a number of cities in China have started to adopt travel demand measures (e.g. imposing restrictions on new car purchases and use and increased parking fees) from the lens of the travel demand perspective following the examples of Shanghai and Beijing⁷⁹. The adoption of these measures together with the further development of the public transit system, such as the metro system and RBT (e.g. in Guangzhou), have contributed to the increase in the public transportation ridership and the reduction in the use of private vehicles. These, to some text, have reduced traffic congestion in those cities, although there may be still a long way to go to achieve significant reductions. The following is a good practice of smart transport and mobility in Shanghai Municipality.

⁷⁷ World Bank (2012) Sustainable Low-Carbon City Development in China.

⁷⁸ Chester and Horvath (2009) Environmental Assessment of Passenger Transportation should Include Infrastructure and Supply Chains, *Environ. Res. Lett.*, 4, pp.1-8.

⁷⁹ Wang, J. and He, D. (2015) Sustainable urban development in China: challenges and achievements, *Mitig Adapt Strateg Glob Change*, 20, pp.665-682.

Figure 20 Life-Cycle Emissions by Passenger Kilometer



Source: Chester and Horvath (2009).

Notes: for energy consumption and GHG emissions per PKT, the vehicle operation components are shown with gray patterns; other vehicle components are shown in shades of blue; infrastructure components are shown in shades of red and orange; the fuel production component is shown in green; and all components appear in the order they are shown in the legend.

Case Study - Smart Transport and Mobility in Shanghai Municipality^{80 81 82}

The development of smart transport and mobility in Shanghai has been accelerated after the Shanghai World Expo 2010. Since then, smart transportation technologies have been widely used in transport sectors, such as rail transit, buses and trolleybuses, public parking, transport hubs, which contributes greatly to transport management and information sharing with the public.

In order to provide a one-stop platform for transportation information, the Shanghai Municipal Transportation Commission released the Shanghai Transport App. The App contains 12 functional modules (see Figure 21), covering air, water and land transport, i.e. real-time bus,

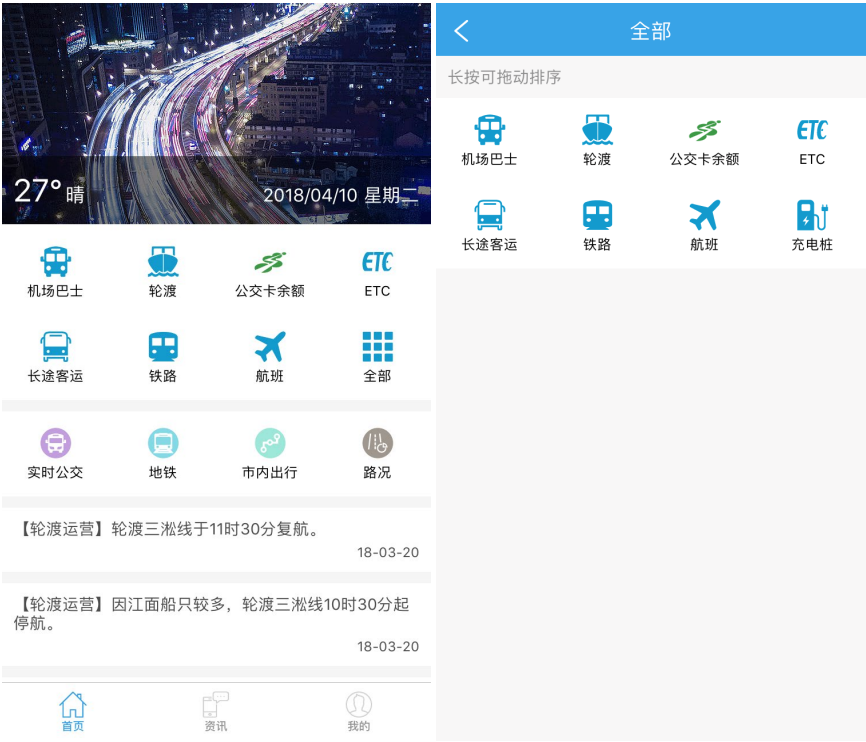
⁸⁰ http://www.sohu.com/a/198740991_182825

⁸¹ <http://www.shanghai.gov.cn/nw2/nw2314/nw2315/nw4411/u21aw1236157.html>

⁸² <http://www.shanghai.gov.cn/nw2/nw2314/nw2315/nw4411/u21aw1283651.html>

metro, road condition, ferry, airport shuttle bus information, etc. It can help residents plan their door-to-door journeys on foot, by public transport and/or car. Residents can also check the balance of their Public Transport and ETC Cards and find information on the location of electric car charging points.

Figure 21 Shanghai Transport App



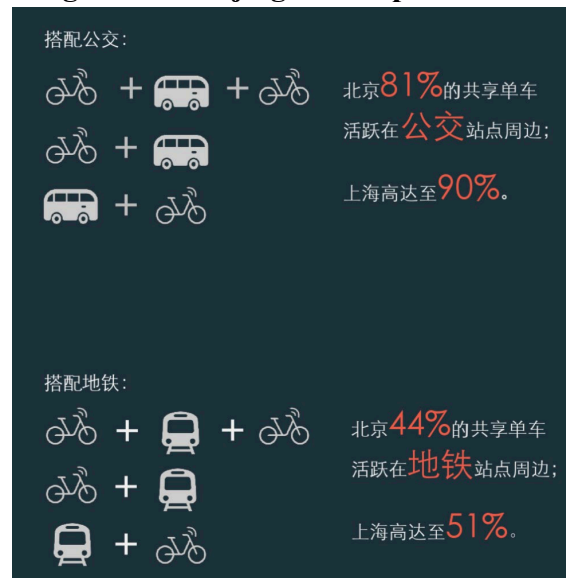
Source: Apple Store

There are other popular transportation applications in Shanghai, such as Shanghai Bus App, and Shanghai Metro App, specializing in providing information on bus, express and highways, and metro services respectively. To realize the above-mentioned smart transport and mobility in Shanghai, there are strong hardware and software support and real-time data feeds. For instance, the data on the 648 bus routes in the municipality that can be accessed by the Shanghai Bus App. The Shanghai Ba-Shi Public Transportation (Group) calculates optimal bus departure and arrival times taking into consideration route planning, road conditions, bus locations to realize the intelligent scheduling system. So far, there are nearly 4,000 buses covering over 340 bus routes in Pudong District that have been integrated into the intelligent scheduling system.

The-above mentioned public transport together with biking sharing in Shanghai have contributed tremendously to solving the “last mile” problem of getting people from public transport to their destinations through bikes. Figure 22 shows that 90% of the dockless shared bikes are used near bus stops and 51% of such bikes are used near metro stations in Shanghai

in 2016⁸³. It is worth noting here that the data was collected from the area of 300 meters within bus stops and from the area of 500 meters within metro stations. There are some overlaps between the two area types. The case study of bike sharing will be illustrated separately in the next section.

