CHAPTER 6

Meso Level: Eco-Neighbourhood/ Community Cases in China

6.1 Introduction

From the perspective of the urban built environment, neighbourhood is a linkage between the individual households and the broad urban context. It is a relatively small geographical unit where social, economic and environmental inter-activities occur. Thus, evaluating a neighbourhood should not only address exactly the immediate neighbourhood environment. It should also include both of the constituent components, such as buildings and people, and a larger spatial context that exerts impacts such as location and urban infrastructure.

Different from the term 'neighbourhood', community is a word, which is people-centric. The term community refers to a group of people that are bound by a specific geography and with a shared sense of collectiveness. Community is transformative and the pivot of information exchange and peer learning. Neighbourhood, as a geographically limited size with intensive interactions between people, is the most important space that people can develop a sense of 'community' and/or 'belonging'.

A 'sustainable community' does not describe just one type of neighbourhood, but the activities that a community engages in to sustain the environment and empower their citizens (Roseland and Spiliotopoulou 2017). One of the prominent examples that are often mentioned for extensive involvement of the general public is the well-known 'Sustainable Seattle Program (SSP)'. Over the past 25 years, SSP has worked to develop

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five sets of community-based indicators, measuring and making progress towards sustainability in local communities. The development of sustainability targets involved grassroots processes including task teams, civic panel meetings and workshops to form consensus (Sustainable Seattle website n.d.).

Mobilising community is also considered as an effective way in China to move towards sustainability. In 2004, the Ministry of Environmental Protection (MEP) has published the Guidance of Constructing Green Community (GCGC). The Eco-School Scheme was initiated by the Ministry of Environmental Protection (MEP) to encourage environmentally-friendly behaviours in primary schools. In 2016, MOHURD launched a new programme to promote sustainability in the rural area and, at the time of writing, 5855 villages across the country have been certified as 'national green villages'.

There are also neighbourhood-level evaluation systems. Examples include LEED-Neighbourhood Development (LEED-ND), CASSBEE-Urban Development (CASBEE-UD), Green Star—Precincts and BREEAM-Communities. China's specific neighbourhood rating system—Eco-Urban District Evaluation System—was just launched as a new national standards set in October 2017. Earlier on, a neighbourhood-level evaluation system in China—Green Campus Evaluation Standards—has been published in March 2013. These evaluation systems have been used to certify neighbourhood projects in China.

Generally, there are mainly four representative methodologies related to neighbourhood sustainable development:

1. Eco-Industrial Park;
2. Eco-Village;
3. Eco-Business Park;
4. Eco-Residential Compound.

An Eco-Industrial Park is focused on creating a circulation economy by sharing resources and increasing economic efficiency. Currently, around 60 projects have been approved for construction of national pilot eco-industrial parks. An Eco-village aims to create a liveable village and encourage behaviour change by community learning. Its launch marks a recent policy development to address sustainability issues in the rural context. Eco-Business Park is a mixed neighbourhood, often located in city centres or major urban hubs, mainly comprising commercial and office

components. Accessibility and walkability are the main issues to be addressed. Eco-residential compounds in China are mostly in the form of small residential districts (SRD), which is a basic planning unit in Chinese cities. SRD is a gated community enclosed by walls and fences. However, there has been a recent debate over opening SRDs to ease urban traffic congestion. There are some business parks and residential compounds certified by neighbourhood evaluation systems, such as LEED-ND and BREEAM-Communities. According to the data from Green Building Map (2017), 22 neighbourhood-sized projects have been certified by LEED-ND in China. In this chapter, we will explore eight case studies drawn from the four neighbourhood categories.

6.2 The Sino-Singaporean Suzhou Industrial Park (SIP), Suzhou, Jiangsu

Type: Eco-Industrial Park

Project Overview

The Sino-Singaporean Suzhou Industrial Park (SIP) is a strategic economic partnership between the Chinese and Singaporean governments. Launched in 1994, it was the flagship cooperation between both parties for the development of an innovative eco-industrial model park and is situated in Suzhou City of Jiangsu province China (Sim 2015). The initial conceptualisation of the project is attributed to the former Chinese leader, Deng Xiaoping, for his comments on the need for China to leverage on experiences from Singapore in key areas of economic and social development, during a tour of southern China in February of 1992. Seeing China's interest as a potentially beneficial opportunity to both parties, Lee Kuan Yew, the then Singaporean senior minister, called for a bilateral project during a state visit to China in September/October 1992. This led to the signing of the SIP agreement between the Singapore Labour Foundation (SLF) International, and the Suzhou government in December 1992 (Souza 2009; Pereira 2003).

The Suzhou Industrial Park (SIP) employs a three-pronged collaboration approach. At the topmost level is a Sino-Singaporean Joint Steering Council (JSC), which provides strategic direction and leadership for the project. The next level is a joint working committee whose members include the mayor of Suzhou city, chairman of the Singaporean Ministry of Trade and Industry, key government officials from Jiangsu province,

Suzhou city and Singapore, who meet around four times a year to deal with more operational issues in the SIP. The bottom level involves more operational daily leadership provided by the joint venture company, the Sino-Singaporean Suzhou Industrial Park Development Corporation Ltd. (CSSD), and the Suzhou Industrial Park Administrative Committee (SIPAC). The ownership of the SIP was based on 65% for Singapore, while the Chinese parties held 35%, until these figures were reversed in 2001. As at 2012 the Singaporean parties holds 28% within the Sino-Singaporean SIP development corporation Ltd (CSSD), while the Chinese parties hold the remaining stake (de Jong et al. 2013).

