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**SMART-ECO CITIES IN CHINA:
TRENDS AND CITY PROFILES 2016**

JANUARY 2017

SMART-ECO CITIES IN CHINA: TRENDS AND CITY PROFILES 2016

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smartecocities

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INTRODUCTION

THE SMART-ECO PROJECT

This report forms part of a series covering France, the Netherlands, Germany, and the UK, and draws on preliminary findings from a three-year (2015-2018) research project titled *Smart Eco-cities for a Green economy: A Comparative Study of Europe and China*. The project is being coordinated by the University of Exeter, in collaboration with an interdisciplinary team of researchers from King's College London, the Universities of Westminster, Plymouth and Cardiff (UK); TU Delft and Utrecht University (the Netherlands); the French Centre for Scientific Research (CNRS) and the University of Toulouse (France); Freiburg University (Germany); and the University of Nottingham Ningbo China. As well as being funded by the National Natural Science Foundation of China (NSFC), the research is supported by the national funding agencies of the Netherlands, France, Germany, and the UK.

The focus of our research is on the 'smart-eco city'. The 'smart-eco city' concept captures the recent trend for future-oriented urban development schemes that display both 'green' and 'smart' ambitions. More precisely, the smart-eco city is defined as "an experimental city which functions as a potential niche where both environmental and economic reforms can be tested and introduced in areas which are both spatially proximate (the surrounding region) and in an international context (through networks of knowledge, technology and policy transfer and learning)". The idea of the 'experiment' in this definition consciously refers to recent work identifying a tendency

for new urban technologies and ways of working to be trialled at a limited scale, often through cross-sectoral partnership approaches, and with the aim of learning lessons, where traditionally firmer policy commitments might have been expected (see eg: Bulkeley & Castán Broto 2013; Karvonen & van Heur 2014; Evans *et al.* 2016). The concept of the 'niche' is taken from the expanding field of 'socio-technical transitions' scholarship, which studies the processes through which innovations come about and are taken up in society more widely (for an introduction, see eg: Geels 2002; Kemp *et al.* 2007).

Each of the national reports in this series profiles a series of cities, selected on the basis that they have relatively substantial smart-eco ambitions and/or activities already taking place. This selection was made following a wider 'horizon scan' of smart and eco initiatives taking place in each country (see this report's Appendix for the method adopted in China). The intention is not to promote the profiled cities as necessarily representing the 'best practice' examples in the field, but rather to illustrate the variety of 'actually existing' smart-eco cities in each country. The profiles provide a contextual overview of each city's aims, relevant policies, and the key actors involved, along with short descriptions of some of the main activities or projects taking place on the ground.

FOR MORE INFORMATION
ON THE SMART-ECO
RESEARCH PROJECT, AND TO
DOWNLOAD THE OTHER

REPORTS, PLEASE VISIT OUR
WEBSITE: [WWW.SMART-
ECO-CITIES.ORG](http://WWW.SMART-
ECO-CITIES.ORG).

THE CHINESE SMART-ECO LANDSCAPE

Since 2008, the Chinese government, recognising the need to reduce carbon emissions and mitigate climate change, has adopted the new concept of eco/sustainable city. Since then, the development of such cities has been supported by the National Development and Reform Council (NDRC). They are in charge of piloting eight locations for low-carbon initiatives throughout China, and these include cities such as Tianjin, Chongqing, Xiamen, Hangzhou and Shenzhen (Cales 2014).

The new eco/smart city initiative in China is very much centrally (Beijing) and nationally driven. In November 2012, the Ministry of Housing and Urban-Rural Development (MOHURD) promulgated a 'Notice on carrying out national pilot smart cities' and delegated city governments to formulate plans on 'interim measures for the administration of national pilot smart cities' and pilot index system for national smart cities (districts and towns) (China Academy of Information and Communications Technology, EU-China Policy Dialogues Support Facility II 2016). The main focus of this national policy is on:

1. security system and infrastructure
2. smart construction and liveability
3. smart administration and service

4. smart industry and economy.

In January 2013, the first batch of national pilot smart cities – 90 in total including cities at municipal, districts, counties and towns level – was launched. In April 2014 and 2015, the second and third batches of 103 and 277 pilot smart cities were launched. In addition to these new pilot cities initiative, on 16 March 2014, the Chinese government announced the new National Urbanisation Plan (2014-2020) with six major directions for smart city development (with five new factors listed as: new industry, new environment, new mode, new life, and new services):

1. broadband information and communication network
2. digitisation of planning and management
3. smart infrastructure
4. convenient public services
5. development of modern industry
6. meticulous social government.

At the same time, in August 2014, the National Development Reform Council (NDRC) also released the 'Guiding advice on promoting healthy development of smart cities' to provide clearer guidelines, and aid the coordination and exchange of best practices.

CHARACTERISTICS OF LOCAL GOVERNANCE IN CHINA

Chinese smart-eco cities are mainly promoted by local governments, which are well-known for their entrepreneurial

behaviour in strategically implementing central policies or innovatively initiating their own local development projects. We

identify four main characteristics in China's local governance as overall institutional backgrounds before we examine the operations and effectiveness of each selected smart-eco city initiative in the main body of this report.

FRAGMENTED AUTHORITARIANISM

The post-socialist Chinese system is better understood as a 'fragmented' authoritarian regime. On the one hand, due to the one party control, China remains necessarily authoritarian, compared with most western countries. On the other hand, since local authorities have powers to negotiate and bargain with the centre, such authority is nevertheless highly fragmented rather than unified. As a consequence, different central government Ministries may stipulate various related but different smart and eco policies, creating greater political space for sub-national local governments to apply or compete. This is one important reason why most Chinese cities have more than one type of smart and eco project.

UPWARD ACCOUNTABILITY

Under the context of the Chinese Communist Party's (CCP) party-state authoritarian regime, where local leaders are not elected by people but assigned by their upper-level governments, those leaders seeking to further their careers are most likely motivated to follow the CCP's performance-based personnel evaluation system. In general, local leaders are assigned to accomplish certain targets from upper-level authorities. Those cadres who accomplish targets and even outperform among same-level counterparts in the period of their tenures under their jurisdictions will have more opportunities for political promotion. In other words, the

performance of smart and eco cities is closely related to whether there are any assigned smart and eco targets from upper-level governments to evaluate top local leaders.

FISCAL RECENTRALIZATION WITH LOCAL LAND FINANCE

1994 tax reform package established a tax-sharing system and centrally-controlled local tax agencies, and therefore most large, stable tax sources have been under the control of the central government ever since. However, at the same time, there was greater decentralization of social obligations, such as education and social welfare. This imbalance between the centralization of tax power (*caiquanshangjiao*) and decentralization of public obligations (*shiquanxiafang*) developed into a crisis that forced entrepreneurial local governments to seek alternatives for local economic development - collecting money from lands under their jurisdictions. Given that the 1994 tax reform did not include land lease fees payable to central coffers, local governments seized this opportunity to expand local extra-budgetary revenue (*yusuanwaicaizheng*) through land finance. And this is a main reason why Chinese local governments are so keen to develop new towns at the outskirts of cities in the name of smart and eco projects.

The trends in eco and smart city development have evolved over time. There is a significant focus on green and low carbon living and user-friendliness for the general public, emphasizing the development of e-services and mobile applications. Learning lessons from the earlier lack of coordination between the different cities and levels of governments, there has been a trend of top-down delegation. We have also recently seen

more regional development in terms of provincial collaboration, such as the South Jiangsu Smart city cluster, and the Zhejiang 3+X model (3: ministries, provinces and municipals; X: special smart apps).

Last but not least, there has been increasing international cooperation such as the EU-China Smart and Green City Cooperation with 15 pilot cities from each

side working to develop a smart city assessment framework. The UK signed an agreement with the Chinese government to pair Manchester with Wuhan and Bristol with Suzhou as partners on smart city development. Other prominent eco/smart projects developed through international collaboration include Tianjin Eco city, and the Sino-German Ecopark in Qingdao.

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CHENGDU

Author: Shiu-Shen Chien

Chengdu, located on the east side of the Sichuan basin, is the capital of Sichuan province with a sub-provincial administrative status. Its economic and administrative autonomous power is higher than other prefectural-level cities and ordinary provincial capitals. As the major city on the 1,600,000 km² Sichuan basin, the biggest basin in China with a major area of agricultural production, Chengdu has the typical urban-rural dual structure. Thus, the question of how to better make urban-rural integration has become one of the main concerns in smart-eco construction. Besides, as one of the major cities in western China, Chengdu is seen as the engine city of the policy of Development of the West Regions (*xibudakaifa*) and has attracted plenty of investments as well as public construction projects, some of which are highly related to smart and eco projects.

For example, China Telecom, the biggest landline internet operator in China, built its new information centre as the main data hub, information security and call centre for Western China, in the Tianfu new district in Chengdu in 2011. Similarly, China Mobile, which controls a 70% market share of mobile services in China, also built a data centre in 2012 in Chengdu (equivalent to six billion CNY of investment). Furthermore, Chengdu has become the first western city in China to reach 100 thousand installations of Fiber-to-the-Home (FTTH). These relatively well advanced information infrastructure and facilities are important advantages for smart-eco development in Chengdu.

RURAL-URBAN INTEGRATION: SMART AGRICULTURE AND SMART CITY ADMINISTRATION

Facing the distinct urban-rural dual structure, the Chengdu municipal committee proposed development strategies to transform Chengdu into a “world modern garden city” in 2009, aiming to promote the integration of urban and rural areas and new district development projects based on the smart-eco city vision. Under the vision, interesting smart city projects that promote rural-urban integration have been implemented, and the development of the smart-eco concept was adopted in the Tianfu new district, the major new district development project.

As Changhong Lee (李長虹), the vice chairperson of the Commission of Urban Economy and Informatization of Chengdu, declared in a journal interview in 2013, the main goal of the smart city construction in Chengdu is to overcome the geographical divide between urban and rural areas, to mitigate the digital gap, to balance public services, and to promote urban-rural integration. Focusing on the rural area, many smart agriculture projects have been implemented in Chengdu, including an Agricultural IoT (Internet of Things), smart agriculture service platform (Chengdu Daily 2015), and an application to assist the aquaculture, facility agriculture and agro processing industries (Wisdom Shulan nd a).

A smart city administration system has also been established to mitigate some of the gaps in public service provision (Wisdom Shulan nd b). In the former city administration system, the monitoring of the function of public facilities, such as

streetlights and manhole covers, relied on inspection by individual officers within their duty grids or through a limited number of surveillance camera system. The smart city administration system aims to establish an inter-connected public service monitoring and administrative system, conceptualised

as ‘inter-sectorial top-down design’, and tries to eliminate delays in the detection and resolution of problems. Chengdu was given the 2015 Smart Public Service in Social Welfare award by the International Data Corporation.

EXAMPLES OF PROJECTS

TIANFU NEW DISTRICT: SMART-ECO NEW TOWN DEVELOPMENT IN CHENGDU

Tianfu New District is a development project located in the south part of Chengdu. Although the southern parts are mostly hilly lands, this ‘heading south’ planning strategy is beneficial for protecting the plains to the north and west of Chengdu, and its southern location is also thought to have more potential to connect with the Chongqing and Yangtze River economic belt. The project included a core new town development (Tianfu New Town) with a 650 km² planning area, of which 25.7% is designated for industrial use, 18.5% is residential, 14.2% for public facilities, and 14.8% for public green space, and with six major functional districts (see Figure 1):

1. Functional district of high-tech industries
2. Chengmei functional district of strategically emerging industries
3. Chengdu science town
4. Functional district of southern advantage industries
5. Longquan Functional district of high-end manufacture industries
6. Lianghuyishan (*Two lakes and one mountain*) functional district of international tourism.

Tianfu New District was planned and designed in line with smart-eco ideas.

According to the master plan approved in 2011, coverage of Fiber-to-the-Home (FTTH) here will reach 99%, and wireless internet will reach 95% by the end of the twelfth five-year plan (2011-2015). The new district has also attracted many large investments by information industries, including the information operation centre of the China Telecom.

The plan for the Tianfu New District also emphasized an eco-friendly approach. The project assessed capacity in land, ecology, and water resources, and included six major environmental monitoring and reduction programmes including: (1) industry control, which established environmental criteria to exclude polluting enterprises; (2) water pollution control, which collected and processed sewage and separated from the rainwater; (3) a waste disposal system, which collected, classified, and processed garbage to reduce and recycle waste; (4) air pollution control; (5) noise pollution control, and (6) electromagnetic radiation pollution control.

The plan for the transportation system in Tianfu New District follows the concept of “low-carbon TOD development”, emphasising expansion and improvements to public transportation. By building an integrated network combining trains with public buses as well as the pedestrian system as branches, the project plans to reach 50% capacity of total travel demand.

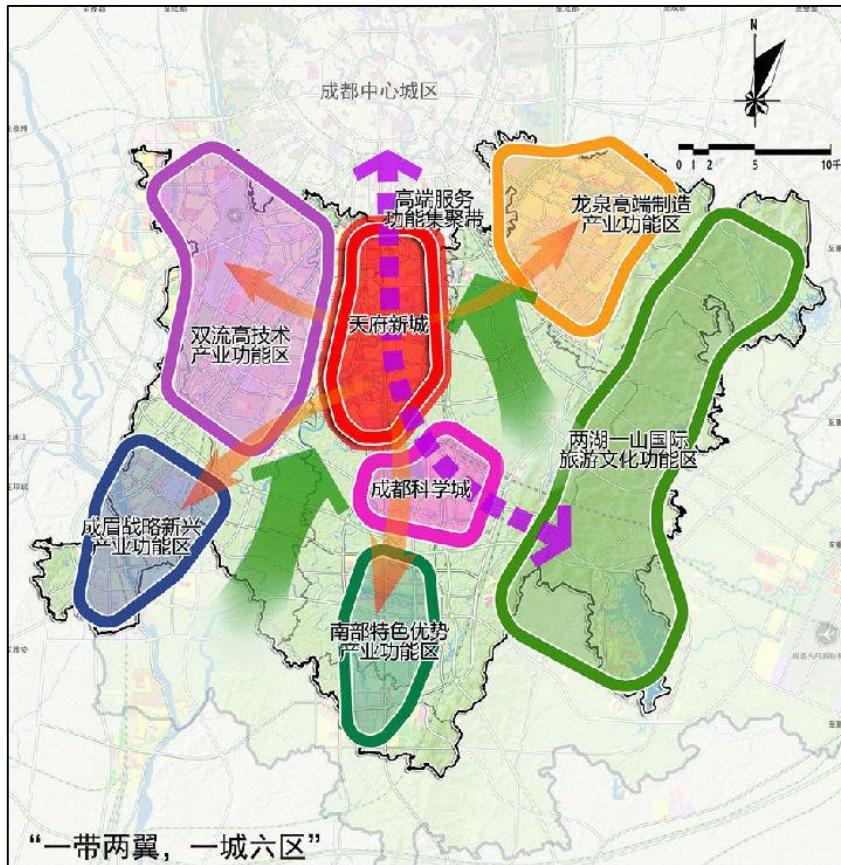


Figure 1: The spatial plan for Tianfu New District

Source: <http://www.cdtf.gov.cn/index.php?cid=46>

The plan for the transportation system in Tianfu New District follows the concept of “low-carbon TOD development”, emphasising expansion and improvements to public transportation. By building an integrated network combining trains with public buses as well as the pedestrian system as branches, the project plans to reach 50% capacity of total travel demand.

In addition, the plan for Tianfu New District also adopted the ‘sponge city’ concept, which enhances the capability of the city to soak up water and reduce floods during heavy weather. Several pilot sponge city projects have been implemented in the Tianfu New District, including Tianfu Park, the waterfront

landscape of Luxi River, and Xinglong Lake (Sichuan Tianfu New Area 2016). Meanwhile, a rainwater storage system has also been constructed to reduce flood risk and efficiently utilize rainwater (see Figure 2). By storing rainwater by lakes and ponds, the peak flow of extreme rainfall can be adjusted to a relatively harmless level, and the water storage can be further purified to serve the municipal water demand.

