Urbanization in the People’s Republic of China

Urbanization in the People’s Republic of China (PRC) has been on an extensive and accelerated path. In 2008, more than 600 million people were residing in 655 cities, pushing the urbanization level to 45.7%. Based on current trends, the urban population in the PRC is projected to cross the 1 billion mark in 2030 and eight megacities—each with a population of over 10 million—would be existing in the country by 2025 (Woetzel et al. 2008).

However, the rapid rate and sheer scale of urbanization are associated with increasingly pressing social, economic, and environmental problems. Clearly, new models of sustainable urban development are needed to cater to this phenomenal urban growth for the coming decades.

Emerging Eco-City Concept

Urbanization in the PRC reflects the pace of development and progress in the country. However, the rapid rate and sheer scale of urbanization is associated with increasingly pressing problems. The proliferation of eco-city development comes at a time when the PRC is reaching peak urbanization rates. Moreover, low-carbon cities generally come at relatively lower economic cost for large developing countries, such as the PRC and India, compared with developed countries. Hence, the potential for cities to help address climate change should not be overlooked.

Although the idea of adopting ecological principles in urban planning surfaced in the PRC in the late 1980s, it is only in the last decade that eco-cities as an urban development model were seriously considered and put into action. As early as 1995, the State Environmental Planning Agency, now the Ministry of Environmental Protection (MEP), issued guidelines for the building of demonstration eco-communities and environmental protection model cities under its Eco-Construction Programme (Liu 2009, Zhou 2008).

Since it was formally adopted by the central government at the 17th National Congress of the Communist Party of China in 2007, the low-carbon eco-city model has been officially put forward as the answer to the PRC’s urban development and environmental problems. The PRC has chosen to frame the eco-city concept within the utopian ideal of an “eco-culture”. An eco-culture calls for the building of “a harmonious world characterized by sustained peace and common prosperity.”

Some eco-cities, such as the Sino-Singapore Tianjin Eco–City and Caofeidian (Tangshan), are high-profile international ventures led by the central, provincial, or municipal governments; others are driven primarily by local authorities and local entrepreneurs. One count of eco-city projects at various stages of development by the Tongji University puts the total at 168 (Shen and Song 2010). A report by the Organisation for Co-operation and Development (OECD 2009, p. 26) indicated that by 2008 about 60 cities from 22 provinces had announced plans to build eco-cities. The Joint US–PRC Collaboration on Clean Energy puts the number of eco-cities in development in the PRC at close to 40 in 2009 (The Economist 2009). While a definitive answer on the number of eco-city projects in the PRC remains elusive, the number is clearly rising.

The eco-city has been presented by the central government as the key to a new and sustainable model of urban development.
The development of eco-cities is tied to the three goals of "eco-industry" (industry metabolism, life cycle production, resource conservation, use of renewable energy, etc.), "eco-scape" (built environment, open spaces, connectors, maximizing accessibility while minimizing resource use and urban problems) and "eco-culture" (understanding the balance between humans and nature, understanding environmental ethics in order to enhance humanity’s contribution to maintaining a high-quality urban ecosystem).

The eco-city model can be applied in two fundamental scenarios—greenfield projects and retrofitting existing cities—but there is no one-size-fits-all solution. Differences in geographic landscape, for example, would necessitate different approaches.

The term “eco-city” appears as a catch-all phase for a variety of new urban development models, contributing to the variations of the eco-city model observed in the PRC, including a low-carbon eco-city model and a livable city model. While the characteristics and objectives associated with eco-cities are varied, a crucial thread runs through these variations in the PRC context. It is the adherence to the ecological principles in an urban context—resource and energy management and conservation, waste minimization and recirculation of materials, and energy—that makes an eco-city.

In concrete terms, the high expectations for an eco-city would include providing for:

- a vibrant economy through environment-friendly production and industry;
- above-average per capita gross domestic product (GDP) levels;
- a healthy environment, effective environmental protection, and resource and energy conservation and intensification to meet international standards;
- reduction in emissions and high air and water quality standards;
- an above-average ratio of green space per capita;
- social harmony with adequate educational and employment opportunities and a social safety net;
- housing and public infrastructure and public services systems;
- protection of physical and nonphysical cultural legacies; and
- promotion of green lifestyles and regional integration.