The SIP is located in the beautiful city of Suzhou, in the Jiangsu province of China. Suzhou is a key traffic hub with relatively good connections from the Shanghai–Nanjing Expressway, the Suzhou–Jiaxing–Hangzhou Expressway, the Suzhou–Shanghai Expressway, the Shanghai–Nanjing Railway, the Shanghai–Nanjing Intercity Railway, and the Beijing–Shanghai High Speed Railway. Intended to be the new eastern township of Suzhou city, the SIP covers a total administrative area of 288 km^2, of which 80 km^2 is devoted to the China–Singapore cooperative zone. As an industrial park, the SIP boosts of a number of layouts, including: the industrial level (machine manufacture), electronics, information, modern service industry, nano-tech applications, bio-medical sciences, and cloud computing. The SIP consists of three key districts: Jin Ji Lake rim CBD, the Du Shu Lake Innovation District of Science and Technology, and the Yang Cheng Lake Tourism Resort. It also has two gateways: the SIP Integrated Bonded Zone and Donghuan Road Area. Furthermore, it is connected with the Suzhou Dushu Lake Science and Education Innovation District (SEID), a 25 square kilometre planned area for universities, science and technology platforms (SIP website).

Eco-Initiatives and Green Features

The SIP is one of the few industrial parks to have actively sought to blend traditional culture with modern advances, particularly with regards to urban environmental issues. It currently has more than 25 million square metres of green area, and records 45% green coverage rate. The annual output of its over 100 energy-saving and environment-protecting industrial projects totals around 42 billion RMB. Key eco-initiatives within the SIP include (SIP website):

Energy and Waste Management: There are 76 two-star International Green Building projects, and a dozen Gold LEED-certified buildings in the SIP. Its recycling system consisting of wastewater treatment plants,

sludge drying facilities, thermal plants, and central AC system covers the sewage network across the entire area. The SIP Sino French Environment Technology Co. Ltd, a joint venture which 49% is owned by Sino French Water and 51% owned by China Singapore Public Utilities, operates the first sludge treatment plant designed in Jiangsu province designed and built by Degrémont.

Transportation: Pedestrian walkways, bicycle lanes and functional public bike services are prevalent across the SIP. Also its smart bus system is capable of scheduling and managing 640 buses, as well as releasing real-time bus information at 455 bus stops.

Social-Cultural: A number of social-cultural activities are often held within the SIP. Communities and schools hold flea market and car-free days, publish books, teaching materials and pamphlets promoting a low-carbon lifestyle. 58 residential communities try out garbage classification; 25 schools pair with local companies in protecting environment; the green coverage rate in residential communities is 90%, and 95% schools are recognised as green campus; and the former rural townships of Loufeng, Weiting and Shengpu are certified as beautiful towns by the national authority. Furthermore, the SIP has a range of facilities, including housing, retirement villages, recreational and senior care facilities, as well as schools, including the Suzhou Singapore International School.

Case Study Reflections

Despite having achieved much in terms of development, SIP faces several key challenges. For example, low-end and labour-intensive industries such as electrical manufacturing are being replaced by high-tech and service industries like nanotechnology and finance. But analysts say there should be an eco-system of large firms and small vendors. Otherwise, transport costs could rise if small firms cannot enter or have to move out. There is also a need to further streamline the SIP's bureaucracy and to better examine officials for top jobs after two officials were placed under anti-corruption investigations.

In two decades, the authorities have turned down 300 projects with total investment of US$ 2 billion since they posed potential hazards to the local environment. SIP leads among national development zones with 351 ISO14001-certified companies. As a result, Its COD (Chemical Oxygen Demand), carbon dioxide emission for producing 10,000-yuan GDP and comprehensive energy consumption in 2013 is one-eighteenth, one-fortieth, and one-third, respectively, of national averages. By October 2015, a total of 5512 foreign businesses were reported to have been

attracted to the SIP amounting to a contractual investment of EUR 37.58 billion while import and export volume was totalled to EUR 5658.73 billion (EU SME Centre website). The SIP is listed as one of the country's first model ecological industrial parks, and pilot areas in building ecological civilisation. The SIP project represents one of the early eco-industrial parks of China. It also highlights the importance of industries and low-carbon transitions in the process of development.

6.3 The Sino-German Qingdao Eco-Industrial Park, Qingdao, Shandong

Type: Eco-Industrial Park

Project Overview

The Sino-German Qingdao Eco-Industrial Park (SGQEP) is a strategic economic cooperation between the Chinese and German governments, focused on the areas of ecological and sustainable development. The project seeks to leverage on the technical know-how of both parties in the application and demonstration of environmental standards and technologies in fields such as energy technology, automotive, automation and supply industries, and in the bio-pharmaceutical industries. In particular, it aims to enhance industrial and technological development by attracting both German and other foreign technical and service-based firms to the eco-park. Development of the SGQEP was approved by the state council of the government of the People's Republic of China on 4 January 2011, as part of the 'Blue economic zone' development plan in Shandong Peninsula (Sino-German EcoPark website; Xinhua 2017).

The SGQEP is situated in Huangdao district, 30 km from Qingdao Lui'ting international airport and 6 km from Qingdao bay ports in the port city of Qingdao, Shandong province, China. It sits on a land area of 11.6 km^2, towards the northern fringe of the economic and technological development area in Qingdao. The project design and implementation involved collaboration amongst key parties, such as the Chinese Ministry of Commerce as the key stakeholder, the German Federal Ministry for Economy and Technology, the City of Qingdao (which has a substantial German cultural heritage, being a former German protectorate between 1897–1914), and technical partners from China and Germany providing support in the areas of masterplanning, design and sharing of experiences in technologies and eco-city standards. As an industrial park, the SGQEP boosts of a number of layouts, including: ecological residential areas;

industrial areas covering both German and Chinese manufacturing companies; science and technology research facilities and schools; with good access to other amenities within the main city of Qingdao (Sino-German EcoPark website).

Eco-Initiatives and Green Features

Central to the conceptualisation of the SGQEP was the idea of 'green integration' in key areas involving planning for the urban spaces, building design, traffic management and landscaping. Of its 11.6 km^2 land area, 30% was allocated for green spaces and landscaping, while the industrial and residential areas used up 45% and 25%, respectively. Below we briefly discuss key eco-initiatives within the SGQEP (Sino-German EcoPark website; Siemens 2017; Yang et al. 2017; Ling et al. 2013; German Energy Center & College website n.d.):

A Passive House Demonstration Project: Occupying a land area of 13,768 m^2 sits a passive house technology centre within the SGQEP, with facilities ranging from showrooms, multifunctional meeting rooms and office spaces to residential apartments. The project, which was developed by Siemens, serves as a demonstration of the importance and principles of passive house technology in building energy management. Passive house technology is primarily founded on a set of building standards, which stipulates key requirements in terms of architectural planning, technology usage and ecological planning. It leverages on thermal insulation and the use of heat exchangers in moderating energy usage within buildings. Available figures show that the passive house technology demonstration centre saves about 1.3 million kWh of energy annually, translating to 500,000 RMB in energy cost savings, and that it uses 90% less energy than a building of similar size and capacity.