Figure 22 The Combined Usage of the Public Transport and the Bike Sharing System in Shanghai and Beijing Municipalities in 2016



Source: Beijing Tsinghua Tongheng Urban Planning and Design Institute and Mobike (2017)
2017 White Paper: Bike-sharing and the City.

3.4 Sharing Economy

3.4.1 Overview

With the development of digital technologies, the sharing economy has become a reality. Combined with an upcoming tendency among urban populations towards sharing instead of owning, sharing services are influencing urban life socially, environmentally and economically. Sharing economy provides potential to challenge established routines. In Europe and China, new sharing schemes are significantly influencing urban life, consumption patterns and have the potential to significantly contribute to sustainable urban development. The JPI UE project **E4-share** developed models for flexible, efficient and economic viable electric car-sharing systems. In the project, different car-sharing models were compared, user incentives determined, and supporting policy frameworks investigated using the case of the City of Vienna. In China, the sharing economy has seen significant growth recently. New sharing schemes and business

⁸³ Beijing Tsinghua Tongheng Urban Planning and Design Institute and Mobike (2017) the White Paper on Bike-Sharing and Urban Development 2017.

models have created a boom of **Bike Sharing** since 2015. Today, bike sharing is especially relevant for “the last mile”, the distance between public transportation and people’s final destination.

3.4.2 Case Study in Europe

JPI UE project E4-share

The e4-share project lays the foundation for flexible, efficient and economically viable car-sharing systems based on electric cars which allows citizens to efficiently use and shift between different modes of transport. The objective of the project was to develop generic models for electric car-sharing systems that can be applied in cities around Europe and to study and solve the optimization problems which arise in their design and operations.

There is a growing concern regarding the problems related to unsustainable transportation systems in cities, including congestions, air pollution and noise, and how it affects citizens’ health and life quality. Cities are confronted with severe challenges and need to manage a transformation process that will lead to less pollution and less energy and land consumption, while increasing the quality of public space available to citizens. Optimizing the transport system in cities is one central task which would improve urban mobility systems.

Car-sharing is part of the so called “sharing economy” (The Economist, 2013) which means the sharing of goods and services respectively, such as renting instead of owning a car. Users have the choice between small and large cars, fuel-driven or electric cars as well as free-floating and station-based cars. Car-sharing systems are becoming more and more popular and the number of operating companies has increased all over the world in the last few years. On the other hand, some operators have already withdrawn from the market, indicating a lack of sustainable business models. In relation to the thematic area of sharing economy and the contribution of private sectors the project therefore gives valuable insights into the operators’ user incentives and provides tools for optimizing technology and business models in an emergent market.

e4-share is an international research project that was funded through the JPI Urban Europe pilot call II offering ‘models for ecological, economical, efficient and electric car-sharing’. The project ended in 2017 and was led by the University of Vienna, AIT, tbw research (a non-profit organization engaged in research and innovation projects), Université Libre de Bruxelles and the University of Bologna in collaboration with car-sharing-operators.

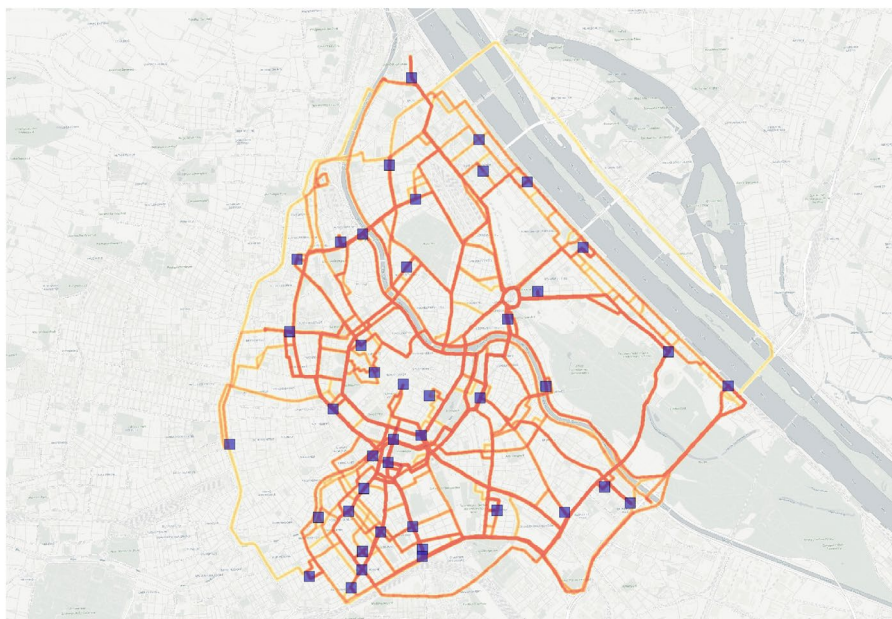
Vienna case study

The city of Vienna was used as a case study. The city was divided into different operating areas and the assumption of the demand was based on taxi data. Additional inputs included a fixed

investment budget for the car-sharing operator and a maximum walking distance of five minutes for car-sharing users. The aim of the model for Vienna was to optimize the expected sales as well as the locations and incentives as well as to model a balanced number of vehicles and stations.

The methods developed for modeling, optimization and simulation in the Vienna case are transferable and scalable and thus applicable to other cities and applications (for example, bike sharing, charging stations in public spaces).

Figure 23 A heat-map of the electric car sharing system, in which the darker colors indicate the more frequently used road segments (AIT – Austrian Institute of Technology)