URL:

[HTTP://WWW.CDTF.GOV.CN
/INDEX.PHP?CID=46](http://WWW.CDTF.GOV.CN/INDEX.PHP?CID=46)



Figure 2: Rainwater storage system planning for Tianfu New Town of Tianfu New District

Source: Qiu (2014)

CHENGDU-BONN LOW CARBON CITY PARTNERSHIP

Chengdu-Bonn Low Carbon City Partnership forms part of the Sino-European Partnership on Low Carbon and Sustainable Urban Development. Other partnership examples include Shenzhen and Amsterdam in the Netherlands, and Shenyang and Le Havre in France. The Chengdu-Bonn partnership project, launched in 2012, focuses on sustainable tourism, drawing on the experience of the Sustainable Bonn project. Within this programme, particular attention has been paid to climate protection and sustainable urban development projects related to

district heating, electric mobility and building waste cogeneration plants where heat and electricity are produced simultaneously. Environmental organisations Germanwatch and E3G supported Bonn in entering into dialogue and exchanging experiences with counterparts from Chengdu in the form of discussion rounds, expert workshops and dialogue events.

Although the China-EU city-to-city partnership program is initiated with good intentions of cross-border policy learning and sharing, it will inevitably take time to assess the effectiveness of the partnership. Potential obstacles include: (1) whether the partnership can be equal or some partners

are superior to others; (2) whether the various documents produced can in fact be used to incorporate overseas experiences within city and urban development, so as to formulate different urban policies, and (3) whether further public participation processes (including with the private sector and non-governmental organizations) help consolidate city-to-city collaborations.



Figure 3: Webpage of Singapore-European Partnership on Low-Carbon and Sustainable Urban Development
 Source: <http://low-carbon-partnerships.org/en/home>



Figure 4: Webpage of EU-CHINA Low Carbon Economy Platform
 Source: <http://www.chinalce.eu/>

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FUZHOU

Author: Ali Cheshmehzangi

Very little has been written about Fuzhou in the English language literature on smart and eco cities, and yet it has been judged one of the ‘smartest’ cities in China in various surveys and reports. As early as 2001, Fuzhou already established the ‘digital Fuzhou’ slogan, with established committees and designated demonstration buildings. In November 2010, Fuzhou was

part of the Fujian province broader development plan to establish a ‘smart Fuzhou’.

Fuzhou is the capital of Fujian province, China, and is one of the main cities of south-eastern region of China. Fuzhou’s population was 7.2 million according to the 2011 census, of which nearly 4.5 million inhabitants are urban residents.



Figure 5: An app page for Fuzhou
Source: <http://fuzhou.scity.cn/>

Two key projects are described further below: the Fuzhou platform for social services, and the Cangshan district smart living initiative. There are no major smart or digital projects which explicitly prioritise eco or low-carbon city goals, as Fuzhou is relatively (compared with other major Chinese cities) unproblematic in terms of environmental quality and level of pollution.

The Fuzhou platform is a ‘digital city’ (closely related to smart city) project

operating city-wide, while the smart living project is at a small district level. It is unclear whether there is any scalar dimension stretch from the district-level project to city-level project: currently, there are no links between the two projects. Nevertheless, the start and ending dates of both projects do suggest a link between the initial city-level project and the later district-level demonstration zone. This is likely to be the case as both projects have

similar actors. The projects do not involve any international actors, but are mainly led by regional level actors (city and district levels) and national actors (for policies). The networks of actors are fairly unclear for the projects, since relatively little information is provided by the various relevant sources.

In the broader policy documentation, the transition of Fuzhou City from 'digital' to 'smart' is highly visible: while digital has been the key word in this city, smart is becoming more popular, and the current plan for Fuzhou is to develop from a digital city to a smart city platform. Proposed and current activities mainly relate to the development of platforms, apps and IT networks. These are small projects related to app development, infrastructure updates, etc., rather than large interventions into urban space. Meanwhile, there are no key eco or green initiatives

that can be considered as key drivers for transition to a more environmentally sustainable city.

Locally, Fuzhou's digital city and smart city initiatives are both defined as early cases of success in China. Globally, these projects have received very little attention, perhaps primarily because of the lack of international actors and collaborative partnerships. The main actors refer to the project as among China's top 10 first smart city projects. The available sources of information do not specify in precise terms what Fuzhou has achieved in terms of transitioning from a digital city to its current smart city status, or provide sufficient data on the smart city initiative to allow a satisfactory evaluation of its achievements. The case of digital city of Fuzhou remains noteworthy nevertheless, as a success story of an early model in China.

EXAMPLES OF PROJECTS

FUZHOU PLATFORM FOR SOCIAL SERVICES

This 'G2C' information exchange platform connects administrators, citizens, and private enterprises. The different stakeholders can use computers, hand-phones, self-service kiosks, family terminals etc. to access government information, conduct online businesses and services such as paying bills and fines, insurance etc. The project aims to provide one-stop government social services for all citizenry at the city level. There are other add-ons, such as digital maps at a district level, which are currently being completed.

The main actors of the project are city officials and Digital China, the largest private company in China specializing in IT services. The project is specific to the city's digital infrastructure at city level, with no

exact figures publicly available for the total investment amount. This fifteen-year long project started in around 2001 and was completed in 2016, as one of the early smart city initiatives in the country.

URL:

[HTTP://WWW.AFZHAN.COM
/NEWS/DETAIL/26797.HTML](http://WWW.AFZHAN.COM/NEWS/DETAIL/26797.HTML)

CANGSHAN DISTRICT SMART LIVING

Cangshan District government will digitalize the map of the Cangshan District. The project aims to improve the efficiency of urban planning and provide precise

information about locations and transportation for citizens, and also encompasses a mobile app providing access to government services.

The project appears to be at an early stage of development with few components completed. The current stage of development points out that the proposed map is not yet completed but the app is already completed. The completion of the app was in 2015 and the start date is recorded either as 2013 or 2014. Beyond this, however, very little official information is available about its progress.

The project is specific to a single component of infrastructure and transport-specific project with the district government as the key actor involved. There are no official figures available for the total investment amount dedicated to this specific project.

URL:

[HTTP://FZCANGSHAN.GOV.C](HTTP://FZCANGSHAN.GOV.CN/)

N/

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HANGZHOU

Author: May Tan-Mullins

Hangzhou is the capital and the largest city of Zhejiang Province in Eastern China, and the capital of the Hangzhou Metropolitan Area, with 21.1 million people. It is also a well-known tourist destination. Hangzhou is one of the 32 cities who have passed the Environmental Model City appraisal by the central government and one of the 13 pioneer provinces to initiate the eco-province development (Wong 2011: 139). An expected 20 billion RMB will be invested in making the city a Model Smart City.

Hangzhou released its smart city plan 2012-2015 with aims to digitalise the city for increasing living standard and competitiveness. Through the Smart City Movement, the government aims to "connect the city with technology and economic development", and "merg[e] the natural environment with cutting-edge technology for the benefit of a more sustainable development" (smartcityexpo 2013).

The Hangzhou municipal government also signed a Memorandum of Understanding with Singapore's Cleantech Partners Pte Ltd, a consortium of local firms, to jointly create a master plan to develop the Hangzhou-Singapore Eco Park (HSEP) in 2009. Estimated to cost between US\$1.5 billion and US\$2 billion, the 5-sq.-km HSEP will be located in the Hangzhou

Qianjiang Economic Development Zone in the northwest part of Jiangsu's Hangzhou Linping industry area (Xie 2009). It is mainly an industrial park for both Singapore and Chinese companies to showcase innovations of clean technology in China.

Another interesting initiative by the Hangzhou government is the White Horse Lake Eco-Creative City project, with a designated area of 20.5 sq. km. It involves 18 villages and a population of 52,000 people, and is located at the urban fringe of the city at Binjiang in the Hangzhou Hi-Tech zone (see Figure 6). It aims to create an innovative community in a rural setting with eco-living.

An ongoing eco initiative by the Hangzhou government which has become well known is the Xixi Wetland. The Xixi Wetland aims to become an epicentre for cultural and eco-tourism. There will be hospitality and tourism facilities, and public spaces carefully constructed with natural beauty in mind. The region will also install a network for walking and cycling in order to reduce the use of carbon-emitting transport means and eventually reduce carbon emission. Another green feature is the combination of major renewal sites and wetland ecology schemes that will dramatically reduce water demands and greenhouse gas emissions (igreenspot 2014).

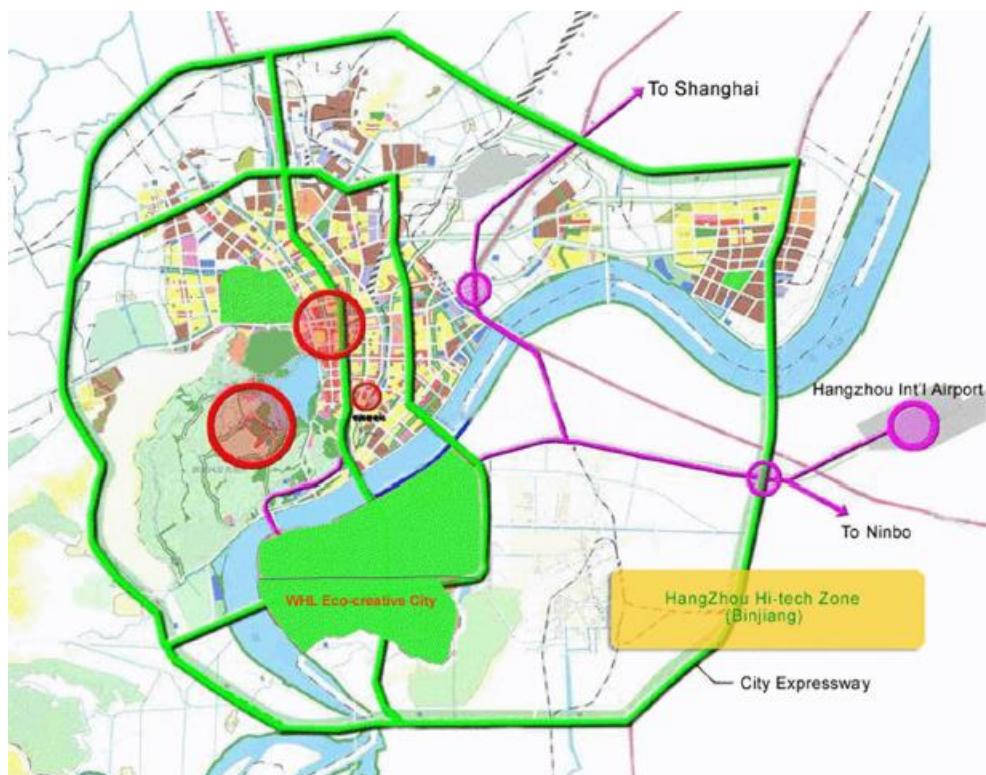


Figure 6: Location of the White Horse Lake Eco-Creative Park

Source: <http://www.hhtz.gov.cn/col/col870/index.html>

URLS:

<HTTP://WWW.96225.COM/SMKNET/SERVICE/INDEX.ACTION?RESULT=INDEXJSP>

<HTTP://WWW.FORESTRY.GOV.CN/PORTAL/XXB/S/2519/CONTENT-565955.HTML>

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KUNMING

Author: Shiu-Shen Chien

Kunming, the provincial capital of Yunnan, is located in the middle of the Yunnan–Guizhou Plateau at an altitude of 1,900 metres above sea level. With its perpetual spring-like weather which provides the ideal environmental conditions for humans and plants, Kunming is also called the Spring City. Economically, it has two major development zones (namely, Kunming High-Tech Industrial Development Zone and Kunming Economic and Technology Development Zone), which together underpin Kunming's status as an industrial hub for the Pan Asia Network connecting China with Cambodia, Laos, Myanmar, Thailand and Singapore via highways and high speed railways. In addition, the biggest company registered in

Kunming is Hongta Group, the most important provincial government-owned tobacco firm in Yunnan. The largest flower market in China is also located in suburban Kunming. These two examples also show Kunming's potential in agricultural industry. The territory of Kunming is 21,000 km² with its urban area covering 2,600km². The total population of Kunming is 6.2 million, with 4.5 million categorized as urban citizens.

Kunming released its ecological plan in March 2008 and proclaimed itself a green province with an equally green economy. Kunming is also one of the top ten cities in China in terms of its smart initiatives. On 10 April, 2016, Kunming hosted the China Smart City Innovative Forum to promote the national 'Internet Plus' strategy.

EXAMPLES OF PROJECTS

BROADBAND KUNMING PROJECT: INTERNET ACCESS AND 4G TO VILLAGES

Kunming is a trial point for the national project of "Broadband Village" (*kuandaixiangcui*) that aims to install wire broadband and wireless 4G infrastructure to rural villages. This Broadband Village project is part of the Broadband China (*kuandaizhongguo*) program initiated in 2015 by the State Development and Reform Committee, Ministry of Finance and Ministry of Industry and Information Technology. Yunnan and Sichuan are two pioneer provinces to experiment with this policy. The Kunming City Government signed a strategic cooperation agreement with China Mobile Kunming to facilitate the

Broadband Kunming Project in all 803 administrative villages.

The Broadband Village Project should be seen as both information technology policy and rural development and poverty reduction policy. Rural villages can develop and update their own databases of key services such as medical service, social security, human resource, job information and so on, which can provide convenience and benefits to villagers and administrators. In addition, with broadband and wireless signals covering up most rural villages, rural jobs, it is hoped, can be created and individual income can be generated through e-commerce businesses.



Figure 7: Policy goals and timeline for Broadband China

Source: http://www.gov.cn/jrzq/2013-08/18/content_2469352.htm

URL:

<HTTP://YN.PEOPLE.COM.CN/NEWS/YUNNAN/N2/2016/0907/C228496-28965225.HTML>

SMART KUNMING PROGRAM: ADMINISTRATION, LIVING AND INVESTMENT

The Smart Kunming program aims to improve Kunming's credentials as a business-friendly location in terms of smart administration, smart daily life experiences and smart investment choices through a coordinated and improved IT system. In cooperation with China Telecom, China Mobile and China Unicom, Kunming is keen to become a self-proclaimed model for China's smart city development in 3-5 years' time.

In the Telecom Planning of the Kunming Downtown Plan (2014 Kunmingzhongxin-

chengquidianxinguihua), constructions of telecommunication base stations are regulated in order to ensure IT and wireless signals are accessible by citizens and solve the problems caused by different private IT providers not being willing to share their infrastructure. The city government is planning to use the budget to build public telecommunication base stations. Also, as is the case for water, electricity and gas, the provision of IT access is mandatory in new government buildings, residential housing and business estate projects.

In addition, Kunming has been chosen as one of sixteen cities entitled as a policy experimental site for 'national-level low-

carbon transportation system construction (*Guojia ditan jiaotong yunshu tixi jianshe shidian chengshi*) by the Ministry of Transportation. A public bike system and a new energy public car and motor system have been provided in some public venues and resort areas. Smart taxi information management matches taxi drivers and potential passengers to save time for both

parties. Travel information is also available for taxi drivers, to help avoid severe traffic jams and reduce petrol consumption while searching for customers. In addition, free Wi-Fi is available on buses, and network-enabled GPS modules are also offered to collect ‘big data’ on travel patterns, for use in optimizing bus routes and other transportation planning.



Figure 8: Smart Kunming homepage
Source: <http://km.zhihuishequ.cn/>

In terms of private investment, Chenggong Information Industry Park also provides a special business environment to attract companies to produce smart-related products such as sensor equipment, GPS, and cloud facilities. For example, IT

firm Nantian invests in Chenggong to develop cloud computing and big data service. In addition, some IT-related companies are also investing in a smart-living community (Chien 2013).

Guangfucheng, a real estate property community in Kunming, is being constructed with many technological infrastructures, including a cloud computing centre and other state-of-the-art technologies. Local residents in Guangfucheng can check real-time positions of buses, pay water and electricity bills, purchase cinema tickets, reserve medical appointments, as well as monitor and remote-control home electronic appliances such as air-conditioners, refrigerators and security key systems.