Energy Efficiency in Building Development: In addition to the passive house technology centre, other industrial and residential developments within the SGQEP were built with a strict adherence to energy efficiency standards. For example, the residential areas within the SGQEP, accommodating 7685 inhabitants, were developed in line with China's two-star system for green buildings. This standard, comparable to the LEED ratings for buildings, evaluates building development with respect to factors such as: water and energy savings, materials savings, indoor environment quality, land savings and outdoor environment, amongst other factors. Industrial developments within the SGQEP also adhered to strict energy efficiency standards, with the German enterprise centre recognised as the first DGNB gold-certified office building in China.

Ecological Primary School Demonstration Project: Eco-initiatives were also extended to the creation of a model eco-primary school within the SGQEP. The project covers a land area of 3.5 hectares, with the current student population put at 1620. Developed to achieve a zero-energy-consumption standard, it is reported to be the first eco-primary school in China and seeks to serve as a model for the adoption of ecological technology standards within school developments in China.

Case Study Reflections

Since its initial conceptualisation and eventual development, the SGQEP has continued to witness tremendous improvement in investments and interest from both foreign and local firms. Figures, as at the first quarter of 2016, placed investment volume within the SGQEP to about US$51 million. Notwithstanding the reported successes discussed above, concerns still remain with respect to the ecological and sustainable development drive of the SGQEP. For example, support from both the local and national government in China helped open up the SGQEP to Qingdao main city, with the construction of roads and linking bridges due to its remote location. As a consequence, there was an increase in the number of cars, which were initially controlled within the SGQEP, leading to concerns over the level of vehicle emissions (Ghiglione and Larbi 2015). This factor reflects on the planning system that is implemented in the project.

Questions of the economic viability of the SGQEP, vis-à-vis its remote location from Qingdao downtown, is seen as the main reason for the possible trade-off in allowing the influx of cars within the SGQEP. With plans in the works for a subway line and other public transport measures to connect the SGQEP with Qingdao main city, it is hoped such issues will be addressed. However, this only depends on how this new area is accessible in the future for trade, businesses, and new industries. It is anticipated that it would still remain dependent on the industries in the surrounding areas.

6.4 Tengtou Village, Ningbo, Zhejiang

Type: Eco-Village Development

Project Overview

Tengtou is a small village settlement located in Fenghua district within the City of Ningbo, in Zhejiang province: an eastern coastal province of China. It sits on a land area of two square kilometres, with a current

population of 817 people. Famous for its eco-tourism attraction potential, Tengtou residents are mostly engaged in agriculture and tourism-focused occupations. Fenghua district itself is a culturally and politically important part of Chinese history. Established as a county during the Tang dynasty, it is the ancestral birthplace of Chiang Kai-shek, who served as the leader of the Republic of China between 1928 and 1975 (Fenghua Government website 2017; Top China Travel website 2017). The region, therefore, offer a combination of tourism, political status, and historical values.

Tengtou village is famous for its eco-friendly developmental approach. This is widely acknowledged in the literature, making Tengtou the only village selected to be exhibited in the Urban best practice area of the Shanghai Expo in 2010. It has also been recognised by the United Nations as being amongst the 'Global Ecological Habitats 500', and is listed as No. 6 in China's Top Influential villages (Han 2010; China Net 2010).

Eco-Initiatives and Green Features

From the onset, developmental initiatives within Tengtou village were planned with keen consideration and adherence to environmental preservation. Particularly during China's reform and opening-up period during the 1980s, Tengtou village had set out clear pathways for its development, some of which includes in the followings (Han 2010; China Net 2010):

Environment-Friendly Development Assessment: Developmental initiatives within Tengtou village are put through a rigorous assessment process, in order to determine their environmental impacts prior to project approval and commencement. For example, a proposal to build a pulp and paper mill in the village by a foreign investor in the 1980s, promising an impressive annual profit of over 1 million RMB, was rejected by the local authorities after its impact on the environment was further assessed. To get the buy-ins of the villagers, a documentary was screened, with the help of an environmental specialist, detailing the impacts of pollution and environmental mismanagement on the occurrence of future environmental and health disasters. As a consequence, the local authorities and the villagers reached a unanimous decision to cancel the project. In furtherance to project assessment in Tengtou village, an environmental protection committee was set up in 1991. Being the first such village-level environmental protection body in China, it was aimed at assessing and approving projects for development within the village. It is reported that over 50 projects, with impressive economic returns but high environmental impacts, have been rejected in Tengtou village.

Renewable Energy Adoption: Tengtou village broadly adopts renewable technologies for environmental protection, with ecological conservation funding by local authorities growing by about 20% annually. The village saves about 50,000 kWh of electricity annually from its residential communities, with these communities equipped with solar-powered water heating systems. An estimated one-third of its roads are reported to be equipped with both wind- and solar-powered street lighting. In addition, the data on air quality, temperature, and humidity conditions within the village are constantly monitored and displayed on electronic boards. These data are measured by the local air-quality monitoring station, helping the villagers to stay abreast of real-time conditions. Therefore, there appears to be a strong sense of awareness of climatic conditions and air quality in the community.

Water and Waste Recycling: Tengtou village broadly practices waste recycling and also encourages the use of fabric bags, as opposed to plastic bags, for shopping. Rainwater and sewage wastes are separately managed within residential areas: Tengtou's main waste and garbage system is managed using an eco-friendly process, within the main Fenghua district. The village saves an estimated 9500 tonnes of water annually by using captured rainwater within its two eco-friendly toilets constructed for the village.