Station-based and free-floating car sharing services

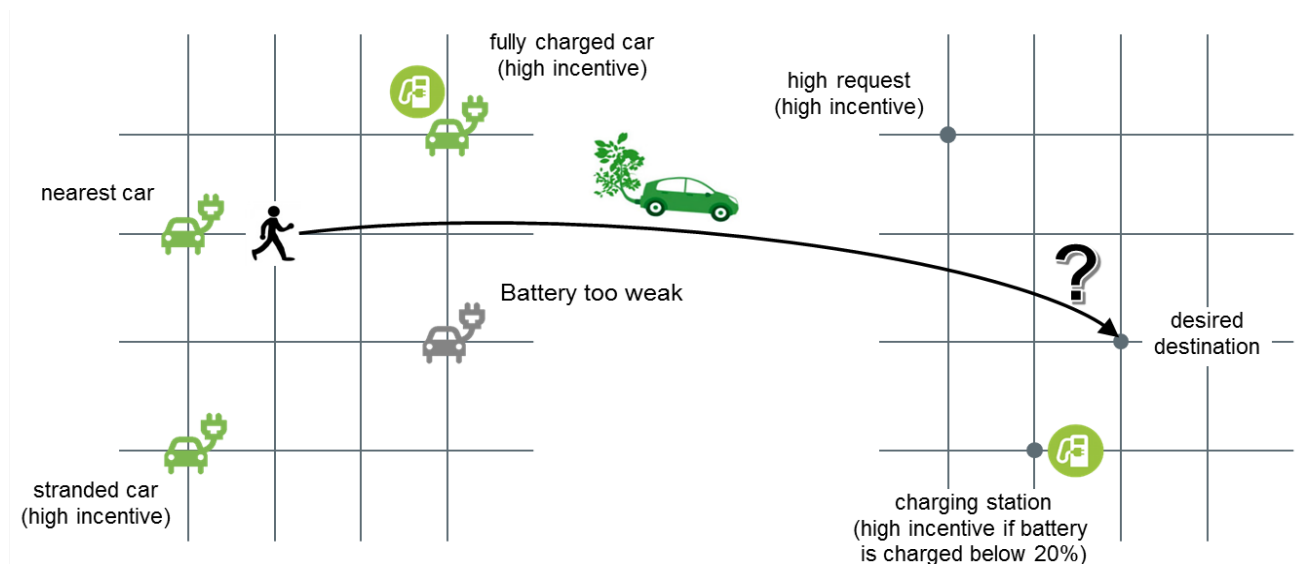
There are basically two types of car-sharing services – station-based services where cars are being picked up and left by the user at fixed places in the city and free-floating services where cars are parked mostly anywhere in the city. The trend is towards free-floating services which are the ones most preferred by users. The mathematic models which have been developed in the project are applicable to both of the car-sharing services and the project had to answer many questions. For station-based systems questions like e.g. Where do the stations have to be built? How many charging points per station make sense? Which customers can be served? All of these questions have been addressed. On the other hand, free-floating systems not only need an efficient distribution of charging stations, but also an incentive strategy or incentive systems to make maintenance, charging of vehicles and other necessary maintenance work as efficient as possible.

Insights into user incentives

The project has gained insights into what incentives are effective to reduce fleet management efforts and provide new ways for car-sharing companies to optimize operations.

For the analysis of existing, and especially potential future incentives, as well as possible management tasks that can be taken over by users, a detailed research of existing car-sharing companies as well as workshops and an online survey were carried out. Various factors such as income, car-sharing usage behavior, interest in possible incentives and their amount were related to each other. The results were integrated into the mathematical models and presented in a *User incentives catalogue*.

Figure 24 User incentives



Solution examples for car-sharing operators

The project e4-share provides example solutions for the car-sharing location planning and charging stations as well as numerous evaluations and analyzes on e.g. vehicle usage intensity, pick-up and return of vehicles in the system or modeled performance of the system with different size of the operating area. These solutions can be a useful decision support for solving the operators' key strategic, tactical and operational problems. Offering electric cars instead of fuel driven ones offers chances of improving urban quality of life but of course poses specific challenges for both service providers and city administrations.

The models developed based on the Vienna case are generally applicable for optimized planning and operation at various planning levels. Simulations based on these complex

mathematical models and an abstracted network with simplified representations of stations, customer requests and walking ranges are available on the project website⁸⁴.

Identified opportunities for urban decisions makers

The outcomes of the project provide arguments for a regulated market to take better advantage of technological solutions and realize efficient and sustainable urban systems and networks.

‘At present the city of Vienna does not regulate the car-sharing market and operators’, says Marlene Hawelka, project leader at tbw research, ‘but shared mobility services can be a valuable asset for urban mobility acting as a supplement to public transport and can help to reduce the land consumption of the mobility system. Therefore, a more widespread car-sharing system is needed where citizens in the outer city districts also could access the system. In today’s non-regulated market the car-sharing companies operate mostly in the central districts where you can also easily walk and take the tram.’

In addition, digital platforms and MaaS (Mobility as a Service) can help to seamlessly integrate new services into the existing urban transport system.

E4-share – Models for ecological, economical, efficient, electric car-sharing

Duration: 2014–2017

Internet: www.univie.ac.at/e4-share

Contact: Markus Leitner, University of Vienna

E-mail: markus.leitner@univie.ac.at

Partners: AIT Austrian Institute of Technology, Université Libre de Bruxelles, University of Bologna, tbw research GesmbH, University of Vienna

3.4.3 Case Study in China

Introduction

The rapid development of the sharing economy in the past decade is the result of the pursuit of better value redistribution and collaborative consumption and the growing salience of natural resource constraints after the international financial crisis^{85 86 87 88}. The peer-to-peer (P2P) sharing of access to under-utilized goods and services online has contributed to the reduction

⁸⁴ <http://www.univie.ac.at/e4-share/>.

⁸⁵ https://www.ted.com/talks/lisa_gansky_the_future_of_business_is_the_mesh

⁸⁶ <https://www.youtube.com/watch?v=AQa3kUJPEko>

⁸⁷ Schor, J. and Fitzmaurice, C. (2015) Collaborating and Connecting: The Emergence of the Sharing Economy, in *Handbook on Research on Sustainable Consumption*, eds., Lucia Reisch and John Thøgersen, Cheltenham, UK: Edward Elgar.

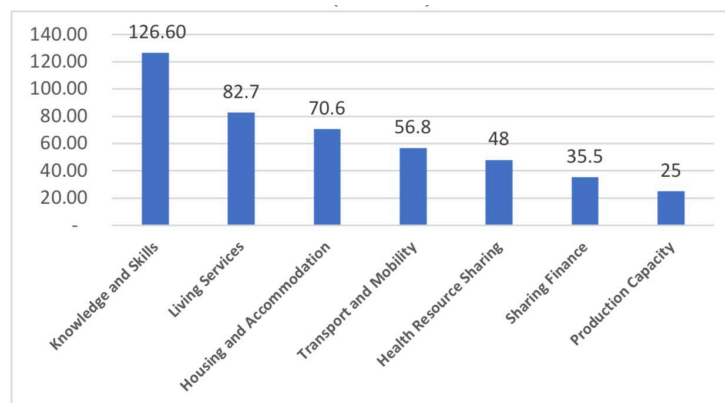
⁸⁸ McLaren, D. and Agyeman, J. (2015) *Sharing Cities: A Case for Truly Smart and Sustainable Cities*. Cambridge, Massachusetts: The MIT Press.

of ecological footprint⁸⁹. Thus, the sharing economy has the potential to offer a new pathway to achieve sustainability⁹⁰.