One final note is that although IBM and Huawei both claimed to be technology partners in the project, IBM has made

华为打造智慧商业综合体



Figure 9: Huawei's plan for smart real estate development

Source: <http://www.jianshu.com/p/37f60acb0a00>

produced very little publicity about Guangfucheng in comparison with Huawei, which often uses Guangfucheng in its studies and marketing and promotional materials. Therefore, rumour has it that under China's special political and economic condition, it is state-owned companies like Huawei, rather than foreign giants like IBM, who are most likely to gain from such pioneer projects like Guangfucheng.

URL:

<HTTP://KM.ZHIHUISHEQU.CN/>

KUNMING-ZURICH COOPERATION FOR ECO DEVELOPMENT

Cooperation between Kunming and Zurich can be traced back to the early 1990s. In 1993, both city governments signed a Letter of Intent to cooperate, in public transportation first but then expanding to other urban affairs, and upgrading to the national-to-national (China-Switzerland) level later. In 2007, a Memorandum of Understanding was signed between The Swiss Federal Council and the Government of the People's Republic of China on Promoting Dialogue and Cooperation.

In the late 1990s, the Kunming-Zurich Cooperation Office for Transportation Planning was established. The office proposed a blue plan for modern public transportation in Kunming, which consisted of light rail, and downtown and suburban express bus networks. In 1997, with the help of Zurich experts, Kunming established a national bus lane system in the city centre, the first of its kind in China. The bus lane system soon became a model for many

cities to learn from. After 2010, Zurich experts also assisted Kunming in designing a new urban growth model based on transport-oriented development instead of traditional urban sprawl which is environmentally and economically inefficient. In 2013, Zurich experts also offered advice for urban anti-flood strategies for Kunming, including building new reserve tanks to be available in order to better capture and control rainfall. This strategy is similar to the sponge city policy recently initiated by Ministry of Housing and Construction. Other cooperation topics for eco urban development also include old town preservation, lakefront design and planning.

URL:

[HTTPS://WWW.EDA.ADMIN.C
H/COUNTRIES/CHINA/EN/HO
ME/SWITZERLAND-
AND/SDC.HTML](https://www.eda.admin.ch/countries/china/en/home/switzerland-and/sdc.html)

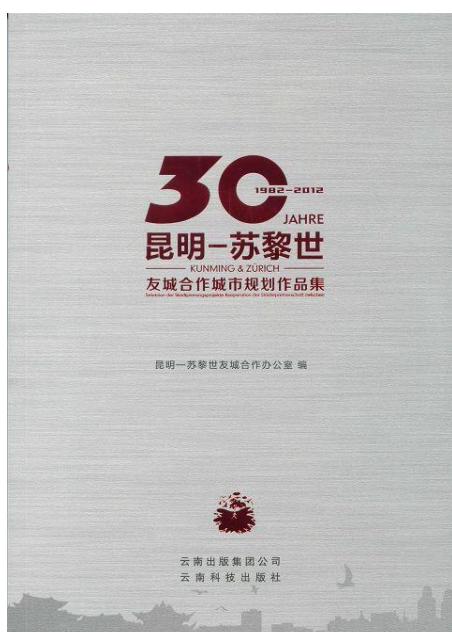


Figure 10: Portfolio of Cooperation Projects between Kunming and Zurich in 1982-2012, published by *Yunankejichubanshe* [Yunan Technology Publisher]

Source: http://www.ynkjph.com/htmls/ynkjcbs/2012/1018/goods_book_181997.html

CHENGGONG ECO-CITY PROJECT

Chenggong used to be a rural county under Kunming, but has been reclassified as a county-level urban district. The change in status from rural county to county-level district has altered the legal structure of land ownership of farmland in Chenggong – from rural collective type to state-owned type. The transition of administrative status has also meant that Kunming's city area (*cheng qu*) has expanded beyond the old down town by Dian Lake, to encompass Chenggong.

As one of the first eight green ecological demonstration cities sponsored by the central government in 2012, the new Chenggong New District is designed with low-carbon development principles in mind, including low-carbon industries, low-carbon energy, low-carbon architecture, low-carbon indicators and low-carbon technologies. The Chenggong Project also won many planning awards, including:

- 2014 National Low-Carbon Model group (*quanguoditanbangyangyouxiushequn*)
- China Top 10 Green City (*zhongguoshidazuijialusechengshi*)
- National Green and Eco Model City District (*quanguoluseshengtaishifanchengqu*)
- National Energy Model City (*quanguoxinnengyuanshifanchengshi*)

- 2014 APEC Low-carbon Model City (*ditanshifanchengshi*).

Chenggong New District is still criticized for the high vacancy rate of its real estate projects, given that it is now the site of the new Kunming City Hall and new campuses for Yunnan University, Yunnan Normal University, and 13 other universities, and many students, faculty and government officials have moved in. Chenggong has even been listed as one of China's top ten 'ghost towns' in the 2010s. In recent years, a mass rapid transit line extending from the old downtown area of Kunming to Chenggong is now in operation. Kunming high speed railway station has also been built in the Chenggong district. A new model of urban planning has been introduced to break existing 'superblocks' down into multiple 'human-scale' and courtyard blocks, with smaller sized streets and more car-free and pedestrian-only pathways to be provided. It remains to be seen whether Chenggong can remove its 'ghost town' stigma.

URL :

<HTTP://URBACHINA.HYPOTHESIS.ORG/6202>

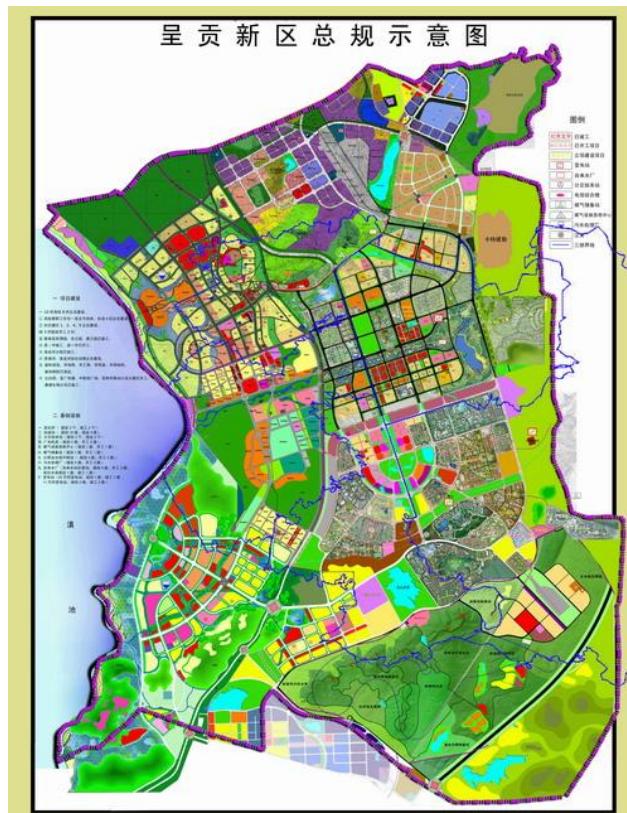


Figure 11: Chenggong New District Plan, Source:
<http://kmxdzy.com/eWebSoft/UploadFile/200952795646898.jpg>

FLAVOURS ORCHARD

Designed by French architect Vincent Callebaut and private developers, the 'Flavours Orchard' comprises of 45 plus-energy (bepos) villas in a Smart Grid in Kunming. The plan is to build 45 villas on 22 acres of former industrial wasteland, using a wood/steel structure to create three different types of homes, each with state-of-the-art sustainable features. The "Mobius Villa," designed in a loop, combines a vegetable garden on the roof with photovoltaic glass. Shutters in glass walls automatically pivot throughout the day to regulate heat and light. The "Mountain Villa" uses panels filled with algae to produce bio-hydrogen. The "Shell Villa" is built around a wind turbine. The 'smart-eco' features include recycling and waste management, zero carbon

emissions, smart home automation and integrated renewable energy.

The project aims to be a model for replication in the rest of China in terms of sustainable innovations. The main aims are for such developments to produce more energy and biodiversity than they consume, through the ongoing recycling of waste in reusable natural resources, so as to create the post-nuclear, post-fossil and zero carbon emission city. However, little substantial development has been observed since the project was first publicised in 2014.

URL:

HTTP://VINCENT.CALLEBAUT.ORG/OBJECT/140220_FLAVOURSORCHARD/FLAVOURSOFRICH/PROJECTS

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NANJING

Author: May Tan-Mullins

Nanjing is a city situated in the heartland of the lower Yangtze River region in China, which has long been a major centre of culture, education, research, politics, economy, transport networks and tourism. It is the capital city of Jiangsu province of People's Republic of China and the second largest city in East China¹, with a total population of 8,235,900 (Nanjing Municipal Statistics Bureau 2015), and it is one of the four 'Great Ancient Capitals of China'. Plans have been made to develop the Sino-Singapore Nanjing Eco Hi-tech Island (SNEI), which is set to be an island showcasing the future of Nanjing and its aspirations to be a centre for the development and practice of high-tech innovation in areas such as IT services, eco-environmental service, modern service industries and modern agriculture (Sembcorp no date). Moreover, Nanjing is a major pilot city for 'green city' and 'smart city' initiatives.

In 2013, Nanjing released 46 planned key smart-city projects with a total investment of 30.3 billion yuan to seek public-private cooperation in smart-city development. There were 13 information technology infrastructure projects published including 100M optical engineering, wireless city upgrading, and a public information service platform construction, with the total investment expected to be over 27 billion Yuan (METERING China 2013). Based on a cloud computing platform, mobile internet use, and the Internet of Things, as well as the construction of a platform providing information about city life and various

services, these projects cover the whole city of Nanjing, aiming to provide service to all its citizens. They aim to integrate a wide variety of Nanjing-related information in a website which can be accessed through different mobile devices, to provide services for the government, companies and citizens anytime and anywhere.

These projects involve numerous actors such as the city government, and private companies bidding the different projects such as SAP on smart traffic project and Huawei eLTE for E-government private network. The vision is that Nanjing city area would be fully realized on optical fibre, buildings and residential fibre access rate above 98%, administrative villages, and villages around the rate of 100% fibre-optic, and 8000 new 4G base stations would have been built by 2015 (METERING China, 2013). However, there is no evidence suggesting whether those targets have been achieved, except that 11,200 mobile 4G base stations are reported as having been built by the end of 2015 (Wu and Yang 2015).

The Nanjing municipal government entrusted the e-government private network construction and operation to Nanjing Commway Wireless Network Communication Ltd, which is a government funded high-tech communication company that specializes in e-government private network construction, operation, and service development. In early 2013, Huawei proposed its eLTE solution to Commway which would fully meet construction requirements based on the Proof of

¹ In East China, in terms of urban population and urban area, the largest city is Shanghai, and the second largest is Nanjing.

Concept (POC) result and initial service demonstration. Huawei won the first-phase contract from Commway in March 2013, and at present, Commway and Huawei are building the second-phase private network that will include 110 eLTE base stations to cover the urban area in Nanjing.

Meanwhile, the eLTE-based comprehensive information platform has also been put into use. Commway and Huawei have implemented network construction and service development together (Huawei 2014).

EXAMPLES OF PROJECTS

SINGAPORE-NANJING HI-TECH ISLAND

One major local eco-smart initiative is the Singapore-Nanjing Hi-Tech Island, which is a 15 sq. km strip of land in the Yangtze River just offshore from Nanjing city located at the Hexi New town. SNEI lies 6.5 kilometres from Nanjing's downtown area and is linked to Nanjing's new central business district. The aims are to develop a completely new city with eco-friendly credentials to act as both a commercial and technology hub for the different target groups of technology (Nanjing Eco Hi-tech Island 2011). Designated as one of four "green lungs" of Nanjing, the island is considered a National Grade 'AA' scenic area. Half of the island's 1,500 hectares will undergo urban development with the remaining area conserved for eco-tourism. Among them, 180 hectares of land are designated for creative and innovative design firms as office space, with an additional 182 hectares of residential land located amid the island's water canals and green spaces.

The Eco Hi-Tech Island consists of five small islands, including Technology Development Island, Multi-Service Island, Cultural Innovation Island, Low-Carbon Experience Island, and Tourism Island. A key part of the proposal is that island should have a low carbon footprint. All the commercial and residential buildings will use renewable energy sources, such as solar and hydrogen. Seven square

kilometres of land will be used for intensive development, among which 40% will be used for technology development. No factories or manufacturing plants, which would result in pollution, will be allowed on the island. In the intensive development area, 40% of the land will be used for housing, most of which will take the form of multi-storey and high-rise buildings. SembCorp from Singapore are providing much of the investment in infrastructure based on the Singapore One North science park (Nanjing Eco Hi-tech Island 2011). The key actors behind the project are the Nanjing government, Singapore government, Sembcorp Singapore, Singapore Yanlord Property group, and Singapore-Jiangsu Cooperation Council.

This project includes a consultation process with the detailed planning proposal posted for public review in front of the Nanjing Planning Convention Centre in 2013. The proposal noted that the island will not have factories, and buses will be powered by electricity. The island is to be connected to the mainland by three highways and two rails; in the future an undersea tunnel will be built. However, there is no news of further development since 2013.

NANJING HEXI WATERFRONT

The Nanjing Hexi Waterfront project combines smart growth and ecological restoration approaches. It includes an 'eco hotel' with rooms alongside the wetland park, and "a meandering boardwalk, waterfront promenades, and street plans laying out offices, parks, and housing that are designed for walkability" (Green 2010). In addition, local residents will be assigned small plots for growing their own food. The urban farming site will harvest its own water, generate power, compost soil, providing a "productive landscape" for Nanjing Hexi. SWA Group has won a design

competition aimed at turning a 7-kilometer long, 460-acre downtown brownfield waterfront into a new destination featuring parks, housing, office buildings, and man-made, water-cleansing wetlands and other main actors are the Nanjing and Hexi government.

Scott Slaney, principal of SWA, said: "The plan addresses larger regional and national objectives including natural resource preservation, environmental regeneration and sustainability, economic vitality and social equity while maintaining flood protection and celebrating the beauty and history of the Yangtze River" (Green 2010).



Photo: Sembcorp development

Figure 12: Singapore- Nanjing Eco High Tech Island
Source: Sembcorp development

URL:

<HTTP://NJ.TOUR.SMARTJS.CN/>

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NINGBO

Author: May Tan-Mullins

Ningbo is a sub-provincial city in northeast Zhejiang province in China. It comprises the urban districts of Ningbo proper, three satellite cities, and a number of rural counties including islands in Hangzhou Bay and the East China Sea. As of the 2010 census, the entire administrative area had a population of 7.6 million, with 3.5 million in the six urban districts of Ningbo proper (Tang *et al.* 2015).

Ningbo is a pilot city for key initiatives of 'smart city', 'low-carbon city', 'green city', and recently, also 'sponge city'. The city has developed a comprehensive Smart City plan which was due to be implemented from 2011 to 2015 with a budget totalling 40.7 billion (US\$6.36 billion). The plan includes building a modern metropolis,

restructuring industrial areas and improving quality of life. While the achievement of this five-year plan has not yet been disclosed, the Thirteenth Five-year Plan of Ningbo Smart City Development has been released in November 2016 (Ningbo Smart City Construction Coordination Unit 2016). However, the details have not been publicized at the moment this report is written. Ningbo adopted a seven-pronged approach and sought professional help by setting up expert advisory committees and Ningbo Smart City Standard Development Planning Academy in order to improve the conditions for implementation of smart city projects in Ningbo.

EXAMPLES OF PROJECTS

NINGBO SMART GRID

The city plans to invest RMB16.5 billion (US\$2.58 billion) planned investment in the power network to create a 'smart grid'. Ningbo Smart Grid is a five-year project which addresses the Five "Speed Ups", which relate to the following (Toppeta 2011):

- speeding up the construction of a major international strong port
- building a modern metropolis with a restructured industrial basis
- creating a Smart City
- constructing an ecological civilization
- improving the quality of life.

The 87 individual projects cover a range of fields including logistics, manufacturing, public services, energy, social

administration, traffic, healthcare, residential site management, and entertainment services (Toppeta 2011). It is also focusing on restructuring industrial areas, green energy, and managing traffic through smart technology.