Agricultural Innovation and Collaboration: In addition to eco-tourism, agriculture serves as a key occupation for the residents in Tengtou village. Prior to the intervention of the local authorities, the villagers had problems engaging in farming activities due to the unfavourable natural conditions of low altitudes and farmlands being submerged from rainfalls. To address the issues the local authority bought up the farmlands, founded an agricultural company focused on developing an industrial agriculture programme, and adopted three key practices: Firstly, they employed organic farming practices whereby the use of pesticides and other artificial fertilizers were discouraged; secondly, a three-dimensional eco-farming approach was adopted wherein farming was practiced under a three-layered framework. The upper layer involved the cultivation of grapes, with this layer serving as a shield against heat and sunlight. The middle layer was used for breeding birds, with the fallen grapes from the first layer serving as a source of food for the birds. While the last layer was used for fish farming, with the fishes feeding on fallen bird wastes from the middle layer. This ecological approach to agriculture was highly commended by officials from the United Nations, earning Tengtou village the Global 500

Award for Environmental Achievement; and lastly, the local authorities in Tengtou village embarked on a number of project collaborations and cooperation with research institutions and universities for the advancement and adoption of technologies for agricultural efficiency. As a consequence, plant tissues and cultivated seedlings from various plantation-yielding fruits were developed.

With such focused initiatives, Tengtou village has seen a huge increase in its agricultural outputs and earnings. It is reported to have earned 30 million RMB from supplying flowers and plants for the Beijing Olympics event in 2008, and also provided the 2010 Shanghai World Expo with about 100,000 tree seedlings. Also its agricultural success and expansion as a major industry has seen an increased demand for land resources, with villagers relocating to other cities and/or provinces within China to set up plantations.

Case Study Reflections

Tengtou village continues to draw increasing attention for its eco-friendly development from tourists and public officials in different parts of China and the world. Its plantations, particularly with beautiful gardens and flower fields, are key tourist attractions. Tengtou is known to be the first village in China to sell tickets to visitors since 1999. Figures in 2009 place ticket sales around about 26.3 million RMB, and the overall tourism earnings were estimated to be about 119 million RMB annually. Furthermore, Tengtou village's model is being studied for its eventual replication to other parts of China, and possibly the world: the village has seen an influx of government officials from various parts of China to study and share experience with Tengtou local authorities on its success. In addition, a mimicked version of Tengtou village, called Tengtou pavilion, was built and displayed at the 2010 Shanghai Expo, with visitors at the expo treated to a typical rural experience of China.

There is still much to be accomplished in Tengtou village with respect to its drive for ecological conservation, enhancing the quality of life of the villagers and its management. Nevertheless, Tengtou's proactive approach to eco-development and its promotion of eco-tourism as a key economic driver provides a valuable lesson for other cities/towns aiming for ecological conservation. Tengtou sets as a remarkable example of its kind amongst Chinese villages that is actively focused on eco-tourism and ecological conservation measures.

6.5 Gubeikou Township, Beijing

Type: Eco-Village Development

Project Description

Gubeikou Township is a strategic water town, supplying most of Beijing's drinking water sources. It is located within Miyun County towards the northeastern part of Beijing Municipality. To the north, it is linked by Luanping County of Hebei province, and to the west by Gaoling and Xinchengzi (both of them towns within Beijing municipality). Gubeikou previously served as an important military passage, connecting much of the northern and southern parts of the Yanshan range. It covers a total area of 85.82 km^2, with jurisdiction over nine villages and four residential neighborhoods. As at 2016, available data placed its total population to about 9154 people, of which 6834 are primarily farmers, accounting for 75% of the total population. This township is not necessarily a neighbourhood-scale project, but is one of the case of eco-village development in China.

Gubeikou is planned to be functionally liveable, environmentally friendly, and economically prosperous, with its economy driven by a high degree of tourism-oriented culture. In 2008, the Ministry of Finance (MoF), the Ministry of Housing and Urban–Rural Development (MOHURD), and the National Development and Reform Commission (NDRC) selected the town as one of the first seven national pilot towns for green and low-carbon development. At the same time, it was also recognised as a key Chinese historical and cultural town (Beijing Miyun 2017; Beijing Tourism 2016; Gubeikou Government website n.d.).

Eco-Initiatives and Green Features

Planning initiatives embarked upon by Gubeikou Township is geared towards achieving three key targets: (1) a green and environmentally friendly town; (2) a culturally preserved zone; and (3) a livable community. Moreover, from the planning perspective, Gubeikou Township is divided into three ecological areas: the first includes mountainous areas, focusing on the conservation of mountainous ecological systems combined with the moderate development of eco-tourism; the second area includes the town centre, focusing on ecological town construction and energy-efficient buildings; while the third is the Chao River, which is a strip of green space with a width of between 100 and 200 meters designed to form a transition between the mountainous area and the town center, and also to serve as a public open space to create interactions amongst people.

In 2012, Gubeikou further developed a plan specially for constructing green and low-carbon township, which proposed a set of targets that must be met as at 2015. Among the key environmental targets are: a 25% carbon reduction per GDP unit between 2010 and 2015; ensuring that all public and new buildings meet the national building energy efficiency standard or attain green building certification; that 30% of households should use at least one renewable technology as energy source, and to attain a 95% mark for wastewater treatment. We briefly discuss progress made towards these targets (Gubeikou Government website n.d.; Gubeikou Township Government 2008; Beijing Miyun 2017):

Promote the use of renewable technologies: From 2010 to 2015, during the period of the 12th Five-Year Plan, Gubeikou has gradually increased the use of solar energy, shallow ground energy, and biomass as the source of energy for buildings. The main technologies adopted are BIPV, ground source heat pump, water source heat pump and reuse of waste heat. All roads and streets have been installed with solar street lamps, and 64.5% of households have been installed with solar hot water systems. Four biomass-fuelled gas stations were built to provide gas to 30% of the households. The street lamps along the main road have also been replaced with solar and/or LED lighting.