The world has witnessed a sharing economy boom in recent years. So does the sharing economy in China⁹¹. The term of sharing economy was defined as “the total sum of economic activities with the main feature of usage sharing that is achieved by mobilizing massive but scattered resources to meet diverse requirements through the use of modern information technologies such as the Internet” in the *Annual Report on the Development of Sharing Economy in China (2017)* released by the Sharing Economy Research Center of the State Information Center. The trading volume of the sharing economy in China was 4.9205 trillion yuan in 2017 according to the *Annual Report on the Development of Sharing Economy in China (2018)*^{92 93}, which increased by 47.2% over the last year. Over 700 million people were involved in the sharing economy, an increase by about 100 million compared to the last year’s figure.

Figure 25 shows the trade volume growth in the sharing economy by sector in China in 2017, with the growth rates of the Knowledge and Skills sector (126.60%), the Living Services section (82.7%) and the Housing and Accommodation sector (70.6%) among the top three out of the seven key sectors. It is estimated that the average annual growth rate of the sharing economy would maintain above 30% in the next five years.

Figure 25 The Trade Volume Growth in the Sharing Economy by Sector in China in 2017 (Unit: %)



Source: Reproduced based on the data from the *Annual Report on the Development of Sharing Economy in China (2018)*

⁸⁹ Cheng, M. (2016) Sharing Economy: A Review and Agenda for Future Research, *International Journal of Hospitality Management*, 57, pp.60-70.

⁹⁰ Heinrichs, H. (2013) Sharing Economy: A Potential New Pathway to Sustainability, *Gaia*, 22(4), pp.228-231.

⁹¹ Wen, S. (2018) Research on Innovation in Holistic Governance for A More Effective System of Urban Bike Sharing Supervision, *E-Government*, 04, pp.21-31.

⁹² http://tech.ifeng.com/a/20180228/44890942_0.shtml

⁹³ <http://baijiahao.baidu.com/s?id=1594089458520055061&wfr=spider&for=pc>

The rapid development of the sharing economy may be not directly linked to the low-carbon development of cities in China. It may depend on the nature of the sectors and how they are related to the reduction in ecological footprint. For instance, bike and car sharing in the Transport and Mobility sector contributes to reducing the level of automobile use, thus having positive impacts on low-carbon and sustainable development. However, some services delivering over-packaged goods in the Living Services sector may not be the case. The following is case study of bike sharing in China. Admittedly, bike sharing may have potential problems, such as financial sustainability and urban management. The focus of this case study will be on the relationship between bike sharing and sustainable urban development in the Chinese context.

Case Study – Bike Sharing in China

There is a bike-sharing boom in China in recent years, which is enabled by digital innovations. The aim of bike sharing is to solve the “last mile” problem of getting people from public transport to their destinations through bikes as mentioned in the previous section. Bike sharing is a new business model of the sharing economy in which companies collaborate with local governments to offer bike rental services in or around places, such as public spaces, residential areas, business districts, bus stops and metro stations⁹⁴.

Bike sharing is also a recent development of public bicycle sharing in China. There are two phases of development with the advance of innovative technologies. The first phase started around 2008 when the concept of public bicycle was introduced to the Chinese market, with shared bikes and docking stations. Hangzhou Public Bicycle is a good example of public bicycle sharing in China. In 2008, the Hangzhou city government launched the Hangzhou Public Bicycle program as a seamless feeder service to public transit throughout the city in light of growing traffic congestion and environmental concerns. The program initially started with 2,800 bicycles, 30 fixed docking stations and 30 mobile docking stations (movable to meet demand) (see Figure 26)⁹⁵. As of January 5, 2013, it had become the largest public bicycle sharing system in the world, with 66,500 bicycles operating from 2,700 stations, which contributed tremendously to the reduction of carbon emissions in the city⁹⁶.

⁹⁴ Wen, S. (2018) Research on Innovation in Holistic Governance for A More Effective System of Urban Bike Sharing Supervision, *E-Government*, 04, pp.21-31.

⁹⁵ Shaheen, S., Zhang, H., Martin, E. and Guzman, S. (2011) *Transportation Research Record: Journal of the Transportation Research Board*, 2247, pp.33-41.

⁹⁶ https://web.archive.org/web/20140808045713/http://www.zj.xinhuanet.com/newscenter/focus/2013-01/05/c_114258328.htm

Figure 16 Hangzhou Public Bicycle



Source: <http://policytransfer.metropolis.org/case-studies/hangzhou-china-urban-public-bicycle-sharing-program>

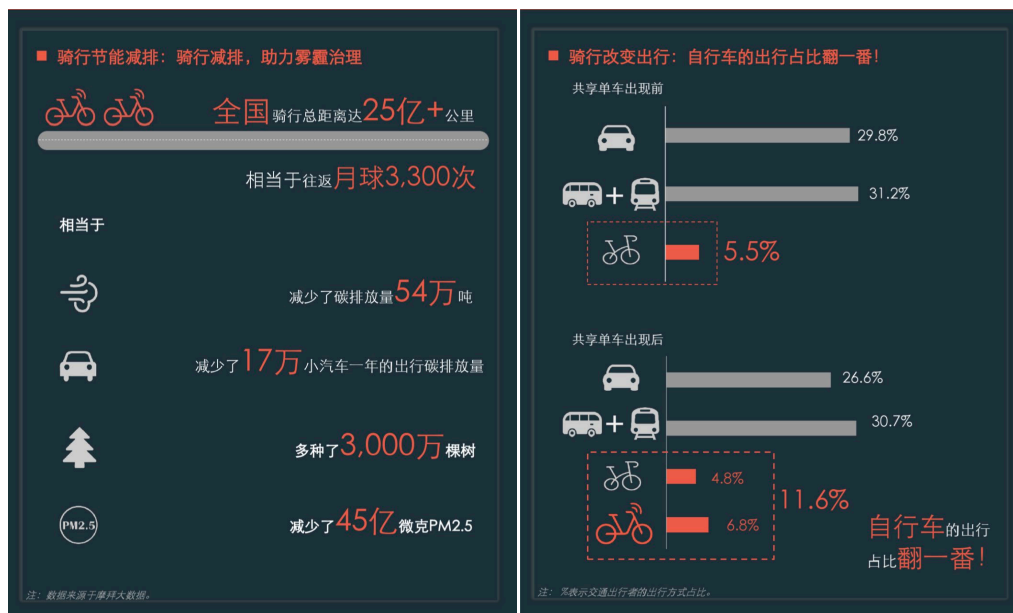
The dock-less bike sharing in China has seen a rapid expansion since 2015 with the development of innovative technologies. There are furious competitions between the bike sharing and the public bicycle sharing, and between bike sharing startups in China. Among many bike-sharing startups, Mobike and OfO enjoy the largest market shares currently. The dockless bikes are equipped with GPS and other innovative technologies, which collect big data from bike usage to help achieve intelligent scheduling through improved optimization algorithms⁹⁷.