The Smart Grid forms part of the effort: during the 12th 'Five-year Plan' period, a total of 15.731 billion yuan has been invested by the Ningbo Power Company to construct the power grid. In July 2016, Ningbo's first 500-kilovolt smart substation, the Mingzhou substation was successfully launched and put into operation. This 500kv Mingzhou substation is built according to the digitalized and intelligence standards. Comparing with conventional substation, it achieves intelligent operation and digital monitoring towards the grid's closing switch, which increases the

operation efficiency by 50% or more (Ningbo Daily 2016). In the three-year action plan from 2016 to 2018, Ningbo Power Company will accelerate the construction of power grid to solve the problem of limited power supply. For example, the construction of 220-kilovolt reinforcement projects in urban area (Baojia - Cheng Lang - Panqiao) and 500 kV Ningbo Yonggang grid and ancillary project will be speeded up to fundamentally address the problem of limited eastern urban area's power supply (ibid.).

URL:

HTTP://GTOB.NINGBO.GOV.CN/ART/2016/11/29/ART_249_758683.HTML

YUYAO INDUSTRY PARK

Another interesting project with international connections is the Yuyao Industry Park, which is a greenfield project launched in June 2014 and expected to be completed by 2030. The total area comprises of 40 square kilometres, 26 of which have already been planned, with a further 14 due to be added in future through sea reclamation to the north. The Mayor of Ningbo and the president of INVITALIA Italy signed a cooperation agreement for the development and construction of this Ningbo-Italian industrial park project. The main investors are the Ningbo government and Yuyao government; it is also managed by Yuyao Economic Development Zone Management

Committee and is supported by the Chinese government and Italian government in collaboration. The total amount of investment has currently reached 5 billion RMB in 2016, and total project investment has exceeded 20 billion RMB.

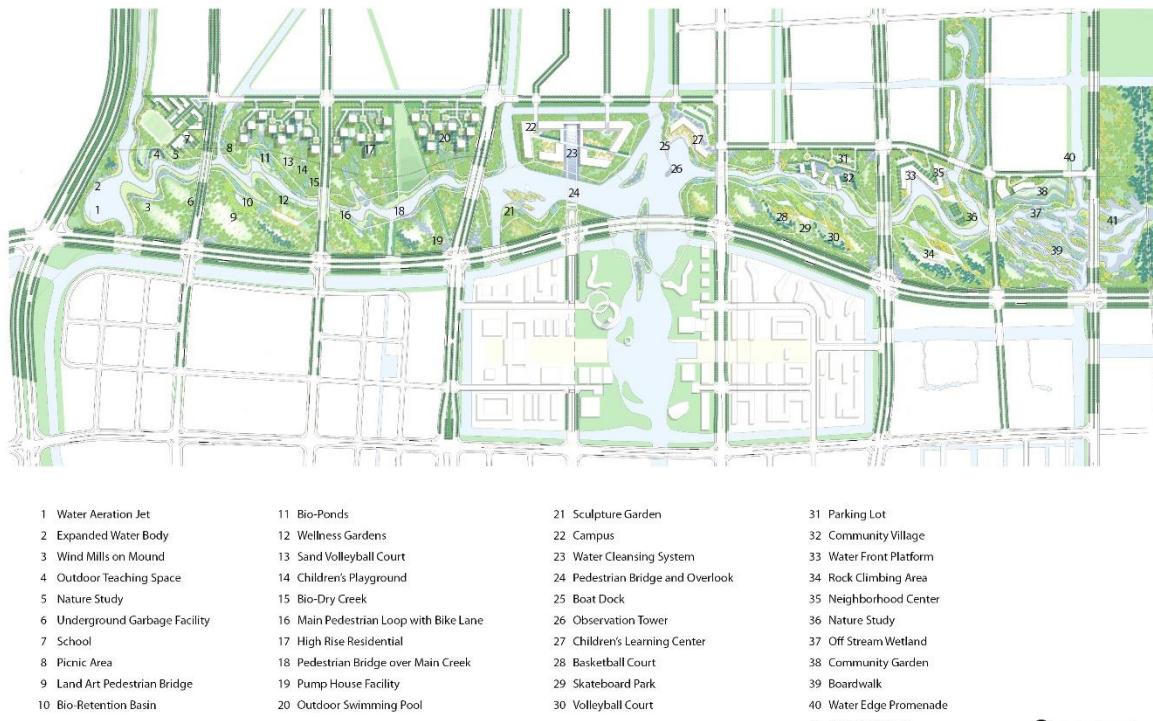
The park will focus on constructing the energy conservation and environmental protection themed industrial park, aviation industry, and the Italian style street—which would basically be a new CBD with Italian architectural style. For the theme and basic target of the industry parks, construction would include the ecological, less smart-city construction ideas and goals, and the ways and means are mentioned in the government official report. This project aims to construct a comprehensive ecological park, which includes a south lake area of residents, a north lake area of eco-city construction, and five other regions that include a central composite Island. The development focuses on environment quality and Italian lifestyle presentation, providing a place for work, consumption, and living; High-end equipment manufacturing Park; Livelihood and Health Industry Park; Energy-saving and environmental protection Industry Park and Research and Innovation Park.

URLS:

HTTP://WWW.YY.GOV.CN/ART/2015/5/18/ART_72029_1925833.HTML

HTTP://WWW.TZB.YY.GOV.CN/ART/2015/12/12/ART_61113_2023713.HTML

NINGBO ECO-CORRIDOR



1 Landscape Master Plan

Figure 13: The Eco-corridor at Ningbo
Source: SWA

The Ningbo eco-corridor is known as the city's 'living filter' and is 3.3km long. Through the innovative synthesis of topography, hydrology and vegetation, the Ningbo Eco-Corridor project transforms an uninhabitable brownfield into a 3.3km long ecosystem restoration zone, aiming to create synergy between human activity and wildlife habitat, and serve as a teaching tool and model for sustainable urban expansion and development in China's rapidly advancing economy (Buttin 2013). This project started early in 2007 and is now in the second stage according to short reports from the local Ningbo daily news and work reports published by the Ningbo government offices. It is funded and managed by the government of Ningbo and

has won the American Society of Landscape Architects 2013 professional honour award (goood 2014).

URL:
[HTTP://WWW.NBEPB.GOV.CN](http://WWW.NBEPB.GOV.CN)

ZHENAI ECO-PARK

The Zhenhai district of Ningbo is earmarked for an 'Eco-Park' initiative. 56.22 of the district's 246 square kilometres of land are industrial (and primarily used by the chemical-based industries). It has proposed to build a two-square-kilometre wetland Eco-Park. This is because the pollution from coal burning coal has become an environmental issue and the local residents have complained about it. In the last 10 years, the Zhenhai District has invested ¥ 260 million into building five forest protection belts that separate the industrial zone from the residential zone. The 200-meter-wide belts have a total area of 9.62 square kilometres with 1.5 million trees. Currently, Zhenhai District has a per capita green space coverage of 12.73 square meters, and the forest coverage rate has reached 27.7%.

To further enhance the natural environment of the district, Zhenhai also proposed to build a wetland Eco-Park, which will purify the polluted water and reduce the amount of runoff in the district. A wastewater treatment plant is currently under construction in the industrial zone. After completion, the plant will release treated water into the wetland Eco-Park.

The wetland plants, along with microbes and soil, will absorb the organic waste and heavy metal in the treated runoff. The factories will reuse the water from the park. More recent updates of the construction of the wetland plants suggest that the second stage expansion project of Zhenhai waste water plant was completed in October 2015. If the final requirements of the relevant procedures have been satisfied, the project will be formally approved by the Environmental Protection Department. Its operation will add new sewage processing capacity of 30,000 tons per day, which will increase the Zhenhai waste water plant's sewage treatment capacity to 60,000 tons per day (Zhang 2016).

URL:

[HTTP://WWW.SUSTAINABLECITIESCOLLECTIVE.COM/GLOBAL-SITE-PLANS-GRID/216396/NINGBO-CITY-CHINA-PROPOSES-BUILD-WETLAND-ECO-PARK-INDUSTRIAL-ZONE](http://WWW.SUSTAINABLECITIESCOLLECTIVE.COM/GLOBAL-SITE-PLANS-GRID/216396/NINGBO-CITY-CHINA-PROPOSES-BUILD-WETLAND-ECO-PARK-INDUSTRIAL-ZONE)

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QINGDAO

Author: Shiu-Shen Chien

Administratively, Qingdao is a sub-provincial city in Shandong Province. This special administrative status allows Qingdao, though governed by Shandong, to be administered independently with regards to economy and law-making. Qingdao is an important international telecommunications hub in China due to its geographical location in the Shandong peninsula facing the East China Sea. Qingdao is one of the three international sea cable landing points in China and the only one in northern China where the East Asia Crossing and Trans-Pacific Express submarine telecommunications cables make landfall.

Qingdao is also a trial point of many national green-related programs, such as

the ‘low carbon city program’, ‘sustainable urbanization program’, ‘smart-city pilots program’, ‘low carbon industrial zone pilot program’, ‘renewables in buildings pilots program’, ‘alternative fuel vehicles pilots program’, ‘low carbon integrated transportation planning pilots program’, and ‘public transit city pilots program’(Hu *et al.* 2015). In addition, Qingdao is one of the pioneer cities to invest in 4G and the first city to conduct 5G experiments. According to 2015 China Smart City Benefiting Citizens Index (*zhongguozhi-huichengshihuiinfazhanpingjiazishubao-gao*) this consisted of a smart city service platform, degree of benefiting citizens, and future development of the environment. Qingdao is ranked in the top ten sub-provincial-level cities.

EXAMPLES OF PROJECTS

SMART QINGDAO: 5G AND SMART SECURITY

The Qingdao city government initiated the ‘Broadband Coverage’ project, which aims to bring broadband to the city (20Mbps for urban household) and surrounding rural areas (4Mbps for rural household). The project involves several key telecommunication providers. For example, Qingdao Unicom is in charge of Broadband to Villages (*cun tong gong cheng*). In addition, China Mobile and the Qingdao City Government signed a strategic cooperation agreement and held an open ceremony for a 5G innovation laboratory for further smart transportation, smart citizenship, smart information

service, smart enterprises, and smart basic infrastructure.

One special focus of smart city in Qingdao is the smart public security project cooperated between Qingdao city government and Haixin Internet and Technology. The basic idea is to connect video surveillance network (including drone-mounted cameras and other vehicle-bounded gadgetry) with other public and private security systems in order to build up a zero-blind-spot surveillance environment to help police combat crime more effectively and efficiently. In addition, with real-time surveillance data stored in the cloud, more sophisticated analytical tools can be introduced to identify criminals and illegal activities.



Figure 14: Launching Ceremony of 'Public Security + Smart City' Policy Innovation Scheme

Source: <http://big5.cri.cn/gate/big5/gb.cri.cn/41431/2016/03/04/8451s5216241.htm>

QINGDAO SINO GERMAN ECOPARK

The Qingdao Sino-German Ecopark (QSGE), the first China-Germany jointly developed smart and eco project, aims to introduce some sustainable development concepts like energy conservation, smart power grids and efficient irrigation and so on from Germany to China. The QSGE is operated on a basis of a Memorandum of Understanding signed by China's Ministry

of Commerce and German's Federal Ministry of Economics and Technology in 2010. German Chancellor Merkel met Chinese Premier Li to confirm the project in 2011. China and Germany established a joint venture company to be in charge of infrastructure development, marketing and investment attraction and operation management of the QSGE.

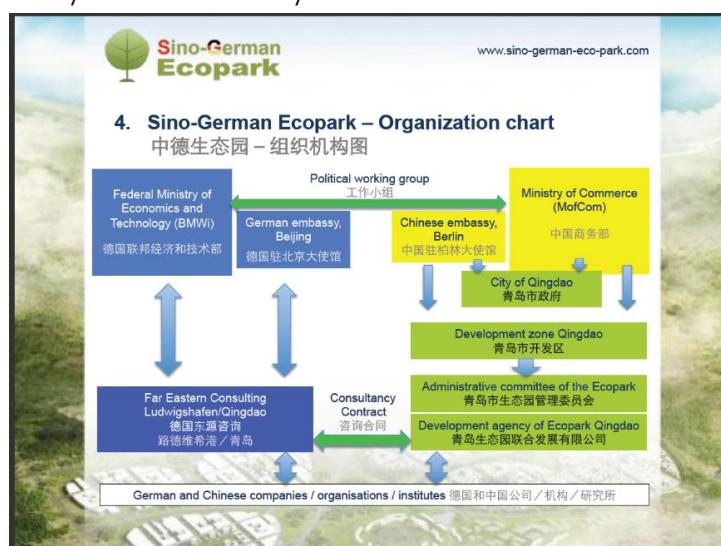


Figure 15: Organizational framework for cooperation between two countries

Source: http://sgb-net.de/fileadmin/downloads/PDF_Library/MagedeburgEvent/Sino_German_Ecopark_ECN_.pdf

Gerkan, Marg and Partners (an international architecture firm based in Hamburg, Germany) has been appointed to prepare the master plan of the QSGE, with the first phase as 10 km² and the long term phase extending to 66 km². The Sino-German Ecopark is to serve as a demonstration zone to use so-called

German standard infrastructure for international settlement business of high-end industry and promote international cooperation for environmental and sustainable development. Designs and constructions need to meet certain high ecological standards such as German Sustainable Building Council certification.

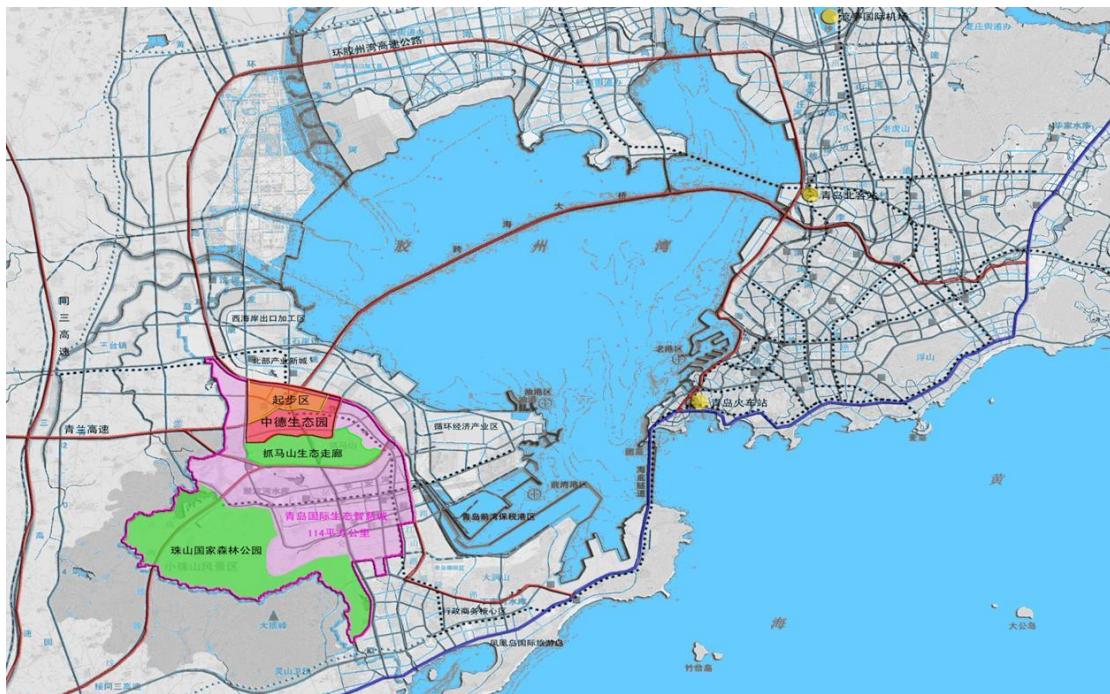


Figure 16: Location of Sino-German Ecopark

Source: http://www.sinogerman-ecopark.com/html/tzzn_tzhj/class_index.html

The key industries in the QSGE are in the fields of energy saving, energy recycling, advanced equipment manufacturing, the automotive and supplier industry, automation, biotechnology and pharmaceuticals. Those investment projects that do not reach certain environmental standards nor comply with the planned industrial layouts are disqualified from entering. In addition, in order to pay attention to IPR protection and other legal considerations, the first institution of intellectual property right arbitration in Shandong province is also built into the QSGE.