Promote green building development: All new buildings in Gubeikou were encouraged to achieve the national mandatory energy efficiency standard for the cold climates. Through this promotion process, developers were also encouraged to attain a GBES certification for their projects. The compliance rate to the national building energy standard is still low in rural areas. Gubeikou is one of the few townships in the rural area that put energy efficiency as a compulsory requirement. The largest new residential development in Gubeikou is Shimatai Village. In addition, air source heat pumps were installed to provide heating in wintertime, saving about 3000 tons of coal compared to heating sourced from coal burning.

A large percentage of residential houses were originally built with no insulation, meaning that they were very susceptible to heat loss. In addition, they were very expensive to heat. The town has invested 18 million RMB to insulate those houses since 2012, and by 2015, 820 houses, totalling 64,000 m^2 of floor area, has been upgraded with better insulation and other energy-efficient measures, such as installing thermal-protective doors and windows. Government buildings and school buildings (in the category of public buildings) were also retrofitted with better insulation, and efficient heating provisions.

Improved environmental quality and community facilities: Gubeikou, as previously stated, is a strategic water town. A key issue, however, has been the contamination of its waterways from the disposal of sewage. To address this issue, a central wastewater treatment plant was built in the township and 23 small-sized treatment stations in the villages. A waste transfer station was also built, as a temporary stack site, before wastes are moved to the disposal center in the Miyun County. Furthermore, investments were also made for the provision of community-based facilities. About 20 million RMB has been invested in building a cultural and sport centre, a kindergarten and a service centre. Every individual village has also been equipped with a square and sports facilities installed to foster and enhance interaction amongst residents.

Case Study Reflections

Gubeikou Township continues to enjoy tremendous improvements in terms of its eco-development agenda. It is also attracted attention from both local and national governmental levels, given its strategic importance in serving as Beijing's drinking water source. Various projects scattered across its township area focused on creating environmental, cultural, and liveable environments, which are already attracting an increasing number of tourists. For instance, in 2015, more than 1.47 million tourists were reported to have visited the nine villages and four residential neighborhoods under its jurisdiction, leading to an income of 460 million RMB; while figures from 2016 place the number of tourists visiting at 243 million people drawing an income value of 720 million RMB (Gubeikou Government website n.d.). Gubeikou is currently listed as one of the most beautiful leisure townships within the Beijing municipality, given its rapid adherence to eco-environmental initiatives while at the same time maintaining its traditional and cultural foundations.

The project is still under further development to achieve its eco-environmental initiatives and agenda. Alongside the recent innovation-driven development region in the Xiong'an New Area (announced in autumn 2017), Gubeikou still remains one of the important areas in the region. However, the project's focus, particularly in the past few years, has been mostly on tourism industries, which puts some pressure on their initial environmental protection strategies. As a result of its natural importance in the region, it is hoped this township area further focus on balancing between the nourishing tourism industries and the environmental protection initiatives.

6.6 The Sino-Singaporean Guangzhou Knowledge City: Ascendas OneHub Business Park, Guangzhou, Guangdong

Type: Eco-Business Park

Project Overview

The development of the Sino-Singaporean Guangzhou Knowledge City (Herein referred to as SSGKC) represents the third strategic urban city development project between stakeholders from both China and Singapore. The project is focused on the areas of economic development, knowledge exchange and urban sustainability. Unlike prior projects (i.e., the Sino-Singaporean Suzhou Eco-industrial Park (SIP) and the Sino-Singaporean Tianjin Eco-city), which were driven by government-to-government collaboration, the SSGKC is led by private sector collaboration with substantial government support from both countries. The SSGKC, located in Guangzhou city within China's prosperous Guangdong province, spans a total land area of 123 km^2 and was developed to serve as a centre for knowledge-based industries focused on areas such as communications technology, clean energy, pharmaceutical and biotechnologies. It was primarily aimed at repositioning Guangzhou's economy, which had been a manufacturing and labour-intensive economy, to a knowledge-driven economy by attracting and warehousing knowledge-based industries and global talents within the project (Guangzhou Knowledge City Project 2016; Ti 2015; Singbridge 2016).

Embedded within the SSGKC is the 'Ascendas OneHub' eco-business park, jointly developed by Ascendas-Singbridge Group from Singapore and the Guangzhou Knowledge City joint venture company. The project sits on a land area of 30 hectares and involves a one-stop mixed-use development consisting of new spaces for commercial, residential, and recreational developments. Leveraging on the idea of 'work, live, play', the Ascendas OneHub Eco-business Park seeks to integrate research-led organisations, multinational corporations, and global talents within a knowledge-driven and innovative community (Ascendas OneHub GKC 2016).

Eco-Initiatives and Green Features

The Ascendas OneHub eco-business park project was designed by S333 Architecture+Urbanism Ltd, a UK-based architectural firm, employing international best practices in green building development and urban

sustainability. The new development is done in line with the US-based green standards (LEED) for building design. Key eco-initiatives embarked upon within the park include (Singbridge 2016; Ascendas OneHub GKC 2016; Sino-Singapore Guangzhou Knowledge City 2017):

Green Space Development: Adopting Singapore's famous 'Garden City' model, the OneHub Eco-business Park is strategically located on a beautiful green valley within the SSGKC. It also reflects the beautiful surrounding natural environment. It is designed with breathtaking landscapes, and an estimated 45% of land use within the park are devoted to green spaces.

Transport Network: The business park offers appropriate accessibility to connecting traffic routes. It sits on the main traffic road within the SSGKC and is positioned close to the Guangzhou Knowledge City metro line currently under construction, which further connects this new business park to Metro Lines 14 and 21 of Guangzhou City. A public bus interchange is also under construction, which it is proposed should be directly connected to the offices within the business park. This potentially helps to promote the use of public transport systems, thereby reducing the carbon footprint from reliance on privately operated cars within the park.

Research Development Initiative: The project also promotes research on technology development and focuses on key areas of urban sustainability and development, pollution control, biomaterials, electro mobility, and food sciences. To support this, a Sino-Singaporean International Joint Research Institute (SSIJRI) was established in 2015. The SSIJRI, a collaboration between Nanyang Technological University of Singapore and the Southern China University of Technology, currently runs about 23 projects with funding support of about 250 million RMB from the Guangzhou City government and the Guangzhou Development District. The SSIJRI's focus areas target mostly projects in related to urban sustainability issues. This initiative provides a collaborative platform for ensuring eco-development within the park, and by extension to the SSGKC development zone.