The bike-sharing boom provides residents with a ‘smart’ alternative for short urban journeys, which is conducive to low-carbon and sustainable urban development. According to *the 2017 White Paper: Bike-sharing and the City*⁹⁸ published by Beijing Tsinghua Tongheng Urban Planning and Design Institute and Mobike, the proportion of bike rides in the most popular modes of urban transport (i.e. cars, buses, the metro and bike rides) had increased by 6.1% (from 5.5% to 11.6%) in 2016 since the introduction of bike sharing in 2015. The total distance of the nation-wide bike ride had reached 2.5 billion kilometers, which contributed to reducing 540 thousand tons of carbon emissions (Figure 27). Bike sharing, to some extent, had reduced car dependency, with the proportion of journeys by car in the most popular modes of urban transport decreased by 3.2% (from 29.8% to 26.6%) over the same period of time.

Figure 27 Bike Sharing Changes Urban Mobility and Contributes to Reducing Carbon Emissions

⁹⁷ Wen, S. (2018) Research on Innovation in Holistic Governance for A More Effective System of Urban Bike Sharing Supervision, *E-Government*, 04, pp.21-31.

⁹⁸ <http://www.fietsberaad.nl/?lang=en&repository=White+paper+2017+Bike-sharing+and+the+City>



Source: Beijing Tsinghua Tongheng Urban Planning and Design Institute and Mobike (2017)
2017 White Paper: Bike-sharing and the City.

3.5 Smart Urban Governance

3.5.1 Overview

To effectively implement and design strategies for sustainable urban development, new collaborative governance processes involving private and public stakeholders are called for. Enabling technologies, big data and ‘real time’ action offer new ways for innovative and smart urban governance and management. Multiple information sources are nowadays easily available for urban decision making, while appropriate tools and methods are required to consolidate and synthesise them. The JPI UE project **UrbanData2Decide** processed information from public social media and open data libraries to develop a decision support system for urban governance. At the same time digital technologies and social media support participatory planning and governance. Another JPI UE project **Incubators for Public Space** embedded such new technologies in participatory planning processes to allow all stakeholders to contribute to urban planning. The project implemented Urban Living Labs in London, Brussels and Turin. In China, e-governance services are implemented in many cities. 80 Chinese cities have been involved in ‘Information-for-the Public’ pilot projects, which aim to set up online e-governance service platforms. The Smart Urban Governance approach of **Weihai City** aimed at tapping the potential of smart technologies by fostering institutional change, capacity building in public administration and socio-technological innovations.

3.5.2 Case Studies in Europe

JPI UE Project UrbanData2Decide

The UrbanData2Decide project aims to extract and process information from two sources, public social media and open data libraries. The aim is to develop new methods to combine existing big data pools and expert knowledge into one optimal framework to support holistic decision making for urban management.

Every day, hundreds of decisions are taken in a municipality. These days, urban decision makers are faced with both unprecedented challenges as well as new opportunities as the environment around them grows ever more complex. However, sources with the potential to be important to decision-making have so far remained largely untapped. UrbanData2Decide provides answers utilizing the increasing amount of data.

UrbanData2Decide started in 2014⁹⁹ and seeks to create the tools needed to react to and make decisions in the digital age. The extracted and processed information from social media and open data sources combined with advice from expert panels, is used to support local governments in their move towards a holistic, sustainable and well-founded decision-making process which considers the views and perspectives of all relevant stakeholders. The challenges include gaining a better control of data, broadening the data available and creating more awareness regarding positive effects of open data and other data sources. In practice this is done by gathering the data, analyzing it and then visualizing it. The case study conducted in the city of Vienna presents ten examples on how the UrbanData2Decide decision support tool could be leveraged in ongoing and future projects.

The structure of UrbanData2Decide

The project is in the context part divided into three sub groups: domain, stakeholder and spatial level, raising among other things data ethics, the data needed and the access type. In the visualizing a spectrum of different ways of showing the data in an easy and understandable way has been created. The last part of UrbanData2Decide is the key target of decision making: the actors, the method, involvement of experts and the technical solutions for that but also frequency, level and the duration are elements in the process.

- We can see a move towards the use of 'data science' in city contexts as a way of informing decisions, and I think our research fits into this trend. “The ideal outcome is that we get better data to policymakers which allows them to make better decisions” says Dr Jonathan Bright, Senior Research Fellow at the Oxford Internet Institute at the University of Oxford.

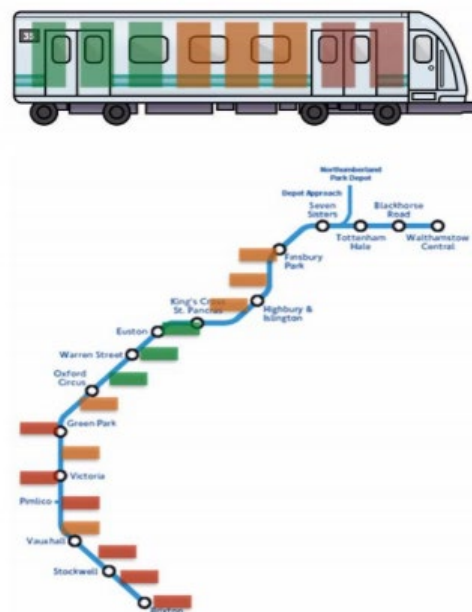
The project leader, SYNIO specializes in researching and engineering novel ICT-based

⁹⁹ <http://www.urbandata2decide.eu/wp-content/uploads/deliverables/UrbanData2Decide-D1.1-Kick-off-Meeting-Report.pdf>

solutions applied to data analytics and information visualization. The focus of SYNIO was situational awareness, what is happening in a certain city and solutions for problems encountered were investigated, and some of them were selected for development: trend monitor (i.e. text-based analysis of social media and online media such as newspapers, blogs), a visual monitor (images, videos), organisations' streams (social streams), and open data maps. The University of Copenhagen focused on images and in particular those from Instagram.

The City of Copenhagen took part in the project as part of the city's aim of trying to make data available to the public in order to make the citizens better informed, and to enable dialogue. The case study conducted in the city of Copenhagen focuses on municipal spatial planning, including information on how decisions are made for a longer period in collaboration with the citizens.

Figure 28 UK04 London Underground Crowding Indicators



Another example on how these kinds of urban data can be used are the train signal data demonstrator for the London Underground (goingunderground.herokuapp.com) by the Open Data Institute. Signal graphs visualize the development of train data over time and allow comparison between multiple sensor data sets. The data is the base for the visualization of train carriage occupancy levels for upcoming trains at specific stations at specific times for the Victoria Line.