Moreover, a low-carbon economy necessitates low-carbon consumerism, and this would provide opportunities for restructuring the economy and industry. The appropriate eco-city model for the PRC should be replicable and self-sustainable in terms of the economic development and operation costs. In the PRC context, an eco-city is not necessarily a high-tech one, but it would instead focus on the use of appropriate technology (Guangzhou Construction News 2009; MOHURD 2009).

**Benchmarks for Eco-City Standards Still Unclear**

Aside from local governments, the Ministry of Housing and Urban-Rural Development (MOHURD) and the MEP are engaged in promoting, developing, and evaluating eco-cities in the PRC. The regulatory and approval framework for the development and construction of government-sanctioned eco-cities appears to fall under the purview of the MOHURD. Both ministries, however, appear to be involved in the setting of eco-city performance standards in the PRC.

The MEP recommends performance standards for eco-cities, eco-counties, and eco-provinces. These standards, which were first issued in 2003 and revised in 2007, cover social, economic, and environmental aspects. The highest number of indicators are at the lowest eco-county level (36), while at the eco-city (prefecture) level there are 28 indicators and at the eco-province level there are 22 (MEP 2008).

- Economic indicators include per capita GDP, annual per capita rural income, energy and water consumption per unit of GDP, and compliance rate for clean production industries.
- Environmental indicators include proportion of forest cover, proportion of protected areas, air and water quality, chemical oxygen demand (COD) and sulfur dioxide levels (per CNY10,000), municipal and industrial solid-waste treatment rates, noise pollution, per capita urban green space, and level of investment in environmental protection.
- Social indicators include urbanization level, Gini ratio (at province level), and public satisfaction with the environment, etc.

MOHURD embarked on a five-year project when it signed an agreement in July 2009 with United States-based United Technologies Corporation and the Chinese Society for Urban Studies to launch the Eco-city Assessment and Best Practices Program in the PRC. The project is in its preliminary phase and a survey has been released to obtain feedback from various parties on their perspectives on key performance indicators for an eco-city in the PRC. The Eco-city Index System to be developed is intended as a measurement tool to both guide and measure the PRC’s eco-city planning and development, as well as existing eco-city practices.

The MEP’s standards have a broader scope and include targets on energy and resource use efficiency as well as measures of economic and social improvements, while MOHURD’s standards are likely to focus on urban infrastructure construction aspects. This is largely a reflection of the different mandates of each ministry.

However, some aspects of environmental sustainability—such as greenhouse gas emissions, utilization of renewable energy, and green transportation—which are usually measured in the development of eco-cities in other countries are missing.
This omission is especially surprising since eco-city development in the PRC is often described as “low carbon” in the PRC research literature.

As yet, there is no consistent framework of performance benchmarks to evaluate and compare so-called eco-cities in the PRC. Ongoing eco-city projects appear to be adopting their own performance benchmarks and priorities (Global Environment Facility [GEF] 2010), especially as many may not be officially endorsed by the MEP or MOHURD and this could lead to uneven quality in the developments.

**Case Study: Sino-Singapore Tianjin Eco-City**

Launched in November 2007, the Sino-Singapore Tianjin Eco-City (SSTEC) project is a collaboration between the Government of Singapore and the Tianjin municipal government, backed by the Government of the PRC. The project is managed through a joint-venture corporation, the Sino-Singapore Tianjin Eco-City Investment and Development Company.

The SSTEC site covers an area 34.2 square kilometers (km²) and is located 40 kilometers (km) from Tianjin City and 150 km from Beijing (Figure 1). Tianjin is the third-largest City in the PRC with a population of 11.76 million. The site is largely salty non-arable land along the Tianjin Binhai New Area (TBNA), with the southern tip of the site close to the Tianjin Economic-Technological Development Area (TEDA). While the TEDA was set up in 1984 as one of the earliest national development zones in the PRC, the region was designated for further development in 2006 with the extension of the TBNA as a special economic zone under the PRC’s 11th five-year plan. The TBNA was officially launched in January 2010, and is expected to become the economic powerhouse of northern PRC, along the lines of Shenzhen and Shanghai Pudong. The SSTEC can thus be seen within the larger context of economic and industrial development of the TBNA, which serves as a hinterland for the eco-city.

**Features of the SSTEC Master Plan**

The master plan was jointly developed by the China Academy of Urban Planning and Design, the Tianjin Institute of Urban Planning and Design, and a Singapore planning team led by Singapore’s Urban Redevelopment Authority. An initial start-up area for the SSTEC is expected to be completed by 2013, while the full completion of the project is targeted for 2020.
When completed in 2020, the SSTEC is expected to house 350,000 people. More than half of the urban population in the PRC currently resides in cities of not more 500,000.