Initial projects in the QSGE include the German Energy Centre & College, to

provide training and consultancy for building energy concepts; and the Shanghai Bavarian Vocational Training Consulting that aims to offer German-based vocational training courses, curriculum and teaching materials for engineering technicians. In addition, a Memorandum of Understanding was signed between the QSGE and German Sustainable Building Council (*DGNB-Deutsche Gesellschaft für Nachhaltiges Bauen*) in order to better promote the DGNB standards to the GSGE. One of the recent investment projects is that Airbus Helicopters signed a letter of intent to build Asia's final assembly line in the Sino-Germany Ecopark in 2015.

QINGDAO LOW-CARBON GREEN PORT

The idea behind this eco-port is to bring environmental concerns into effective port management. Qingdao port has been selected by the Ministry of Transport of China as one of four pilot projects to develop the concept of a low carbon/green port. The other three ports are Tianjin, Lianyungang, and Shekou. The Qingdao local government has invested in some 27 distinct projects in different areas of infrastructure construction and upgrading, including energy-saving technologies, terminal handling system, smart port technology and environmental protection. The plan is to reduce 40% of energy per 10 thousand Twenty-foot Equivalent Unit (TUE) of 2005 standard by 2020.

The Qingdao port is also expanding its Dongjiagang territory to its south, which aims to be a shipping and storage centre of

bulk cargo and energy-related sources. Dongjiagang is a part of the Qingdao low carbon port project being constructed with latest technologies and renewable energies to reduce energy consumption and improve water treatment. Some major power generation companies in China, like China Huaneng Group and China Datang Corporation have invested in coal and general-purpose berths, while other foreign trading companies like Switzerland's Mercuria Energy Group and IMG Group with its headquarters based in Singapore are also negotiating to build their operation sites in Qingdao. However, given that the global maritime industry currently has no clear plans for development in the near future, more close observation is needed to see whether the southward expansion of Qingdao port will develop as planned (or become another 'ghost' port and harbour front).



Figure 17: Master plan of the Qingdao Blue Economic Zone to show port city expansion to the south

Source: http://www.chinadaily.com.cn/regional/2011-03/07/content_12129023.htm

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SHANGHAI

Author: May Tan-Mullins

Shanghai has over 24 million residents with a density of 3,800 people per square kilometre. The municipality is divided in 15 districts, 1 county and 210 towns and sub-districts. The per capita income is US\$16,553 - the third largest in China (National Bureau of Statistics of China 2015). The city is located on the expanding peninsula between Yangtze Delta River and Hangzhou Bay.

In terms of eco-development, there are many eco-city initiatives such as the 'ecological protection bottom line', referring to the zones set by the Shanghai government where development is forbidden in order to protect natural habitats. The aims are to protect the water sources of Shanghai and endangered animals, with approximately 5,000 square km of land included in the protection zone. In addition, it also proposes an urban development boundary, allowing the city government to control the speed of urbanization in outlying areas and improve the efficiency of land use. The ecological protection bottom line plans are still currently at the consultancy phase.

In terms of smart strategies, Shanghai initiated a three-year plan for a 'Smart Shanghai' in 2011 and has successfully realized objectives including electronic health records, food safety traceability, e-bills of water, and electricity and gas (Wu, no date). Compared with many other cities, Shanghai has been successful in implementing its smart initiatives, and these are more oriented to the daily lives of its citizens. In addition, there are many district-level initiatives such as the 'Smart Yangpu, Wise City' and 'ipudong project', which are briefly described below.

Smart and eco strategies at the city level are mainly tied to national policies and documents in terms of harmonious society and ecological civilization. Many of its initiatives focus on both ecology (low carbon) and smart-living. For example, the city smart transport information system focuses on smarter ways of parking and carbon reduction, the 'Smart Yangpu, Wise City' project looks at innovation hubs located within an expanding greenbelt area while 'ipudong' concentrates on smart energy, smart transport and environmental protection.

EXAMPLES OF PROJECTS

SMART YANGPU, WISE CITY

Yangpu was selected as a pilot district in a national program to develop innovation centers in urban areas and is gearing up to further transform itself into a major hub for modernization, technological advancement. It is mainly focused on retrofitting an old district with new ICT facilities. The project is a city and district

level initiative with smart grid and eco-friendly environmental park. It includes various green initiatives, and is focused on creating an eco-friendly community and high-quality infrastructure, smart grid. Yangpu District's four emerging strategic industrial bases are:

1. Shanghai Cloud Computing Innovation Base

2. Shanghai Demo Base for the 'Internet of Things'
3. Shanghai Smart Grid Demo Base
4. Shanghai Environmental Park

As part of the Yangpu District government's commitment to green initiatives, it is working to expand the per capita public green space up to 4.3 square meters during the 12th Five-Year Plan period, and to maintain the excellence rate of ambient air quality at 90% and higher. As a part of the 12th Five-Year Plan period in 2010, Yangpu District was envisioned to foster the development of New Jiangwan Town as an international, eco-friendly community, and the establishment of high-end business projects to make New Jiangwan Town a core area in the Jiangwan-Wujiaochangcenter in terms of business, housing, and ecology. The aims are to build an ecological network system featuring the

harmonious co-existence of green areas and water resources and develop high-quality infrastructure in accordance with international standards and improve access to public services (Deloitte 2014).

In terms of information infrastructure, optical fibre will be extended into households in apartment blocks and office buildings, full wireless broadband coverage will be provided for the Wujiaochang business district, science and technology parks and key office buildings. In addition, there will be full integration of information and industries through e-business by construction of three digitalized science and technology parks. The different initiatives are at various stages of implementation, and the actors involved include the municipal and district governments, as well as multi-national companies and e-commerce giants in China such as JD.Com (Ding2016).

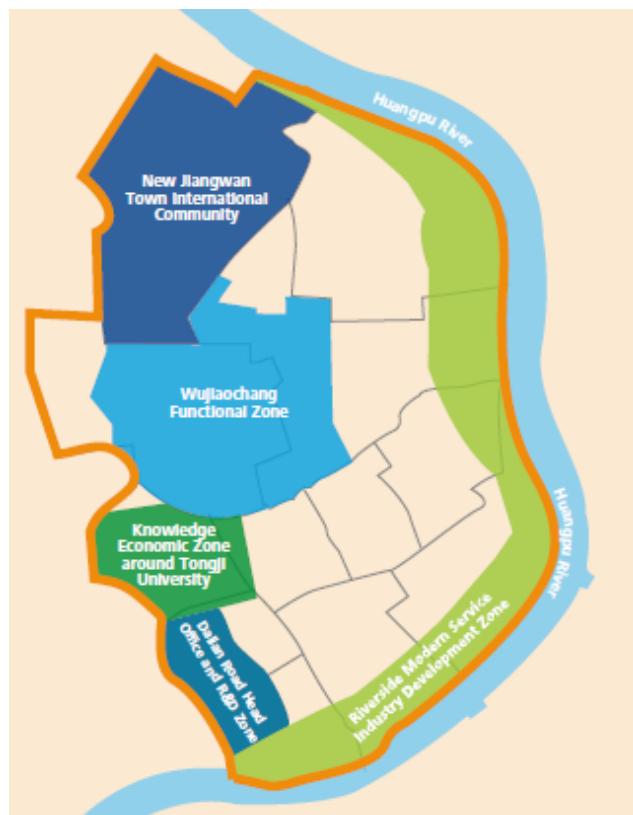


Figure 18: Smart Yangpu
Source: Wise city plan (Deloitte 2014)

IPUDONG

Another flagship smart-eco project in Shanghai is the 'iPudong project' which was implemented in 2015. iPudong could be described as a miniature version of the modern development of Shanghai. It is the only pilot area for a Smart City in Shanghai and the first development of a Smart city approved by MoHURD with key investments allocated into following sectors: smart transportation, food safety, smart healthcare, smart community, smart energy, smart environment protection, smart living, city security and emergency response (Wu nd). Its main SMART-ECO characteristics are smart energy, smart transport and environmental protection. The main aims and strategies of iPudong are to provide smart infrastructure that meets citizens' needs, by optimizing smart applications and consolidating bases of smart industries. Ultimately, iPudong hopes to integrate innovations into the strategies and also as main drivers of livelihood growth.

DONGTAN ECO-CITY

A widely publicised but indefinitely suspended project is the Dongtan Eco city on Chongming Island. It is a district level project but was initiated by Shanghai city government. In 2005, the Shanghai Industrial Investment Corporation (SIIC) hired the global design, engineering and business consultancy firm Arup to design and plan a city. The goal was to make Dongtan as close to being a carbon neutral and zero-waste city as possible. The following are the listed principles of the Dongtan Eco-city in a report by Arup (2007):

1. to preserve the wetland habitat
2. to create an integrated, vibrant and evolving community

3. to improve quality of life and create desirable lifestyles
4. to create an accessible city
5. to ingrain contemporary Chinese culture into the city fabric
6. managing the use of resources in an integrated manner
7. working towards carbon neutrality
8. utilising governance to achieve long term economic, social and environmental sustainability.

The city is planned for Chongming Island, situated in the mouth of the Yangtze River, where it empties into the East China Sea. Across the river lies Shanghai, the largest of five cities in the Yangtze River Delta area (Designbuild-network.com). The site size is 8,600 hectares. Chongming's population is expected to surge with the 2009 completion of a bridge and tunnel to Shanghai. But at present, a ferry is the only connection. Arup produced a master plan and sustainability guidelines in the 2000s. As of 2015, Dongtan had ten wind turbines but no buildings (Designbuild-network.com). It was scheduled to be completed in 2050 but the project has been indefinitely postponed.

The main aims are to attract companies to Dongtan so that most residents can work on the island. If the plans go ahead, it is expected to house up to 500,000 people in 40 years' time. Arup claims that, compared with typical developments, the city will have an ecological footprint that is 60% smaller, will require 66% less energy, will produce 40% of its energy from bio-energy and emit almost no carbon dioxide (Designbuild-network.com nd).

URL:

[HTTP://WWW.DONGTAN.CN](http://www.dongtan.cn)

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SHENZHEN

Author: Ali Cheshmehzangi

Shenzhen's multi-scalar projects provide a unique model of Chinese smart-eco city transition that includes various initiatives, stakeholders and partnerships. Shenzhen is a major city in Guangdong Province, China. It is located immediately north of Hong Kong Special Administrative Region. It currently also holds sub-provincial administrative status, with powers slightly less than those of a province. According to the Government report for 2015, Shenzhen transformed to a city with population of 10,778,900 and a metropolitan area population of over 18 million. Shenzhen was one of the fastest-growing cities in the world during the 1990s and the 2000s. Shenzhen's population boom slowed down to less than one per cent per year by 2013 as the manufacturing boom ebbed in favour of other industries. The city is currently part of a city-level eco-city initiative and also includes district level eco-development projects in two of its new districts. These projects have both local and international cooperation. Also, Shenzhen claims to become China's first low carbon eco-demonstration city.

Shenzhen is a relatively young city which has experienced significant growth and expansion in the past four decades. Its rapid development started in early 1980s, when Shenzhen was merely a collection of fishing villages. Nowadays, the city is a major financial centre of China, and is defined as a mega-city. Shenzhen is one of the three financial cities of China (apart from Beijing and Shanghai) and has a diverse culture of multiple backgrounds and industries. Although in the local news in 2014 (Shi 2014) it was announced officially that the city is now in its post-industrialisation stage since 2010, Shenzhen still relies on

production industries. Due to its coastal geographical features and partly due to neighbouring Hong Kong in the south, Shenzhen is also a major port city as one of the strongholds of national and international distribution zones.

The city of Shenzhen has agendas and specific projects at both city-level and district-level. The city's overall ambition is to create a low-carbon smart city. Some of the early visions behind this go back to November 2010, when Shenzhen hosted the third conference on 'Next Generation Infrastructure Systems for Eco-cities'. In August 2012, Shenzhen International Low-Carbon City was officially launched. In June 2013, the city also hosted the first forum on the project, which was a part of China's first national low-carbon day. In cooperation with their Dutch partners, Shenzhen is aiming to develop a low-carbon model city. This is called Pingdi project, which is a collaborative project between Dutch and Chinese partners. The Pingdi project focuses on low carbon emissions, sustainable cities, low carbon economy, "ecological society, industrial redevelopment, and being 'green' in the new economic development model" (Cales 2014).

There are four key strategic plans for the Pingdi project:

1. Climate friendly city area
2. Low carbon industry clusters
3. Leading area of low carbon way of life
4. Zone of low carbon international cooperation.

These include the following characteristics for developing a low-carbon transition:

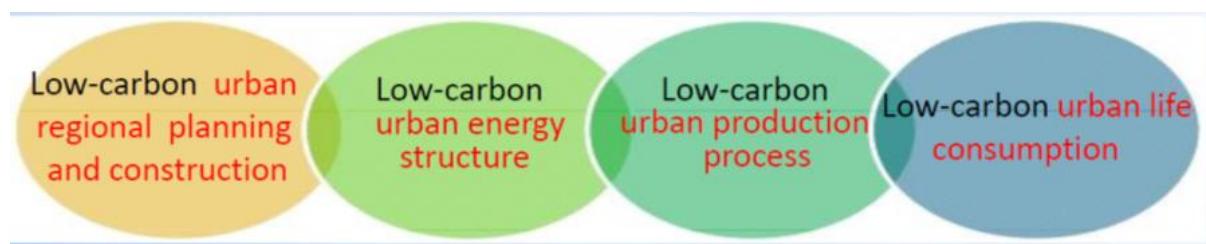


Figure 19: Pingdi low-carbon characteristics
Source: Wang (2014)

The project goals are also to achieve a total of 45% reduction in CO₂ emissions per GDP by 2020 (in comparison with 2005 figures). The 2005 figures indicate 0.59 tons per ten thousand Yuan GDP and the estimated 2020 figures are at 0.33 tonnes per ten thousand Yuan GDP (Wang 2014). Three project phases are proposed: development; pilot-scale test; and promotion. The implementation plan includes a top-down governance model, encompassing the following six planning features:

1. industry and city merged layout
2. site-specific carbon sink network
3. bus-preferable green traffic
4. intensive, highly efficient, and low-carbon municipality
5. energy-saving green buildings

6. convenient, liveable, and low-carbon community.

The project starts as a 'core promoter' low-carbon initiative in the region, with a gradual extension to cover the whole area of Pingdi Town (Wang 2014). Another major feature of the project is a wide range of industry choices, mostly covering low-carbon development of the project. Some of these industries are promoted or developed by its international partners, particularly the Dutch ones. The main cooperation of the project is undertaken across six key elements of 'planning', 'industry', 'management', 'technology', 'capital' and 'talents'. The project is also supported by the EU transformation projects, led by the Project Advisory Council in the Netherlands.



Figure 20: Master planner's vision of Pingdi low-carbon city project
Source: www.joostvandenhoek.com

Shenzhen's smart and eco activities involve a mixture of regional, national and international actors; the Pingdi project includes significant international cooperation with the Netherlands.

Shenzhen is envisioned to become a global low-carbon city model with cooperation amongst multiple sectors. The planning vision is focused on low-carbon initiatives, including some of the smart initiatives. Therefore, we can see a combination of 'eco', 'low-carbon' and 'smart' features in the projects. The projects are funded heavily by the central government at the national level. They run regular events to demonstrate the progress of the project. Also they have a very rigid

plan of progression towards a model city, which is updated regularly with reports on the project. Both parties of the project (local and international) consider this project as one of the early low-carbon cities.

Currently, there is no evidence of oppositional discourses or resistance from a regime level, but there are mixed discussions on the project development. Of course, the project has slowed down slightly but its planning process includes three stages (development, pilot scale and promotion) as initially anticipated, and the project is not yet at its promotional level. Several of the key projects are described below.

EXAMPLES OF PROJECTS

PINGDI INTERNATIONAL LOW CARBON CITY

The Pingdi International Low-Carbon City project is located in Shenzhen's Longgang district. The strategy for this district places strong emphasis on green and smart development. Longgang district is one of the six main districts of Shenzhen, located in the north-eastern side of the city. The whole district covers an overall area of 844.07 square kilometres (325.90 square miles), which makes the district the largest one (by size) in the whole province of Guangdong. The overall population of the district is 1,831,225, which includes a total of ten sub-districts. In 2011, the Sino-Dutch government-to-government cooperation was confirmed. In November 2013, the mayor of Shenzhen, Xu Qin, proposed to designate Pingdi a Demonstration Zone of China-EU Urbanization Development Cooperation to provide mutual assistance in furthering

sustainable urbanization. The EU Commission President José Manuel Barroso and Chinese Prime Minister Li Keqiang agreed to sign a Memorandum of Understanding. From that moment, Pingdi was a flagship project between China and the EU and a national level demonstration project for China (Jong *et al.* 2013; Cales, 2014).