Figure 29 Vision of integrated data visualisation and decision-making solutions to forecast and manage complex urban challenges



*UrbanDataVisualiser and UrbanDecisionMaker*¹⁰⁰

Building on the broad data collections in the form of social media content and open data sets, the UrbanDataVisualiser aggregates, structures and visualises this data using a multi-layered and multi-dimensional approach. The framework extensively uses data mining, sentiment analysis and visualisation techniques and leads to the development of a proof-of-concept demonstrator to showcase the information using intuitive and clear dashboards. For the development of the UrbanDataVisualiser a report on different tools in the countries was written, showcasing different ways of monitoring and visualizing data and the use of different data sources, and making an overview over the tools and the sources used. Here the project also gives an overview over the different data types and the accessibility of each of them.¹⁰¹ The Open Data Institute developed the visualization tools and examples.

– They developed different ways and methods to visualize, which you could use yourself, “you could see how you can do it with different forms of visualizations in order to make it easier to understand the great amount of data” says Per-Olof Hallin, Malmö University and one of the project participants.

The tool UrbanDecisionMaker on the other hand integrates external experts and advisors using scientific multi-round expert integration methods and tools such as the Delphi method, a structured communication technique, developed as a systematic, interactive forecasting method which relies on a panel of experts. It features among other things the tools Expert Integrator, Collective Deliberation Tool and Expert Pool.¹⁰²

The result of UrbanData2Decide shows the need to develop visualization tools and the project has been able to test several prototypes. Results from these tests have been used in projects such

¹⁰⁰ <http://www.urbandata2decide.eu/wp-content/uploads/deliverables/UrbanData2Decide-D3.1-UrbanDataVisualiser-Report.pdf>

¹⁰¹ <http://www.urbandata2decide.eu/wp-content/uploads/deliverables/UrbanData2Decide-D3.1-UrbanDataVisualiser-Report.pdf>

¹⁰² <http://www.urbandata2decide.eu/wp-content/uploads/deliverables/UrbanData2Decide-D3.3-Interface-Design.pdf>

as urban safety and security.

- The result in our case was that data is not being used, there is no policy on how to work around it and there are no good methods. “This is partly because people are not used to working with these kind of data sources and there many different actors” says Per-Olof Hallin.

- We are in an experimental phase where lots of cities are trying lots of different things with data, and my recommendation would be to be open to this type of experimentation at an institutional level: allow your staff to work with data, get access to it, play around, and try and develop useful tools. “This kind of 'start-up' culture has historically been very difficult to develop in a local government context (at least in the UK) where budgets are very strained and there is a high fear of failure” comments Jonathan Bright regarding recommendations for others.

UrbanData2Decide has served as an inspiration for other projects when developing methods for data collecting and sharing, for example, in the making of joint overviews over situations between different stakeholders such as public offices and private companies, for example city councils and property owners. UrbanData2Decide has been instrumental in creating processes for teaching and the development of shared views regarding data as part of developing cities.

UrbanData2Decide – Integrated data visualisation and decision making solutions to forecast and manage complex urban challenges

Duration: 2014–2016

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Partners: University of Oxford, Oxford Internet Institute, Malmö University, Open Data Institute, IT University of Copenhagen, Software Development Group, ZSI Centre for Social Innovation, SYNYO GmbH, Research and Development Department

JPI UE Project Incubators of public space

The Incubators of public spaces is a project that provides tools and means to enhance active involvement from local stakeholders in activities which seek to shape their local environments. Incubators addresses ways to harness the power of new technological possibilities and integrate them within co-creative urban planning and governance, which includes a plurality of stakeholders in the making of vibrant public spaces. Incubators of public spaces allows local stakeholders to go online or join a public meeting, and easily shape their own scenarios for their local area, with clear and simple 3D models of spaces. They can stroll around or freely fly

through their environment and transform their surroundings, exploring and making changes. Then, crowdfunding is the scenario to provide their support.

Embedding new technology in participatory planning processes

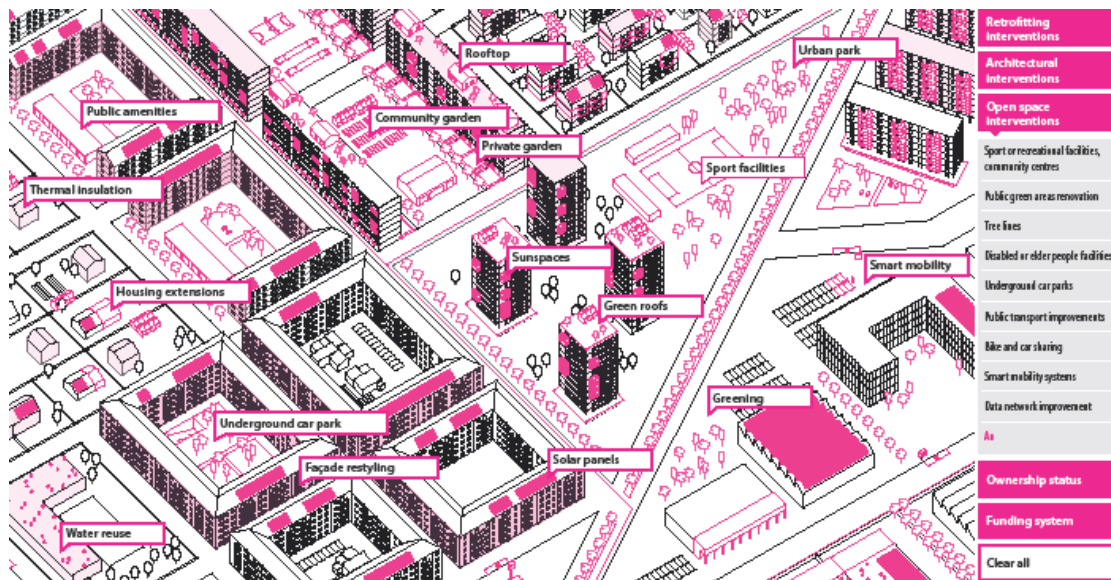
New developments in technology from Artificial Intelligence (AI) to online web interfaces, ‘dashboards’ of urban performance and visualizations of development proposals, have unleashed great potential for users of the built environment to play a more active role in interpreting and proactively shaping their built environments. These developments not only pose technological challenges – in terms of design and management of human-computer interactions – but also raise questions of how those technological challenges are bound up with the aptitudes and inclinations of different kinds of user. Hence, they raise questions such as ‘who is best able to make the most use of these technological processes?’, and ‘how best they may be embedded in specific participatory planning processes?’.

Online platforms and scenarios

Incubators is an ambitious international research project funded in JPI Urban Europe’s second pilot call (2014–2017) led by Politecnico di Torino in cooperation with Innovation Service Network GmbH (ISN), Katholieke Universiteit Leuven, Neurovation GmbH, University College London and the City of Torino.

Incubators aims to support the self-organisation of places and communities, enhancing the factors that motivate, encourage and enable urban actors to reach a common understanding. This will create space for coordinating actions by reasoned argument, consensus, and cooperation rather than simply relying on top down strategic thinking. The means to this goal are information and communication technologies which empowers actors to advance their co-creation capabilities of urban space.