Case Study Reflections

The Ascendas OneHub Eco-business Park holds a strategic position in the SSGKC's ambition to serve as Guangzhou's pioneer for a knowledge-driven economy. It presents a major meeting point for businesses hoping to tap into, and contribute to, the potential presented by such economic

shift. Though a lot of the projects within the park are still under construction, initial commitments shown so far with respect to investments, regulatory frameworks, government support, and interests from multinational corporations, show that progress is being made. However, what remains to be seen is how sustainable the project will be in the face of changing and conflicting requirements between achieving urban sustainability and economic viability as was the case with the Sino-German Qingdao Eco-Industrial Park (SGQEP), where a trade-off was made to loosen the control on the influx of cars into the SGQEP so as to open up the SGQEP to Qingdao main city. Moreover, the project's location and its relationship to the municipality of Guangzhou makes it important as a new zone in this economically viable region. It plays a major role in development of innovative industries as well providing support to surrounding industries in the region.

6.7 Hongqiao Business Park, Shanghai

Type: Eco-Business Park

Project Overview

The Hongqiao Business Park or central business district (Herein referred to as HQCBD) was established in 2009 as a strategic initiative by the Shanghai municipal government to enhance and promote the city's business environment. The project integrates four key districts: Changning, Jiading, Minhang, and Qingpu. It also provides an alternative business development environment within the municipality of Shanghai, away from the crowded main Pudong Central Business District (CBD). Its proximity to the Hongqiao transportation hub, consisting of both an airport (with domestic and international terminals) and a high-speed railway station, makes it even more important as a major business hub in the region. HQCBD is located towards the western fringe of the Shanghai Pu Dong CBD, and covers a land area of 86 km^2. Of its total land area, 59 km^2 is reserved for future expansion initiatives, while 27 km^2 was earmarked for immediate development with 4.7 km^2 dedicated to the development of the core business area consisting of commercial office spaces, limited residential apartments, hotels, retail and shopping centres, recreational, and cinema facilities (Thomas 2012; Shanghai Hongqiao Central Business District 2016).

Eco-Initiatives and Green Features

Local authorities in Shanghai put considerable emphasis on the urban sustainability agenda in the planning and development of the core business area within the HQCBD. A mix of high-performance building insulation, natural ventilation, green roof technology, and water recycling practices, amongst others, were adopted for the development of the HQCBD. In the highlights below, we briefly discuss two of the main eco-initiatives embarked upon within the park (Ramanujam 2015; de Vries and Dai 2015; Shanghai Hongqiao Central Business District 2016; Amy 2013; Tang 2016):

Green Building Development: A strategic eco-partnership was agreed upon between the local authorities and the US Green Building Council (USGBC) for the creation of a low-carbon community within the HQCBD. This involved the adoption of LEED certification for green buildings, and also ensures compliance to China's green building standards within the HQCBD. As a consequence of this major initiative, a large number of building projects within the HQCBD have applied for LEED certification, while new targets have been set to ensure every project within the HQCBD satisfies the requirement for China's two-star system for green buildings. This approach sets a remarkable example in the region for large scale green building certification.

Low-carbon Transportation Network: The development of the HQCBD was integrated with Hongqiao's extensive transportation network, which consists of the Hongqiao International Airport, metro lines, high-speed rail corridor, inter-city and intra-city bus lines. The transport network serves as a hub for local, regional and international connections for residents and businesses within the HQCBD, with the hub's passenger flow reaching 250 million in 2013. This integration enhances the ease of travel and encourages the use of sustainable modes of travel, thereby minimising travel-related carbon footprints. The methods undertaken are to enhance the multilayered transportation network of the area, by focusing on the possibilities for low-carbon transportation. The emphasis is given on the integration of the already existing transportation network in the new development, and also to enhance it where needed. This extension allows for improved accessibility to public transportation means and other connections in the larger context of the Shanghai Municipality. The project also sits in close proximity to the industrial regions around Shanghai, allowing for more transit-oriented development opportunities in the larger context. Therefore, the emphasis on low-carbon transportation network is expected to be a major mainstream of the HQCBD development.

Case Study Reflections

With the development of the HQCBD, it is hoped that businesses operating within Shanghai's main Pu Dong CBD will consider relocating in order to take advantage of lower rental fees and business operating costs. However, as the project progressed, concerns were raised with respect to the cost of relocation regarding the potential benefits promised, and calls made for inducements in the form of tax rebate for companies considering possible relocation (Thomas 2012). Reports show that the investment agreement between local authorities and about 28 companies to establish offices within the HQCBD totalled 11.7 billion RMB as at 2016, with about 220 local and international companies currently operating within HQCBD. From a sustainability perspective, the HQCBD's urban transport integration initiative and its wider sustainability goals embody a positive model to emulate for future business park developments.

The HQCBD project also incorporates some of Shanghai's smart city initiatives. For instance, to further develop the low-carbon transportation network, the project is now preparing for the creation of a new comprehensive transport service information platform. This new smart system will be developed to facilitate issues of road conditions, the availability of car parking, and route navigation in the area. A central traffic information platform is also under development as a mobile app, which is expected to be operational in the coming years (estimated between 2020 and 2025). Since the project is being developed at a comparatively late stage (particularly in comparison to other main CBD areas of Shanghai), it can also learn lessons from similar cases of development in the region. Its geographical advantage nurtures its economic growth, and its policy advantage is expected to model the project as the 'demonstration area of low-carbon development and smart city' (Shanghai Hongqiao CBD 2016b). According to local government reports, the documents issued by the Ministry of Finance and Ministry of Commerce, emphasise the HQCBD zone as an integrated pilot model area for the development of modern service industries. These include promoting a wide range of 'management system and mechanical innovation of the modern service industry and aim to create the best systems, mechanisms and policy environment for the service industry' (ibid.). Finally, the case represents a unique approach to combine green/eco strategies and low carbon initiatives with a more recently developed smart development strategies; a hybrid model that can be considered as one of the potential future directions in sustainable urbanism (Cheshmehzangi 2017).