The Shenzhen International Low Carbon City project is located at Ping Di Street in Longgang district, Shenzhen, the border of Shenzhen, Dongguan as well as Huizhou. Development at present is relatively slow, and the intensity of carbon discharge is high. The built area accounts for above 60% of land for construction. As the flagship project of Sino-Euro sustainable urbanization cooperation, Shenzhen International Low Carbon City will combine city and low-carbon green development of urban management and pooling-of-interest under the constraint of carbon index, discovering and demonstrating a

reproducible and applicable path of low carbon development in new urbanization.

Pingdi International Low-Carbon City is aiming to become a model national comprehensive demonstration district of low carbon development. The project is an ongoing district level project. The ‘initial

zone’ of 1km² was approved by the Urban Planning Authority in January 2013 and is currently under construction. The planned work on further phases covering 5km² and 53km² (see figure 16) is now in progress (C&D Group 2014, cited in Cales 2014).



Figure 21: Construction Plan of Pindi international low carbon city

Source: C&D group, 2014-I, cited in Cales (2014)

The Pingdi project includes several stakeholders and actors. The presence of the national government, NDRC, Guangming District Management Committee, Shenzhen city, EU, Dutch government, UPDIS, SEZ Shenzhen Construction and Development group, demonstrate the importance of this project. The project was initially planned at city level but, after the involvement of the national government, was changed to district level. Also some of the dynamics of the projects were adjusted as part of this major change of the project.

No clear information is available about the total investment in the Pingdi project. The project’s governance structure (involving a variety of Chinese and international actors), indicates possible multiple investment from project partners and the national government. The project

encompasses both greenfield and brownfield areas. The project started in 2011 but the completion date is not officially confirmed. However, some sources indicate that 2020 was proposed as the completion date. While the project has not stalled nor displayed any evidence of failure, this completion date seems unlikely since its progress to date is not as fast as initially expected.

URLS:

<HTTP://WWW.NEWTOWNINSTITUTE.ORG/PDF/MASTERTHESISRU.BENCALES.PDF>

HTTP://WWW.SZDAILY.COM/CONTENT/2013-06/18/CONTENT_8190736.HTM

SHENZHEN ASIAN CAIRNS PROJECT

Shenzhen Asian Cairns project is a green urban vertical farming concept with the buildings as the “acme of three connected eco-spirals” (Vincent Callebaut Architects 2013). The project emphasises biodiversity development, density and public services as well as urban agricultural fields. The project benefits from the use of grey water from pod-farms which will be collected and recycled in the same area, through a process of ‘phyto-depuration’ which combines biological, physical and chemical technologies. Each tower in the project is supported by the structural framework, which is a central vertical boulevard. All sections attached to the central spine are smaller sections of this eco project. The space around the proposed project is covered with solar panels and wind turbines, as the main renewable energy technologies of the project. In addition to these eco- features, the project benefits from hanging gardens functioning as urban farming areas that are managed by smart technologies for water and energy source (Vincent Callebaut Architects 2013).

The project aims to provide food security and green development through urban farming. The master plan refers to this concept as the development of “Farmscraper”, which currently remains at a conceptual design level (Vincent Callebaut Architects 2013). The proposals focus on urban food production, and particularly urban vertical farming, in an urban multi-use project: “In this context of

hyper growth and accelerated urbanism, the Asian Cairns project fights for the construction of an urban multifunctional, multicultural and ecological pole. It is an obvious project to build a prototype of green, dense, smart city connected by the TIC [information and communication technologies] and eco-designed from biotechnologies” (Vincent Callebaut Architects 2013). The project master plan, for a new build area of a brownfield zone, proposes six farmscrapers that include residential units, leisure spaces, offices and a central boulevard forming the framework of each tower. The towers are also regarded as eco-quarters and accommodate suspended gardens. The project also includes other key sustainability features of photovoltaic and photo thermal cells, wind turbines, waste water management system and vertical farms.

Shenzhen Asian Cairns Project is a partnership between the city government and design firm Vincent Callebaut Architects. The project is proposed at a small master plan scale, with possibilities of expansion at the city level. The overall intention is then to transform the city's ecosystems by including and promoting new quarters of greenery, forests and multi-functional green spaces. The project so far remains at the design stage, and there is no evidence of further implementation since 2013. As a result, the available documents do not include any investment figures, or indicate any official start or completion dates.



Figure 22: Asian Cairns Design in Shenzhen

Source: www.e-architect.co.uk

URLS:

<HTTP://VINCENT.CALLEBAUT.ORG/PAGE1-IMG-ASIANCAIRNS.HTML>

<HTTP://WWW.MNN.COM/YOUR-HOME/ORGANIC-FARMING-GARDENING/BLOGS/SKY-HIGH-HORTICULTURE-SHENZHENS-FARMSCRAPER-PLAN-UNVEILED>

RAINWATER UTILIZATION AND RAINWATER TREATMENT EXPANSION PROJECT, SHENZHEN BAO'AN AIRPORT

This project has been proposed as a way of improving water circulation in the urban

area, and aims to save 2,555 thousand tons of water per year in the airport area alone. More importantly, in some districts in Shenzhen, especially Guangming, such projects have been under development since 2011 and are trying to change Shenzhen into a major "sponge city" pilot study; not merely for water reservation, but also the improvement of water quality and whole environment in the urban area. The transitional aim of this project is to deal with rainwater management and purification of water for its reuse. This project is proposed at district level and the development is currently under progress. Currently, there is no evidence of project failure or slowdown.

The project includes the district of Bao'an where Shenzhen international airport is also located. It is funded by Shenzhen Airport Ltd. and constructed by companies who win the bidding. The project responds to the Eco-city project competition, proposed by the Guangdong

government and Shenzhen government. There are no clear indications of the total investment amount as it is not a regular master plan project. It was launched in January 2016 and is due to be completed in June 2016. The project includes rainwater utilisation technology which fulfils the requirements of rainwater treatment, district condition adaptability and regional ecological environment.

URLS:

<HTTP://NEWS.CARNOC.COM/LIST/285/285503.HTML>

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HTTP://WWW.CHINAJSB.CN/BZ/CONTENT/2015-11/12/CONTENT_174220.HTM

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TIANJIN (SINO-SINGAPOREAN TIANJIN ECO-CITY)

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The Sino-Singaporean Tianjin Eco-City (SSTEC) project is a new city development, located on the eastern side of the city of Tianjin in China. With its coastal settings, this new development is one of the first eight Chinese eco-cities from the first batch of eco-city projects in China. SSTEC is located 40km out of Tianjin City Centre and is within the 150km proximity to the Capital City of Beijing. It is also near the Tianjin Economic Technological Development Area (TEDA) and Tianjin Binhai New Area (TBNA), which are two new economic zones of Tianjin. The project is the result of a bilateral agreement between the Chinese and Singaporean governments. The construction of this eco-city project initiated in September 2008 and is expected to be completed by early-to-mid 2020s (the initial plan was completion by 2020). When fully developed, SSTEC's expected overall population is estimated at 350,000 residents within its total area of 30 km². It is more of a district initiative than a city level initiative (Caprotti *et al.* 2015; International Enterprise Singapore nd).

SSTEC is more an eco-initiative than a smart one. This is one of the first eco-city model cases of the first batch of (8) eco-cities in China. The project started with three key visions to be 'socially harmonious', 'environmentally-friendly' and 'resource-efficient', which all signify the importance of sustainable development. This vision is supported by the concepts of 'Three Harmonies' and 'Three Abilities'. While the three harmonies include 'social harmony', 'economic

vibrancy', and 'environmental sustainability', three abilities are focused on the nature of the eco-city being: (1) practicable – including the key elements of affordability and viability of technology use and adaptation in this new development city; (2) replicable – including the knowledge transfer from the principles and models achieved from the development of SSTEC; and (3) scalable – including the application and adaptation of the project's achievements for other developments at different (larger) scales. The project also encompasses two main politically-driven slogans of 'harmonious urbanisation' and 'ecological civilization' that have both widely been used since 2007, when the SSTEC was also approved for construction (Caprotti *et al.* 2015; International Enterprise Singapore nd).

Although nearly half of Chinese urban growth takes place on arable land, SSTEC is sited on non-arable land, formerly sites for large areas of saltpan, deserted beach and wastewater pond. From four possible sites of Baotou (Inner Mongolia), Tangshan (Hebei province), Tianjin municipality and Urumqi (Xinjiang), SSTEC's site was selected based on the state of existing surrounding infrastructure, the notion of accessibility and connectivity in its region and future commercial capacity and viability. Located in one of the fastest growing regions in China, SSTEC's close proximity to two main cities of Beijing and Tianjin makes it an ideal location for regional connectivity and economic development. While its economic growth may be over-shadowed by the municipal area of Tianjin and two of its viable economic zones, SSTEC can focus

on developing a harmonious society which can represent a sustainable development in the region (information obtained from official webpage of <http://www.tianjinecocity.gov.sg/>).

With a comprehensive Key Performance Indicator (KPI) system in place, SSTECS's development process is monitored carefully on the basis of its 22 quantitative and 4 qualitative indicators. The development of these KPIs is based on national standards of both China and Singapore, as well as international standards that are used for certification of the new developments. These KPIs are grouped into four assessment categories of social, economic, environmental, and resources dimensions. The KPI decomposition process then include further breakdown of these 26 KPIs into 51 core factors, 129 key areas and 275 control targets. In here, core factors are referred to the factors that affect the achievability of the original KPIs. For instance, SSTECS requires over 20% renewable energy usage in the city (original KPI), which involves two core factors of 'Increase of Renewable Energy Supply' and 'Reduction of Total Energy Consumption'. Subsequently, key areas refer to the areas that have significant impact on the core factors. For instance, buildings, transport, infrastructure and industry are the four key areas that directly affect the attainability of 'Reduction of Total Energy Consumption'. In addition, control targets are the quantitative and qualitative measurements used to measure performance of the key areas. The control targets are also integrated into corresponding government authorities' routine management. For example, building is a key area to achieve renewable energy usage in SSTECS.

SSTECS's master plan was jointly developed by parties from both countries. The team includes the China Academy of

Urban Planning and Design, the Tianjin Urban Planning and Design Institute and the Singaporean Planning team led by the Urban Redevelopment Authority. Other technical team members were included during the process of project development. This includes key members, such as Bluepath City Consulting team, Siemens and several others whom have supported the development of KPI system, KPI breakdown and provision of technologies at meso and micro scales. While the SSTECS project is less than half way to completion, the master plan endorses new possibilities for small-scale city development in China. With three principle planning elements of 'land-use planning', 'transport planning' and 'green and blue network planning', SSTECS is planned to be compact, mixed use and based on a transit-oriented development (TOD) pattern. Divided into one central district, two sub-centres and eco-districts, the master plan of SSTECS proposes for two large central areas of eco-core and eco-chain. There are also six eco-corridors around the new development zone that are expanded towards outside of these districts. All these centres (including the sub-centres) are developed based on a TOD pattern in order to promote a better connectivity between the inner districts and the outer areas of SSTECS. This is proposed under the theme of one axis as a network, three centres and four districts. The axis of SSTECS is referred to as the eco-city valley spine, which goes through all centres and districts and also links the southern and northern surrounding areas of the eco-city.

All buildings in the eco-city project feature an environmentally sustainable design and use green materials for construction. They are equipped with intelligent building systems, building energy optimisation, district cooling/heating systems, vacuum sewage

systems and pneumatic waste collection systems. Over 280 billion RMB will be devoted to advance the optical fibre, wireless, digitization, smart grid and other important information infrastructure and some pilot projects for cloud computing related to energy-saving, intelligence traffic, food safety, education, medical, community, etc.

The project's transitional aim is to ensure this eco-city model is a sustainable development. The emphasis is being laid on public transport and use of non-motorised modes of transport. Tianjin Eco-City's light rail system will help in achieving this aim. Moreover, there are four quantitative control targets that are thought to be important for the building sector to contribute positively to the renewable usage target:

1. all buildings in the city must be certified by a green building rating system;
2. minimum 70% energy reduction for residential buildings in the design phase and 50% for public buildings;
3. minimum 15-20% operational energy reduction compared to conventional buildings;
4. minimum 5% onsite renewable generation for commercial buildings and 10% for residential buildings.

The project is being implemented at district level; however, the project is known and introduced at a city-level scale. The proximity SSTEC to the city of Tianjin and the overall size of the project, can demonstrate the project as a district-level project. SSTEC is currently under construction and is partially completed. The initial anticipated project completion was 2020, which has now been postponed to mid-2020s. The construction phase is not yet completed. Also the next phase of the SSTEC expansion may require further land reclamation on the eastern side of the city.

The main actors of SSTEC are Sino-Singapore Tianjin Eco-City Investment and Development Corporation who are the master developer of the project. This is a joint venture between Tianjin TEDA Investment Holding and the Keppel Group. The master plan for Tianjin Eco-City was jointly developed by the China Academy of Urban Planning and Design, the Tianjin Urban Planning and Design Institute and the Singapore Urban Redevelopment Authority. The total investment in SSTEC amounts to 280 billion RMB.

The SSTEC project involves multiple stakeholders as well as a major governmental agreement between the two countries of China and Singapore. This alone indicates a major achievement in linking the local, national and international players of the project. The introduction of the KPI system and the holistic vision that it offers are used as not only a development instrument but also as a monitory system towards achieving a sustainable development model. Given the current incomplete status of the project, its successes or failures cannot be adequately assessed. The steady pace of development, however, creates a possibility for researchers and practitioners to assess the effects of such eco-city project in a wider range of practices, mainly in planning and green building design. While the initial expected completion date of 2020 is possibly out of the updated target plan, the eco-city committee's latest update in 2014 indicate further implementation in revising the vision, development of further mechanisms for financial incentives and support as well as enhancement of transport network and the new development's economic viability.

The SSTEC project demonstrates a possibility of networks between governments and also businesses. These networks of actors are at various levels of:

regional (city and district), national (national government) and international (Singapore government and private companies). The project includes new infrastructure development, a network with other districts in the regions and the city of Tianjin. New structures also include new buildings (all certified), green-corridors and eco community projects. As indicated earlier, SSTECC is more of an eco-project than smart or low-carbon. The project highlights three key visions of: 'socially harmonious', 'environmentally-friendly' and 'resource-efficient', which all signify the importance of sustainable

development. Moreover, the SSTECC project's approach to implementation of both national and international standards in practice puts an emphasis on potential policy and planning transitions at detailed design level.