**Layout**
To minimize the need for commuting, the building block of the SSTEC consists of integrated mixed-use zones in an “eco-cell” layout, a modular 400 meter (m) by 400 m grid which is repeated throughout the site to form neighborhoods, districts, and urban centers. The eco-cell integrates different land uses within the cell, including education, commercial activities, workplaces, and recreation. “Eco-neighborhoods” created by combining four to five eco-cells will accommodate 20,0000 residents with mixed housing types to avoid the formation of ghettos within the city. The majority of day-to-day services and necessities is expected to be available within a 500 m radius. The eco-city will also incorporate a comprehensive green transport network using nonmotorized and public transport. The main mode of transport within the city will be a light-rail transit system. The target is for at least 90% of trips within the SSTEC to be made using eco-friendly transport methods.

Green corridors known as “eco-valleys” will run through the city in a north–south direction. Eco-valleys also incorporate water-sensitive urban design elements such as swales and dry streams. Eco-valleys are expected to serve as the key public open spaces and focal points of the eco-city. Green areas in the city are designed to be easily accessible. To ensure ecological conservation, a 5 km² zone of protected nature areas and bird sanctuary has been designated within the SSTEC. All the original wetlands have also been preserved.

**Water**
Water conservation and reuse will be promoted by implementing water conservation techniques, reclamation and/or recycling of domestic and industrial wastewater, rainwater harvesting, and desalination. The use of nontraditional water sources such as recycling and desalination is projected to reach 50%. The daily water consumption is expected to be 120 liters per person per day by 2020 in the SSTEC, compared to the national average in the PRC of 212 liters per person per day.

**Energy**
The SSTEC will prioritize energy conservation, energy-saving manufacturing processes, and clean manufacturing technologies in an effort to move toward a low-carbon economy. The target for the SSTEC is to have per capita energy consumption which is at least 20% lower than the national average in the PRC, and at least 20% of energy is to be produced from renewable sources (above the national average target of 15%). The energy management and energy efficiency strategies to achieve this include building waste-to-energy plants, using wind power and solar heating, reclaiming residual heat from the sea water desalination process, as well as incorporating heat pumps and/or exchange into wastewater and water management plants to supply heated water and central heating. Carbon emissions per $1 million of gross domestic product (GDP) should not exceed 150 tons in the SSTEC. Buildings should meet green building standard and should not consume more than half of the city’s energy supply, while emission standards will be imposed on motorized vehicles.

Sustainable economic development is a key pillar of the master plan. The mixed land-use plan will accommodate housing and service-oriented, high-technology, and environment-related industries including tourism and meetings, incentives, conferences, exhibition (MICE) outsourcing services, and financial services. Other environment-friendly industries which leverage the SSTEC’s eco-city expertise—such as green building technologies, renewable energy technologies, and energy conservation technologies—will also be promoted. These economic drivers are anticipated to create 190,000 jobs, equivalent to about 80% of the expected working population (GEF 2010). Apart from the main city center, commercial subcenters will also be located in each suburban area to provide employment opportunities for residents and reduce the need for commuting.

There will also be dedicated service industry parks and university and hospital sites located within the eco-city. At least 20% of public housing will be reserved for low-income groups. In a green building pilot site, public housing for low-income groups will have a total floor area of 37,000 square meters (m²) for 569 apartments at an investment cost of $33.8 million (GEF 2010). The first public housing project with 500 units for lower-income groups is expected to be completed in 2011. Whether such housing is viewed as affordable when the average annual per capita income in the PRC is about CNY17,175 may be debatable.

**Performance Indicators for the SSTEC**
The SSTEC’s performance will be measured against 26 indicators, including the following quantitative and qualitative indicators:

- Natural environment (air quality, water bodies quality, tap water quality, noise pollution levels, carbon emissions per unit of GDP, net loss of wetlands).
- Built environment (proportion of green buildings, native vegetation index, per capita public green space).
- Lifestyle (per capita daily water consumption and domestic vegetation index, per capita public green space).
waste generation, proportion of green trips, overall recycling rate, access to public recreation amenities, waste treatment, barrier-free accessibility, public services network coverage, proportion of affordable public housing).

• Economy (use of renewable energy, water from nontraditional sources, proportion of research and development scientists and engineers, employment–housing equilibrium index).

• Qualitative indicators such as adopting innovative policies for regional collaboration, improving the environment of surrounding regions, and preserving the historical and cultural heritage.