Figure 30 Example of a scenario generated in one of the case studies



For this purpose, the project developed and applied an online platform. The online platform allows public users to access information about the site, and to remotely and interactively make innovative proposals for interventions in the urban fabric (for example, adding anything from a bench to a whole park; or in principle, moving existing elements around) all visualized in 3D scenarios. Scenarios present a coherent overview of the interventions of various scales and budgets that can be flexibly bespoke and implemented on demand, giving the community the capability to control its own progress and ‘mold’ its own place.

An important part of the project was to develop a system – a taxonomy – to transfer conceptually the knowledge about the domain of urban space into a hierarchical and interrelated semantic structure with relevant concepts, elements and their mutual relationships, providing explicit and unambiguous definitions.

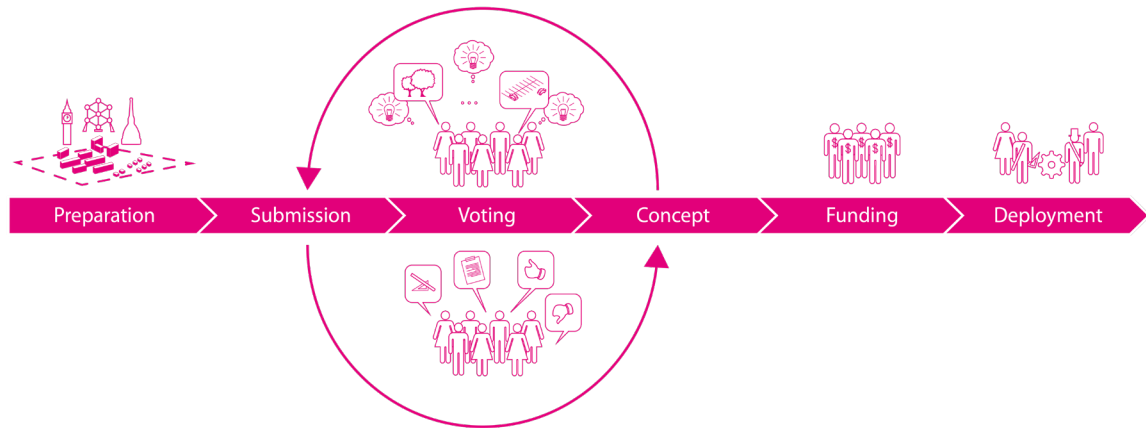
Crowdsourcing ideas and crowdfunding projects

Open innovation and crowd technologies were another feature of the project. In the last few years crowdfunding has become a promising tool for generating funds not only for private projects, public organisations or start-ups, but also for urban areas. Besides the acquisition of financial resources, crowd-related activities offer several added values regarding innovation aspects and risk management.

The project has implemented a software platform for crowdsourced and crowdfunded placemaking that allows the crowd to be activated throughout the whole innovation process (see Figure 31), crowdsourcing ideas by inviting a wide target group to submit their ideas in response to a defined challenge, to provide feedback on project ideas, or to vote for the best ones. Ideas that have been evaluated successfully in the first phase are further supported for promotion on an appropriate crowdfunding platform. Thus, the realisation of a collaboratively

developed new project is supported by the crowd both by gathering the relevant know-how and raising funds.

Figure 31 Overview of the Crowd creativity and Crowdfunding Process



Urban Living Labs in London, Brussels and Turin

The project's methodology and technology has been tested in urban living labs in three cities. Each living lab had the opportunity to unfold in its own particular and context-based configuration that could best support the local self-organisation of places.

The London case study is focused on an existing 14 ha housing estate, the Pollards Hill. The Brussels living lab is located at the Josaphat site, consisting of a 30ha large area currently planned to be transformed into a new sustainable neighbourhood. The Josaphat site, as such, forms an interesting case for experimentation on how the Incubator tool can support the current and future uses of Josaphat and the inclusion of the aspirations of the citizens as well as the public stakeholders.

The Turin living lab is focused on the regeneration of Quartiere Mirafiori Sud a social housing neighbourhood of high-rise apartment buildings built in the mid-sixties which totals about 2700 dwellings and 6000 inhabitants. Through design workshops and other living lab activities local stakeholders have been engaged in the definition of collaboration and self-organisation scenarios for the rehabilitation of public spaces and buildings.

The digital platform is ready for implementation

Experiences with the Incubators methodology in the Brussels, London and Turin cases have been promising. "It seems the taxonomy triggers discussions and helps explicating ideas. Allowing stakeholders to shape their own scenarios in 3D models proves to be a promising approach that enhances the understanding among lay people and thereby their capability to contribute to the shaping of their local communities," says Luca Caneparo, Researcher at

Politecnico di Torino, Italy. Luca Caneparo continues by saying “Testing the design platform and the taxonomy of objects has brought insights in the variance in how stakeholders understand objects in a map. There are differences across countries which implies that the tool needs to be tailored and adapted to different countries”.

The digital platform is in principle ready to be scaled up from the pilot cases and to be employed in other projects at a neighbourhood level, however legal property rights are a barrier for wider spread of the tool at the moment.

Incubators of public spaces

Duration: 2014–2017

Internet: www.jpi-urbaneurope.eu/incubators

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3.5.3 Case Study in China

Introduction

Similar to the concept of smart city, fragmentation exists in the concept of smart city governance. But it is widely agreed that smart city governance is not merely a technological issue, as technologies themselves are not likely to make a city smarter; fostering a smart city requires a political understanding of the technologies. Thus, smart urban governance is rather a complex process with institutional change and the acknowledgment of socio-technical governance and about creating new forms of human collaboration by using ICTs to achieve better outcomes and more open governance¹⁰³. The synergy between social structure and new technologies has been the focus of e-government research over the past decades, with a special emphasis on investigating how new technologies could be used to improve the quality and effectiveness of government¹⁰⁴.

In China, progress and institutional breakthroughs have been made in smart urban governance in the past few years, with the application of more advanced information and network technology. ‘Internet+’ has transformed urban management model and service provision and delivery models in a profound way. Smarter ways to manage population and monitor urban

¹⁰³ Meijer, A. and Bolívar, M (2016) Governing the Smart City: A Review of the Literature on Smart Urban Governance, *International Review of Administrative Sciences*, 82(2), pp.392-408.

¹⁰⁴ Gil-Garcia R (2012) Enacting Electronic Government Success: An Integrative Study of Government-wide Websites, Organizational Capabilities, and Institutions. New York: Springer.

road networks and the smart emergency response system are among the typical examples of smart urban governance.