URL:

[HTTP://WWW.TIANJINECOCITY.GOV.SG](http://www.tianjinecocity.gov.sg/chinese/bg_masterplan.htm)

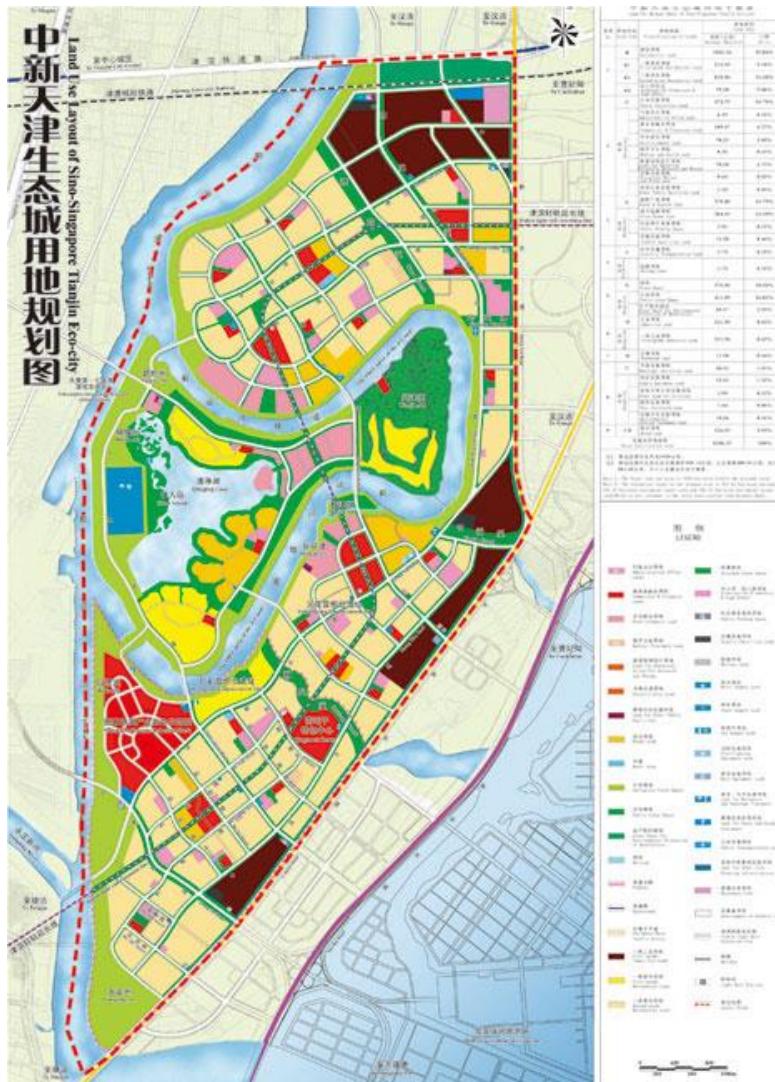


Figure 23: Tianjin eco-city masterplan

Source: http://www.tianjinecocity.gov.sg/chinese/bg_masterplan.htm

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WUHAN

Author: Shiu-Shen Chien

Wuhan, located at the intersection of the Yangtze and Han rivers, is the capital of Hubei province and the biggest city and the only sub-provincial administrative status city in Central China. With a population of around 10 million in a territory of 8,500 km², Wuhan also serves as a major transportation hub of railways, roads, and river transport due to its geographical location. Wuhan is one of the most important centres of heavy industry, including steel and car manufacturing, and its total GDP in 2014 was 1 trillion CNY, ranked 8th in China.

Wuhan is also one of the leading cities in the development of eco-smart city projects in China. A strategy of smart city development was proposed by the city officials in 2010, and Wuhan was then chosen as a pilot location by the national '863 Program' (State High-Tech Development Plan) in 2011 as well as by the Chinese Academy of Engineering in 2012. Wuhan was also chosen by the National Development and Reform Commission of the central government as a pilot location for the strategy of 'resource-conserving

and environment-friendly society' [*liangxingshehui: ziyuanjieyuexing, huanjingyouhaoxing*] in 2007. Wuhan is also a trial location for many national green-related programs, like 'low carbon city program', 'sustainable urbanization program', 'smart-city pilots program', 'low carbon industrial zone pilot program', 'renewables in buildings pilots program', 'alternative fuel vehicles pilots program', 'low carbon integrated transportation planning pilots program', and 'public transit city pilots program' (Hu *et al.* 2015).

Wuhan released its smart city plans as early as 2010. Chosen as one of the pilot cities of the national low-carbon transportation system construction in 2011, Wuhan also started promoting plans for low-carbon city development, which aimed at mitigating carbon emissions, and developing low-carbon smart transportation, green buildings, low-carbon districts and communities. According to the 2016 China Internet + Index published by Tencent Ltd., Wuhan is listed as one of the top ten 'Internet+' smart cities in China

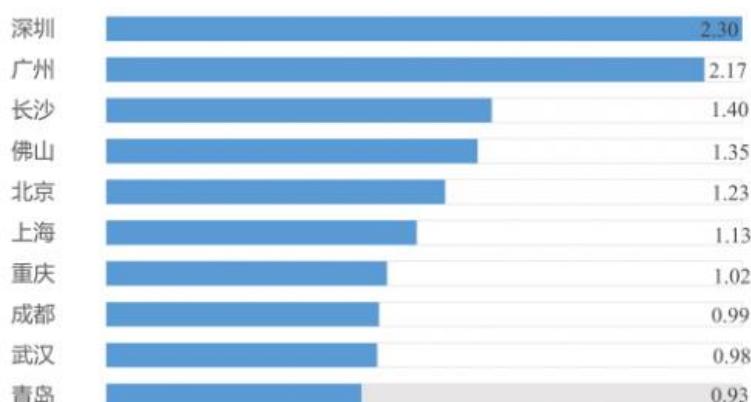


图 1 “互联网+智慧城市”分指数城市 10 强

Figure 24: 2016 China Internet+ Smart City Index

Source: <http://www.zhihuichengshi.cn/XinWenZiXun/23044.html>

EXAMPLES OF PROJECTS

WUHAN OVERALL SMART CITY SCHEME

In order to carry out the smart city scheme, several initiatives including a city database will index information about food and vegetables, with barcodes on food indicating the producers, amount of pesticides and fertilizer used, harvest date and transport mode etc. In schools, students' cards are directly linked to

parents' phone apps in terms of arrivals and also student/ teachers interactions. In hospitals, there are smart wristbands which coordinate all information from different departments and create medical files about each patient. Finally, plans have been made to manage the local logistics industry by using big data. There are 38 completed IT projects – one example being the provision of free wifi in 25 public areas.

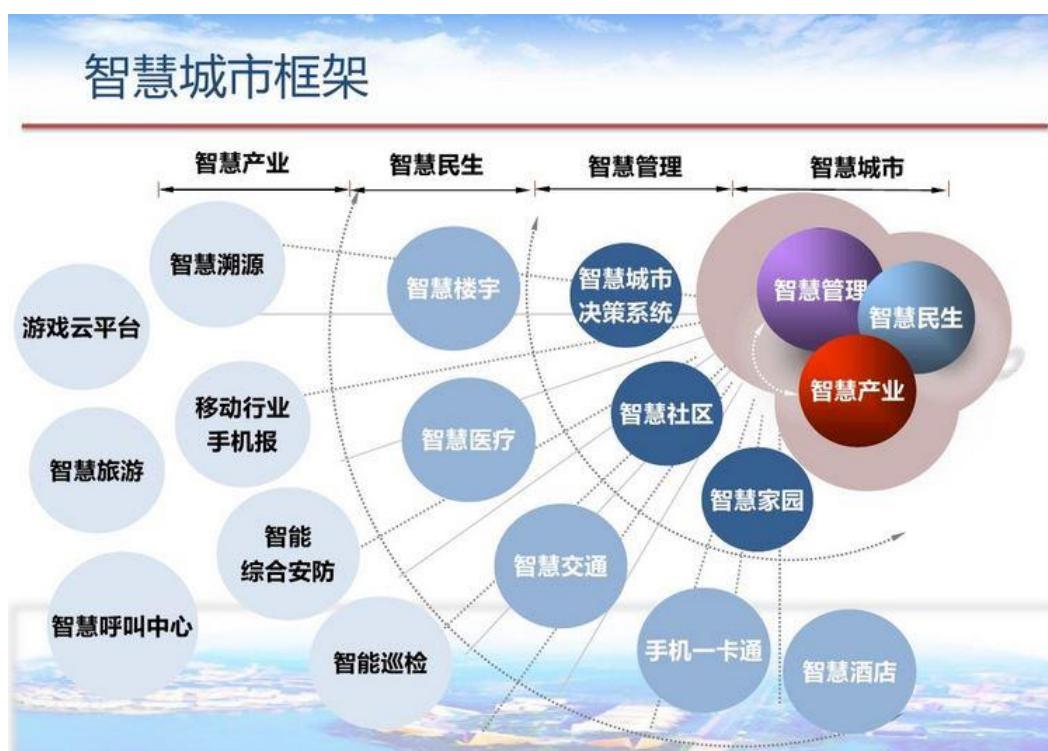


Figure 25: Wuhan smart city framework
Source: <http://www.360fdc.com/news/16204.html>

The Wuhan Research Institution for Smarter Cities (WRISC) is responsible for implementing many of the smart city programs. WRISC was established in 2012 and focuses on resource sharing, R&D, as well as training and education. For example:

- Smart services: (1) smart TV city project; (2) digital urban administrative service

platform; (3) QR code signboard of historical architecture; (4) operation platform of sewage management; (5) vegetable delivery service; (6) public Wi-Fi construction; (7) information system of the municipal service center

- Smart transportation: (1) smart public bus; (2) electronic toll collection system; (3) smart management system for public parking lots

- GIS Data platform: (1) Wuhan GIS cloud system; (2) GIS decision support systems
- Smart monitoring: (1) smart surveillance camera system for public security; (2) information tracing system for meat quality.

URL :

<HTTP://WWW.WRISC.CN/WRISC/DEMOPROJECT/PROJECTS>

WUHAN OVERALL LOW CARBON URBAN DEVELOPMENT PLAN

In August 2013, the National Development and Reform Committee ratified Wuhan's Low-carbon Urban Development Plan (*ditan chengshi shidian gongzuo shishi fangan*). By 2015, it was intended that the city's green areas should account for 28% of the city. Also, 2,000 new hybrid buses would appear on local roads and 20% of all new buildings would be eco-friendly. These targets have been accomplished as planned, and three state-level development zones – Wuhan Economic and Technological Development Zone (Zhuankou Development Zone), East Lake Hi-Tech Development Zone (Optical Valley of China) and Wuhan Wujiashan Economic and Technological Development Zone – have been classified as part of the low carbon urban development plan.

In addition, the polycentric urban pattern is confirmed in the Wuhan Master Plan. It describes the outlines of a green and blue framework in which the urban nodes are located and separated. The green area in the outskirts penetrates into the core zone of city's urban network, mitigating the effect of 'heat-islands', establishing ecological corridors and separating the urban nodes. Six open

wedges between the urban nodes are designated. They represent inherent values of ecology, landscape, agriculture and water storage. To ensure protection of these open spaces and green-blue wedges, the master plan has identified zones forbidden or restricted for use as urban construction land. It is considered a demo zone for cooperation framework on 'sustainable urban development' between China and France (for further details, see below).

URLS:

<HTTP://WWW.CHINANEHYUAN.COM/NEWS/50920.HTML>

HTTP://WWW.WUHAN.GOV.CN/HBGOVINFO/SZFXXGKML/FGGW/SZFWJ/201505/T20150515_30339.HTML

WUHAN HUASHAN ECO-CITY

Wuhan Huashan Eco-city located in Hongshan District is a new town development project, which has been designed by the Chinese Academy of Engineering (*zhongguogongchengyuan*) and funded by Hubei United Investment Group (*shengliantoujituán*). The former is the most pioneering national-level engineering consultancies in China and the latter is the most powerful provincial-level state-owned investment firm, with stakeholders including Wuhan Steel, Dongfeng Motor Corporation, China Three Gorges Corporation, Hubei Tabaco and other important provincial-related state-owned companies. The total area of the new town development covers 67 km² and construction started in 2009.

Focusing on the investment of transportation infrastructure and the ensuing land development, the project adopts a low-density mode based on the assessment of ecological capacity. Within the project area, 40% of the total area is set as the construction forbidden area, and about 40 km² are ecological preservation area, including the Yanxi Lake and the Yandong Lake. The real estates and housing development in the project zone are also designed and built as low-density villa and mansions. The construction also includes the largest scale of security rental housing for the lower income households in Hubei province, which plans to settle 10,000 households. The idea of green buildings is demonstrated by the iconic public architecture of this project, the Huashan Eco art museum. It is the first public architecture in Hubei that obtained the

three-star certification of green buildings with zero carbon emission.

Besides the green built environment, the project also promotes the idea of transit oriented development (TOD). In the project area, 147 kms of bicycle routes and 200 kms of eco-trail are built. In 2016, The Huashan Investment Company signed a contract with an electric car service company to build an operation base within the area and offer low-carbon transit. Green energy such as wind and solar power were widely used in the project. It plans to build solar power with a total capacity of 56 MWp. This market-oriented investment approach was considered successful, and labelled the Huashan mode of eco-city development. A similar project called the Zishanhu new town has been implemented in Xianning City of Hubei province by the Hubei United Investment Group.



Figure 26: Location of Huashan new ecocity in Wuhan

Source: <http://news.cnhubei.com/hbrb/hbrbsglk/hbrb05/201107/t1756116.shtml>

Despite this perceived success, conflicts and tensions still exist in the project. While the real estate housing within the project area were well-known for its good environmental quality, nearby industrial districts may exert certain negative impacts on the environment. According to a news report, some residents in the Huashan eco-city complained about the unpleasant smell spreading from the nearby industrial factories. While the conflict may be seen as illustrating the common problem of 'NIMBY' objections to development, it also reveals the inherent tension which often exists between an eco-city niche and its surrounding areas

URL :

[HTTP://WWW.WRISC.CN/WRIS
C/DEMOPROJECT/PROJECTS](HTTP://WWW.WRISC.CN/WRIS/C/DEMOPROJECT/PROJECTS)

SINO-FRENCH ECOLOGICAL DEMONSTRATION CITY

Based on an MOU signed by the Chinese President Xi Jinping and French President

Hollande in Paris in 2014, the Sino-French Ecological Demonstration City is a cooperative project to develop a 300 km² area in the Caidian district of Wuhan. The master plan of the project was established in 2015, envisaging a new town, eight industrial districts, and several French style tourist sites.

As the core of the cooperation project, the design of the demonstration city named as the Zhiyin New town has been executed by both Chinese and French experts. Three main design ideas were shortlisted after a week of joint investigation in 2014. First, in order to mitigate carbon emission, that the development should be integrated with the transportation such as subway, high-speed rail, and green energy buses. Second, new methods of regulating temperature such as cooling down buildings by the water of the Han River, or heating up buildings by geothermal resources and marsh gas were to be implemented. Third, that the original natural and cultural resources of the rural society should be maintained.



Figure 27: Simulation of the Sino-French Ecological Demonstration City

Source: <http://www.sfwedc.gov.cn/ggjs/cdxm/9735.htm>



Figure 28: Location of Sino-French Ecological Demonstration City
Source: <http://www.urcities.com/native/20141224/13845.html>

Besides the construction of the new town, the project also plans to build eight jointly developed industrial districts as part of the collaboration between China and France. Each industrial district aims for one following specific sector:

1. China-France automobile components industry
2. French-style Wedding industry
3. Circulation industry and renewable energy industry
4. China-France Cultural creative industry
5. China-France Information technology industry
6. China-France Yacht industry
7. China-France General aviation industry: plan for building a multi-functional district for aviation training, research and design, and services
8. France-style Farm and Winery

URL :

<HTTP://ECOEN.CAIDIAN.GOV.CN/>

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WUXI

Author: Ali Cheshmehzangi

Wuxi is an old city in the south of Jiangsu province. Split in half by Lake Tai, Wuxi borders Changzhou to the west and Suzhou to the east. The Yangtze River lies between the northern half of Wuxi and Taizhou, while the southern half of the city borders the province of Zhejiang. Wuxi is also famous for being one of the birthplaces of China's modern industry and commerce, as well as the hometown of many important businessmen who have played essential roles in building commerce in Shanghai since the early 20th century. Wuxi is part of the first batch of eco-city projects in China, is home to a major Sino-Swedish eco-city project, and is also a smart city pilot study area.

A lake pollution crisis, which meant that more than 1 million residents had no drinking water for several weeks, had an upside. The crisis got the city thinking about

a deliberate economic reorientation that would focus on relatively cleaner high-tech industry. In the case of Wuxi, it moved from essentially a large-scale processing city to a smart city with more than 600 core 'Internet of Things' (IoT) enterprises. This focus on IoT has led the city to have more than 1,000 high-level IoT researchers and more than 50 research institutions. The city has involved key national telecom service providers in its quest for modern infrastructure, and it has generated economic output of roughly \$4.8 billion. Wuxi's approach to multiple branding has put the city on the spotlight in the Chinese media and at smart city conferences. As well as being associated with one of the first eco-city projects in China, the city is also now part of the national agenda of Sponge City development, which has recently been released.