6.8 The Beijing Olympic Village, Beijing

Type: Eco-Residential Compound

Project Overview

The Beijing Olympic Village (BOV) is a residential complex within the Beijing Olympic Park, providing accommodation for contesting athletes, coaches and other accompanying officials. It was opened in July of 2008, in preparation for the 2008 Summer Olympics in Beijing, China. The development of the BOV follows Article 42 of the new Olympic Charter, which aims to situate competitors, team officials and team personnel in one central residential location by providing an Olympic village for a stipulated time period as determined by the executive board of the International Olympic Committee (International Olympic Committee (IOC) 2003). The BOV project involved a strategic partnership between key parties, including: the Beijing municipal government, the Beijing Ministry of Science and Technology, and the US Department of Energy, with representations from Japan and Germany. Guoao Investment and Development Company served as the developer, while Beijing Tainhong Yunfang Architecture Group worked on the design of the project (Beijing Organizing Committee for the Olympic Games 2008).

The village is situated towards the northern fringe of Beijing's north–south axis, and bounded by the Olympic forest park to the north and the famous 'B Nest' stadium to the south. It covers an area of approximately 660,000 m^2, with about 40% of its land use devoted to green spaces. The project includes 42 high-rise residential buildings (consisting of 20 nine-storey buildings, and 22 six-storey buildings), several public buildings, and separate facilities for leisure, entertainment and medical services. It is segmented into different areas, including: the athletes' village able to accommodate about 16,000 contesting athletes; media village (consisting of Green Homeland media village and the Huiyuan apartments media village) able to accommodate up to 7000 media staff; and two hotels able to accommodate around 800 guests (Pasternack 2008; Jia et al. 2012).

Eco-Initiatives and Green Features

The BOV was developed, by taking into consideration modern urban sustainability practices, including: The utilisation of renewable energy technologies, water reclamation, green building materials, ecological landscapes, and energy-saving buildings. It has been described as the

world's largest green building complex, employing a mix of both high and low-tech solutions in reducing energy usage and increasing energy efficiency (Pasternack 2008). Key eco initiatives within the BOV project include (Beijing Organising Committee for the Olympic Games 2008; Pasternack 2008; Jia et al. 2012; Lassalle 2012; China Net 2008):

Water efficiency: Water conservation measures included the use of underground wells for irrigation and stormwater management, using permeable bricks in the pavements to form a rainwater recovery system, and applying micro-irrigation technology in order to water the village's green spaces. In addition, a biological sewage treatment plant with greenhouse structures was used to purify wastewater, thereby recycling between 200 and 300 tonnes of water daily to watering the landscape in the BOV.

Energy efficiency: the BOV employed a heat exchange system, which gathers up to 22 MWh of thermal energy from the Sun and recycled water. The system taps energy from the Qinghe Sewage treatment plant and upgrades it through a heat pump for cooling and heating during summer and winter, respectively. It saved 40% of the energy in comparison with a conventional air conditioner. The garage space for 2800 vehicles utilised T-8 fluorescent tubes with electronic ballasts and automatic controls. Furthermore, 6000 m^2 of solar energy collecting tubes provided bathwater to the 16,000 users during the games and 2000 users after the games, saving an estimated 5 GWh/year worth of electricity. Other new green technologies employed include solar heating, solar hot water, solar thermoelectric co-generation, optical pipes, LED lighting technologies and double-layered LOW emissivity glass windows. With these technologies, the BOV buildings used only 3.3% of energy consumed in modern buildings and annually saved about 147 MWh of energy. In addition, geothermal energy, using ground source heat pumps, radiant floors, desiccant cooling with active solar regeneration and seasonal thermal-storage system, helped to meet heating, ventilation and cooling demands.

Urban Green Spaces and Gardens: As stated in the above section, about 40% of the land uses in the BOV were devoted to green spaces. Also building roofs were planted with vegetation; with native plants making up 90% of the vegetation. This was one of the main key performance indicators of the project.

Case Study Reflections

Prior to the commencement of the 2008 Beijing Summer Olympic Games, plans had been made for the BOV to be remodelled and sold off as private apartments. An estimated 70% of the apartments were sold off

prior to the games, at 16,800 RMB per square meter in December of 2006 while the remaining 30% were sold off after the games (Xinhua 2008). The BOV functioned as the Paralympic village for the Paralympic games immediately after the Beijing 2008 Summer Olympics, as such remodelling work in the village and subsequent occupation by the new owners began after both games were concluded. Therefore, the project has taken on board a flexible approach to reuse the facilities and remodel the operations and services.

There are two key points that we can draw from the experience of the BOV: Firstly selling off the apartments in the BOV was an effective strategy to ensure the posterity and sustainability of its facilities, while making an appreciable return on investments for the developers in the post-Beijing 2008 Summer Olympics Games period. Examples abound from previous Olympic Games (Amatulli 2016; Bradley 2016), where such facilities are often left to decay due to the lack of appropriate plans for their sustenance. And secondly, hosting the Beijing 2008 Summer Olympics, in a city that was largely seen as one of the world's most badly polluted, was China's opportunity to demonstrate its commitment and passion for reducing the city's and the entire country's pollution and carbon footprint (Lassalle 2012). Seeing that a lot of the athletes, officials and global media outlets were residents in BOV, the project was strategic to demonstrate China's commitment to global sustainability.

6.9 The Grand MOMA, Beijing

Type: Eco-Residential Compound

Project Overview

The Beijing Grand MOMA is a linked hybrid set of eight high-end, high-rise apartment buildings in Dongzhimen Beijing, designed by the renowned American architect Steve Holl, which was privately developed by Modern Green Development Co., Ltd. The project sits on a land area of 220,000 m^2 and consists of mostly residential apartments, limited office spaces, stores, a movie theatre, library, restaurants, recreational facilities, a Montessori and kindergarten school. It is a mixed-use development, with residential use as its primary land use. Situated in close proximity to the eastern fringe of Beijing's second ring road and adjacent to the famous embassy neighbourhood, the Grand MOMA promises residents a safe and

conducive living condition while adhering to strict eco-friendly environmental practices (China Daily 2008; Steven Holl 2009).