So far, 80 cities have carried out the ‘Information-for-the Public’ pilot projects. The e-governance has increased government efficiency. The online service platforms introduced in Shandong, Zhejiang and Guangdong provinces have helped innovate and improve government services and transparency and law enforcement supervision in those cities.

Case Study - Smart Urban Governance in Weihai City¹⁰⁵

Weihai City set four major objectives when it started on its smart journey in 2013, three of which are closely related to smart urban governance, i.e. improving information infrastructure, enhancing governance capacity and providing, and managing public services in a more efficient way to improve people’s livelihoods (the fourth one is stimulating urban economic development). The city has implemented various projects since then. The following are main focuses and achievements that are relevant to smart city governance.

a) Integrating Departmental Resources to Realize E-governance. The city has invested 13.5 million Yuan in a cloud-based e-governance system, installed 98 fiber optic links and integrated over 150 computer cluster and server devices in its governmental departments. It has achieved uniform technical platform, computing and storage, integrated internal and external networks, and uniform security protection, and operation and maintenance in over 200 governmental departments.

b) Improving Governance and Public Service Delivery through E-Government. An integrated online system has been established in the city to improve the effectiveness and efficiency of its governance and public service delivery. The system includes a web portal for public service provision and information sharing¹⁰⁶, which can be accessed by citizens via PC, mobile phone, pad and digital TV; and multi-application citizen cards, by using which citizens can access smart community, healthcare, education, transport and mobility, tourism and cultural services.

c) Introducing Smart Traffic Management to Reduce Congestion. The city has established a smart management and control platform and eight application systems to real-time monitor road traffic, integrating weather and other related data, automatically recognize key vehicles and report, and release traffic information on major road junctions every 5 minute. This has

¹⁰⁵ http://www.whoic.gov.cn/art/2018/3/14/art_6864_1163457.html

¹⁰⁶ http://www.whsmwy.com/wh_portal/

reduced the average waiting times during morning and evening peak hours of workdays in central districts of the city.

d) Establishing the Smart Urban Construction Profile. The Profile includes an underground pipeline information system, urban construction filing system, onsite surveying data collection and project data collection system. It contains 967 files of 73 construction projects, covering 13,994-kilometer pipeline data of 96 Gigabits, covering six vertical sectors such as water supply, sewerage, gas, heating, electricity and telecommunications.

e) Realizing Smart Water, Heat and Power Supply Management. The city has established a digitized water supply pipeline platform as well as water supply and sewerage coordination system to share information with other pipelines such as thermoelectricity, telecommunications and gas, and to realize onsite data real-time collection, automatic alarming and emergency coordination. Besides, it has established a smart power supply platform, realizing automatic collection of electricity usage data and automatic calculation of the electricity bills of 1.31 million clients; and established an integrated smart power supply service system, consisting of the photovoltaics micro-grid energy storage system, light guide illumination system, energy saving lamps, smart power utilization service system, electric vehicle charging piles and energy efficiency services for residents. Furthermore, the city has established a smart heating management platform by upgrading 12,880 electric control valves in corridors of buildings and installing 330,000 indoor temperature control valves. This has reduced energy consumption by 27.6%, achieving the digitalization of heat metering, smartness of energy saving minoring and grid-based government supervision.

Chapter Four: Conclusions

The Conclusions section is intended to identify potential areas and ways of collaboration between Europe and China in sustainable urban development by analysing similarities and differences based on the good practices that are presented in this report. The good practices are selective rather than exhaustive, which represent, to some extent, related projects that have been funded by JPI UE and represent the sustainable urban development landscape in China.

The similarities in sustainable urban development between Europe and China are largely due to common urban challenges that both sides are facing. The differences are caused by different levels of urbanization, stages of socio-economic development as well as different approaches to governance and sustainable urban development between the two sides in general. The following two main differences can be determined from the cases investigated:

- ***Different Scales and Ways to Scale up.*** In general, the European side has implemented more sustainable urban development projects in European cities on the project scale, which focuses on testing frameworks, approaches and /or innovative technologies and on the rollout of the already tested and approved demonstration projects. While the Chinese side has made more efforts on the city scale, which puts more emphasis on implementing projects concerning sustainable urban development in pilot cities and selecting and involving more eligible cities to start related projects.
- ***Different Ways to Engage the Public.*** Different ways have been witnessed on both sides in public engagement. According to the cases reflected in the report participatory approaches and co-creation methods are more strongly applied in European projects than the projects in Chinese cities. This may be due to the different governance approaches, a more top-down approach in Chinese cities, compared to a mixed model of top-down and bottom-up approaches in European cities.

Besides those differences in scale and policy and governance approaches the cases very well demonstrate that urban transitions requires integrated approaches and the involvement of different actors and stakeholders. In principle the following three main elements are key for driving sustainable urban development:

- Availability of new technological solutions or social innovations that help to tackle a specific urban challenge
- New governance models as well as capacities and expertise in public administration fit to take highest advantage of such new technological and social opportunities and to create frameworks for urban transitions

- Mobilisation of citizens to create awareness of new approaches and solutions, drive behaviour change and support uptake of new solutions through early involvement in urban planning and local development

According to this, efforts are needed on all scales and of all stakeholder groups to achieve sustainable urban development and research and innovation can strongly support these. To deal with this complexity, experimental settings on local or city level can help addressing specific challenges, through local pilot projects or living labs, allowing all stakeholders to cooperate, co-create, engage in urban development actions. Through this evidence can be created for good practice and conclusions can be drawn for wider implementation, including new policies, partnerships or business models. The examples given in the report highlight the potential of such multi-stakeholder approaches and create interesting references for further exchange between European and Chinese actors.

As sustainable urban development is a complex, long-term process, no single stakeholder can achieve the goal alone. Rather, it requires the collaboration between various stakeholders, such as cities, businesses, universities/research institutes and financial institutions. As the two sides are different in the above-mentioned aspects, it could be worth exploring each other's market by better understanding local knowledge and needs.

- In general, the Europe side could provide Chinese cities with sustainable urban development framework and experiences (in related areas such as open data and urban living labs) by sharing its already tested and approved demonstration projects in collaboration with Chinese key stakeholders.
- China has a huge market with enabling environment for innovation and could provide information and network technologies and physical infrastructure construction in European cities where needed in collaboration with European key stakeholders.
- Partnerships may be needed to mobilize and integrate resources from the key stakeholders on both sides.
- Given the fields of action and work of JPI UE and CCUD in Europe and China mentioned earlier, it could be helpful for the two organisations to play a facilitator role on each side. Suggested ways of cooperation may include, but not limited to the following: conducting cooperative projects involving key stakeholders from both sides, with European and Chinese cities as demonstrator and/or observer cities; and organising events to gather expertise of European and Chinese experts and key stakeholders to better understand local knowledge as well as exchange ideas and experiences that could be transferable and adapt to other local contexts.