Figure 29: A vision of Sino-Swedish Eco-City in Wuxi

Source: www.news.frbiz.com

A wide range of smart-eco activities are taking place in the city of Wuxi, in the fields of telecommunications, modern infrastructure, and enhanced energy and eco services (including smart home, water and air quality monitoring) among others. Additionally, the Wuxi smart city working group at the Institute of Electrical and Electronic Engineers (IEEE) has published proposals for two significant further initiatives:

EXAMPLES OF PROJECTS

SMART WUXI PROJECT

This project covers the whole of Wuxi city, providing public services to all its citizens through its Cloud platform. Through the construction of the Wuxi city big data centre, and four platforms (the electronic governmental administration information service platform, city management information platform, economic operation information service platform, livelihood service information platform), and the development of many other smart applications in different industries, Wuxi has gained an international reputation as an ideal model of smart city activity.

This project has many similarities with Nanjing's smart ambitions, since both have emerged under the Smart Jiangsu province project, which is approved by the provincial government, and implemented by Chinanet Jiangsu. Technical support is also provided by the Chinanet Jiangsu.

The aim of 'Smart Wuxi Project' is to build Wuxi as a model smart city. The project is proposed at city level and is still under development, although some key initial parts of the project have already been completed. There are initiatives and plans for smart healthcare and smart environmental protection. The project is

1. 'Smart Environment Protection in Wuxi' (Wu *et al.* 2016);
2. 'Smart Healthcare in Wuxi' (Yuan *et al.* 2016).

Although many eco projects are taking place in Wuxi, it is mostly well-known for its large investment in smart city initiatives, as elaborated below.

claimed to have 'advanced economic base', 'abundant capital investment' and 'government's active propulsion of smart city construction' (Wuxi Local Government 2014). The project is appraised based on three categories of: (1) high internet broadband accessibility proportion; (2) foundation database construction such as the city's large cloud platform application; and (3) integrated livelihood service ability and open service level of government data (Wuxi Local Government 2014). The Wuxi Smart City project is also highly focused on Internet of Things and the future plans are to enhance and integrate the idea further.

The project is funded by the Wuxi government for a total of over 10 billion RMB. As part of a bigger project, different sub-projects would be undertaken by different bidding companies. There are also Chinese companies involved such as Chinanet Jiangsu (there is also a major Sino-Swedish eco-city project in Wuxi, also described below). The project is mainly a retrofit of the existing urban environment, but focuses on specific components of smart city infrastructure, including Internet of Things, wireless network, etc.

The project's start date is 2012 and the completion is expected in 2020. The project is still on-going with no records of failure so

far. Most importantly, Wuxi has become one of the key smart city projects in the country.

URLS:

HTTP://WWW.WUXI.GOV.CN/WEB101/WXQK/GAZETTE/GOV_FILE/6771752.SHTML

<HTTP://WWW.WUXI.GOV.CN/DOC/2012/04/29/231154.SHTML>

<HTTP://WWW.WUXI.GOV.CN/DOC/2016/03/15/963317.SHTML>

<HTTP://XDJ.WUXI.GOV.CN/DOC/2015/12/25/845561.SHTML>

<HTTP://NEXT-GENERATION-COMMUNICATIONS.TMCNET.COM/TOPICS/DYNAMIC-ENTERPRISE/ARTICLES/337918-WHAT-WUXI-CHINA-TEACH-US-THE-SMART-CITY.HTM>

<HTTP://WWW.TMCNET.COM/TMC/WHITEPAPERS/DOCUMENTS/WHITEPAPERS/2013/8212-ALCATEL-LUCENT-VOICE-SMART-CITY-CITIZENS-WUXI-PRESENTATION.PDF>

SPONGE CITY WUXI

Based on its natural landforms, combined with the green channel networks, ecological wetlands, and park greenery, the city plans to construct the green ecological sponge network, which covers the whole urban area. Through the rebuilding of city roads and squares, combined with the construction and transformation of different types and levels of sponge projects, such as the sponge community, sponge town, the city plans to become one of the key models of sponge city project in China. Based on reconstruction of the original city drainpipe network, pump station of city drain flooded field, enhancement and improvement of the city Greenland system and river water network, completing the combination of human project and natural water absorption and drainage network system, the project is aimed to transfer the city into a sponge city.

The design and construction of sponge city project will combine with other people's livelihood projects, which preclude the impractical image project and movement. This project will not merely focus on the image of the city and government, but also try to help the old urban community areas with the damaged drainage and anti-water-logging function. It also pays attention to the natural water circulation and purification of the city.

Wuxi National Hi-tech District (WND) is scheduled to improve the drainage system of Samsung SDI's Wuxi subsidiary (source:www.js.xinhuanet.com). The initial phase of the project is to target key industries and enable factories to better absorb rainstorms and optimise the sewer system, including rain water management and urban drainage system. A further development on guidance for water collection planning, facilities for water

recycling and use are under development by the district's planning bureau.

According to the Jiangsu government document, this project aims to strengthen the conservation of natural water system in urban areas. It also aims at enhancing the function of water storage and purification of landscape, change and construct all roads into 'sponge road' which could strength the ability of roads to percolate and absorb nature water. Additionally, it targets the improvement of the urban sewerage system. The project is proposed at district level and is currently at its initial stage of development. The main actors involved in the project are district planning bureau, policy makers and corporates. The project is also supported by the central government at the national level.

The project can be regarded as a mixed project between new buildings and retrofitting the existing urban environment and has just started in May/June 2016. No completion dates or total investment amount are proposed at this moment.

SINO-SWEDISH ECO-CITY

The Sino-Swedish Eco-City in Wuxi is the result of collaboration between the Chinese local government and several Swedish stakeholders aiming to create a sustainable urban infrastructure comprising environmentally conscious energy systems. They proposed a new urban area with a focus on use of technology for renewable energy, waste management, low carbon. It is located at Taihu New Town in Wuxi

The Eco-City is destined to be the home for approximately 20,000 inhabitants (Fulco 2011). Although the project is in its initial phase, many of the goals and targets for its success are already clearly defined. The integrated system of sustainability that the Eco-City forms, will go beyond the

existing facilities and also comprise of the awareness of sustainability with the people living in it. The project's ability to succeed is understood to depend on how much its residents embrace the mission that the city has set out to fulfil. One example is provided by the Eco-City's transportation. The plan is to assign eighty per cent of the total commuting in the area to public transport, and by doing so, encourage the residents to travel by buses or trains in order to lower total emissions. Roughly fifty per cent of transportation vehicles are set to run on renewable energy sources (Qian 2011). Another goal for the Eco-City is to exemplify the local inhabitants' cooperation in terms of local waste management. By educating and promoting sound recycling and proper discharge of household organic waste and combustibles, the systems can work in a superior way, where energy, gas and other rest products can be extracted from the waste (Qian 2011).

The aims of this Eco-City in Wuxi will, in addition to the Swedish technologies, use the best systems and processes available in order to create an urban environment that is minimizing its negative environmental impact without affecting the quality of the city's residents. The ambition is to create an eco-city that serves as both a role-model flagship for eco-cities as well as an educational showcase for future peers (Qian 2011).

The Sino-Swedish Wuxi Eco-city project is a new project at city level, which is currently under construction and partially completed. The project strongly focuses on energy has the following aims (Stoltz 2013):

1. to develop a systems model taking into consideration all major energy subsystems.
2. to conduct an in-depth analysis of the energy system.

3. to develop an innovation system model for the Eco-city.

The conceptual system is to achieve efficient energy systems at five levels:

buildings, the eco-city as a whole, Taihu new city, the Wuxi region, and the national level.

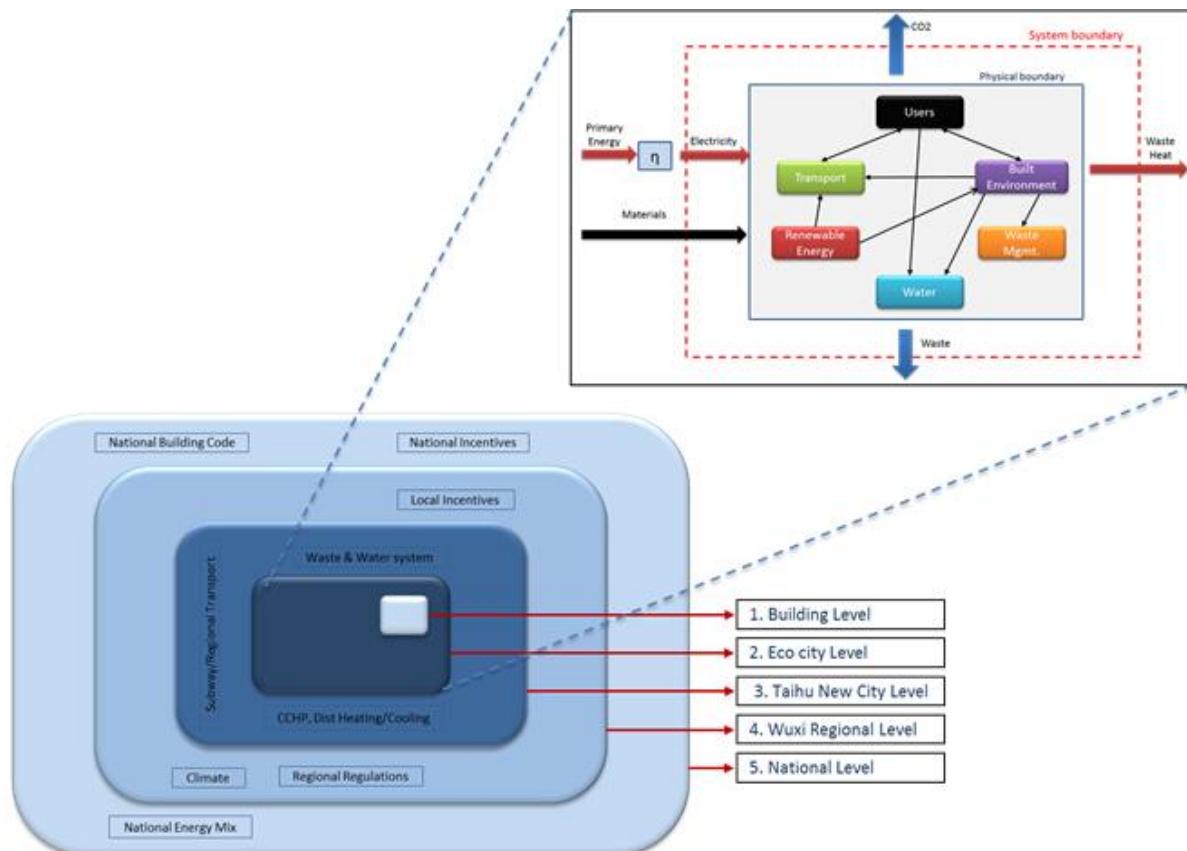


Figure 30: Conceptual Systems Model for Wuxi Eco-City

Source: Stoltz, 2013 – by KTH Department of Energy Technology

<https://www.kth.se/en/itm/inst/energiteknik/forskning/ett/projekt/wuxiecoicity/project-description-1.338870>

The main actors involved in this project are Wuxi municipal people's government, the Swedish government and architectural firm Tengbom. There are no exact data available for the total investment amount. This project is a new build project (using a mix of existing brownfield and greenfield land) and was commissioned in 2009. The completion date is unknown and the project development is still ongoing.

URLS:

[HTTP://WWW.DIVA-
PORTAL.SE/SMASH/GET/DIVA2:
631144/FULLTEXT01.PDF](HTTP://WWW.DIVA-PORTAL.SE/SMASH/GET/DIVA2:631144/FULLTEXT01.PDF)

<HTTPS://WWW.KTH.SE/EN/ITM/INST/ENERGITEKNIK/FORSKNING/ETT/PROJEKT/WUXIECOITY/PROJECT-DESCRIPTION-1.338870>

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Yuan, Y., Fang, W. and Wu, X. (2016) *Solutions and Plan of Smart Healthcare in Wuxi*. Online: http://smartcities.ieee.org/images/files/pdf/solutions_and_plan_of_smart_healthcare_in_wuxi.pdf (accessed 10 April 2016).

APPENDIX

METHOD FOR SELECTING CHINA CASE STUDIES

Author: Ali Cheshmehzangi

The method for selecting Chinese case studies involved several steps. First, urban areas with over 100,000 residents were identified. In this selection process, 440 Chinese cities met this criterion (additionally, many township regions and even districts had populations at least this large, but these were not considered in the case study selection process).

Next, an internet search was conducted on all the 440 identified Chinese cities (from 2010 and 2012 databases) using the two key phrases of 'green' (*lvse*) and 'eco' (*shengtai*). Both phrases, '*lvsechengshi*' and '*shengtaichengshi*', are similar by definition in the Chinese literature. This process was undertaken to filter out cities which did not obviously display prominent eco or green characteristics or ambition.

At this stage, it was observed that all 440 cities have at least one of the following: a green agenda, a low-carbon development plan, a green sustainability plan, or an eco development initiative. Eight eco-city projects were also included which represented the first wave of eco-cities in the following cities: Tianjin, Caofeidian (Tangshan), Wuxi, Changsha (Meixi Lake), Shenzhen, Chongqing, Guiyang and Kunming. Since some of these eco-city projects started after 2012 or are at district level, they may not have appeared in the original list of 440 Chinese cities. However, given their significance to ongoing 'eco' and 'smart' activity, for the purpose of case study selection, it was decided that they should also be included in a 'long list' of possible cases. Table 1 below provides some key information about these eight special cases.

Table 1: the eight cities from the original wave of eco-city development in China

绿色生态城区 Eco-City Projects	面积 (平方公里) Area	人口 (万) Population	Current status
中新天津生态城 Tianjin	30	35	Under Const./Operation
唐山市唐山湾生态城 Cao Feidian	150	100	Under Const./Operation
无锡市太湖新城 Wuxi	150	100	Under Const./Operation
长沙市梅溪湖新城 Changsha	7.6	17.8	Under Const./Operation
深圳市光明新区 Shenzhen	156	80	Under Const./Operation
重庆市悦来绿色生态城 Chongqing	10	30	Under Construction
贵阳市中天未来方舟生态新区 Guiyang	9.6	17	Under Construction
昆明市呈贡新区 Kunming	160	95	Under Const./Operation

The second stage involved narrowing down this list by bringing in the phrase ‘smart’ in to the shortlisting process. It became evident that most of the cases currently include smart initiative, plans or strategies in their agenda. There is also a large range of varieties in smart development and initiatives; from as small as an app development (e.g. in the case of Fuzhou) to city-level smart development plans (e.g. Wuxi). Therefore, to better validate our selection, the list of city cases was cross-referenced against two major lists of smart city development projects in China, from 2010 and 2014.

The first of the sources used for this cross-referencing was the list of smart city development projects from the 2010 ‘First Report on China’s Smart City Development Level’ (首届中国智慧城市发展水平评估报).² The second was the list of the top 20 China smart cities presented at the 2014 ‘Summit on Chinese Smart City Development’ (中国智慧城市发展高峰论坛).³ By identifying the overlap between these two lists and our own, 12 cases were identified for inclusion in the current report: Shanghai, Kunming, Qingdao, Hangzhou, Wuhan, Tianjin, Fuzhou, Ningbo, Nanjing, Shenzhen, Wuxi and Chengdu. All 12 include at least one eco/green project and at least one major smart initiative. Some cases include projects at multiple spatial levels and with multiple partnerships (e.g. Shenzhen and Shanghai). Out of the 12 cases, there are a few with international collaborators or partnerships, mostly from the European parties.

Finally, and looking beyond the present report, four cases of Chinese smart eco-city development were selected for in-depth study during the second year of the research project. These four cases are: Ningbo, Shanghai, Shenzhen and Wuhan. The final selection is based on the following factors: a) a variety of partnerships (international, national and local – or mixed); b) accessibility to the cases; and c) regional case representatives; i.e. two from coastal east, one from coastal south, and one from inland central). Each has a relatively well developed programme of initiatives which clearly fall into the ‘eco’ and/or ‘smart’ categories, even though the final selection did not depend primarily on the precise way in which the initiatives and cities labelled themselves (e.g. ‘eco city’, ‘smart city’).

² <http://www.im2m.com.cn/zt/29/>

³ <http://sz.people.com.cn/n/2014/1117/c202846-22927699.html>



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