Eco-Initiatives and Green Features

Environmental sustainability was a crucial requirement in the planning and eventual development of the Grand MOMA. The complex was developed for minimal energy consumption, energy conservation and pollution control. We briefly discuss three key eco-friendly environmental practices embarked upon within the Grand MOMA (Pasternack 2006):

Building Energy Management and Control: The Grand MOMA was designed to utilise passive energy sources. This is based in part on the passive house technology, which stipulates key requirements in architectural, technological and ecological planning. Water stored in a number of 100 metre-deep caissons beneath the underground parking lot of the complex was used to heat and cool the buildings, thereby reducing reliance on conventional heating, ventilation and cooling (HVAC) systems. This was made possible as a result of reliance on the geothermal energy heating principle, where underground stored temperatures can be leveraged upon to heat up and/or cool the water stored in the caissons. Heated and/or cooled water from the caissons is funnelled through pipes embedded within the floor slabs, helping to maintain temperatures within buildings at a range of 20–26°C. In addition, heat conservation within the buildings is achieved by equipping the windows with argon gas-filled double-paned glass, which also serves as shield from ultraviolet rays from sunlight.

Wastewater Recycling: The grand MOMA leverages on membrane biology technology for its wastewater treatment. It is reported that an estimated 58% of its wastewater collected from bathing and cooking activities of its residents are passed through a bioreactor and other sterilising devices, for recycling. The recycled water is then channelled back into the building for domestic usage and also watering and maintaining the landscape of the environment.

Pollution Control: Given Beijing's reported high rate of pollution, the Grand MOMA applies a proactive pollution control mechanism. The air coming into the buildings are first captured and screened to remove air particles. The air is then sterilised for contamination, after which it is regulated to the appropriate temperature. The clean air is then released into the rooms within the buildings, to create a safe indoor air quality environment.

Case Study Reflections

The linked hybrid-like structure of the Grand MOMA represents a very unique architectural creation, with its entire structure fused together to create an interactive space for its residents. In addition to its beautiful aesthetic qualities, the Grand MOMA prides itself on its ability to produce about four times the heating and cooling ability of conventional and traditional HVAC systems. The project continues to inspire architectural discourse, particularly with its brilliant adoption of geothermal technology to heat and cool the buildings within the compound. This represents a positive leap forward for eco-development; it helps to reduce reliance on traditional HVAC systems, thereby helping to curb the carbon footprints from such systems.

6.10 Conclusions

This chapter has presented eight meso-level case studies, categorised into four types of development: Eco-Industrial Park, Eco-Village, Eco-Business Park, and Eco-Residential Compound. These case studies represent a variety of sustainability practice at the neighbourhood/community level in China. All of them have adopted a development mode of mixed land use. As discussed in Sect. 2.3.6, the main focus at meso level is on the key aspect of 'patterns' that include neighbourhood forms, neighbourhood layout and related spatial qualities. Neighbourhood patterns should be able to facilitate walking and cycling, and promote interaction between people in public spaces. In this regard, the model of mixed-use development has a significant impact on neighbourhood performance as a whole. Technically, people living in a mixed-use neighbourhood would have a better chance of finding a job nearby, and a better accessibility to various facilities by walking and cycling. This reduces car dependency and changes people's travel behaviour accordingly. A survey was conducted by Qin and Qi (2015, pp. 113–115), which investigated the environmental performance of ten neighbourhoods in Beijing. This research indicates that neighbourhoods built after 2000 tend to have higher carbon emissions while older neighbourhoods would have lower emissions, some of which are due to the new added car-oriented housing development pattern (e.g., the increased incidences of gated communities in China). This is partly attributed to that the neighbourhoods built before 2000 are

higher land use mixed with more facilities such as restaurants, parks, cinemas and public transport means in a walking distance, as well as more employment opportunities. Most of these are due to many factories or office buildings that are built in the nearby area (Qin and Qi 2015, p. 113). This also reflects a fact that Chinese cities are sprawling—but perhaps different in terms of pattern to the western models—and that many neighbourhoods built in newly developed areas lack public facilities and employment opportunities. More importantly, most of the daily commuting activities, as minimal as daily household shopping, place substantial reliance on private cars.

Physically, neighbourhood is a combination of multiple building plots, and public open spaces such as roads and parks. As an 'organised area of land', neighbourhood is universally subject to laws, planning regulations and urban/rural masterplans. Neighbourhood is a nexus between individual buildings and the broader urban context. However, in our view, the meso-scale built environment is still largely overlooked in the current eco-development practice in China. We have not found a case that directly aims to achieve zero-energy or zero-carbon performance, akin to the BedZED project in London (see Chap. 3). To date, only nine neighbourhood projects have been certified by LEED-ND in China (Green Building Map website 2017) and China's rating system for neighbourhoods is not scheduled to be available until July 2017 (and then released in October 2017). This local rating system is in place 11 years after the establishment of the building-level rating system. We also conclude that achieving a zero-energy neighbourhood is more complicated in the Chinese context due to the higher building density and building energy load (i.e., particularly, in comparison to the European models). This surely requires a concerted effort between buildings and spaces. For example, this is possible by utilising the open spaces for renewable generation, meaning that the power generated from open spaces can be fed back into building operations. Technologies, such as combined cool, heating and power (CCHP), ground source heat pumps, district cooling and heating systems, and smart grid are more suitable to apply at the meso level. An integrated set of strategies addressing the mutual impact between buildings and spaces is necessary to develop zero-energy neighbourhood in the future. The next chapter will discuss a few case studies at the micro level and further explore the strategies, technologies and evaluation tools in use in China. Some of

these forthcoming examples are currently known as the main eco-/green building projects in China, and some, although outdated, provide us with the background of micro-level development and strategies in China.

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