The performance indicators were formulated based on national standards in the PRC and Singapore, with the more stringent of the two standards being adopted wherever feasible. In general, the SSTEC performance standards appear to be more comprehensive and stringent than the MEP’s eco-city standards. Another notable aspect of the SSTEC’s performance indicators is the intention to make the indicators transparent and publicly available.

Progress of the SSTEC

Commercial interest in the project may be viewed as an indicator of the viability of the project. By May 2010, the SSTEC had attracted over CNY17 billion of funding, and 125 companies with a combined capital of about CNY10 billion have already registered in the eco-city.

The ground-breaking ceremonies for a number of projects in the Tianjin Eco-city Start-up Area were held in 2009. The Keppel Land Development is a 35-hectare integrated commercial and residential development, with a total gross floor area (GFA) of 680,000 m². The Farglory integrated eco-community development, with a total GFA of 1.4 million m², will include a recreational and entertainment hub. Malaysian property developer Suncity will invest CNY9 billion to establish the Lifestyles of Health and Sustainability (Lohas) Community. Hitachi Corporation and Sino-Singapore Tianjin Eco-City Investment Development Corporation have signed a memorandum of understanding. Three other land use agreements were signed with PCR–foreign joint-venture companies, attracting more than CNY1 billion in investments for the eco-city.
In July 2010, the SSTEC received a GEF grant of $6.16 million from the World Bank to support the development of policy, regulatory, institutional, financial, and monitoring mechanisms for the eco-city.

In general, PRC researchers view the SSTEC as serving as a workable model for subsequent eco-city developments with regard to its master planning, project management, use of technological innovations, and especially the inclusion of systematic and objective key performance indicators into the planning and development process (Ma 2009).

In the longer term, the SSTEC offers a test bed within a relatively low-cost environment for enterprises to flourish and attract investments and talents for sustainable development. The SSTEC model also aims to develop a more efficient government administration, by streamlining and standardizing government regulatory processes, for example.

Case Study: Dongtan Eco-City
The first eco-city project to be announced in the PRC in 2003, the Dongtan eco-city, was also proclaimed as the world’s first purpose-built carbon neutral eco-city. The first phase of the project was targeted for completion in 2010, in time for the Shanghai World Expo. Aside from the Chongming Island Bridge, which links to Shanghai mainland, and a wind farm, however, Dongtan eco-city has since largely failed to materialize for a number of reasons.

The Dongtan site is located on an estuary tidal flat at the east end of Chongming Island at the mouth of the Yangtze River, about an hour’s ferry ride from Shanghai. Phase one of the eco-city, which was scheduled to be completed in 2010, was expected to accommodate up to 10,000 residents in an area of 1 km². The start-up area of 6.5 km², housing 80,000 people, was targeted for completion in 2020, while the completed eco-site was to have covered 30 km² with a population of 500,000 by 2050. The eco-city was envisaged to have small pedestrian-friendly, self-contained towns and an ecological footprint of 2.6 global hectares per person, which is 60% smaller than that of conventional cities in the PRC, 66% lower energy demand with 40% energy supplied from bio-energy, 83% reduction of waste going to landfills, and almost zero carbon dioxide emissions (Cheng and Hu 2010). The visualization of the eco-city by design and engineering firm, Arup (based in the United Kingdom), is shown in Figure 2.

Problems and Pitfalls
The project was perhaps ill-considered at the onset. Chongming Island is the most rural area of Shanghai and the economic sustainability of the eco-city was questionable. The eco-city would most likely have had to rely on Shanghai for most employment opportunities. In addition, displaced farmers were not likely to be able to afford housing at the eco-city site, even with 20% of dwelling units designated as affordable housing.

The proposed eco-city was sited next to the Dongtan National Nature Reserve, a Ramsar Convention wetland site, and the construction of an eco-city would likely have had significant adverse impact on the adjacent protected wetlands. The Dongtan site did, however, have the potential to tap renewable energy sources such as solar and wind, and a wind farm started operations at Dongtan in June 2008. Eco-farming activities have also taken root at Dongtan (Cheng and Hu 2010).

Management problems contributed to the demise of the project. According to one report (Brenhouse 2010), there was confusion between the city design firm (Arup) and the state-owned developer (Shanghai Industrial Investment) as to the source of funding for the project, estimated to be $1.3 billion (Cheng and Hu 2010). Political backing for the project also evaporated when the former Shanghai Communist Party chief, Chen Liangyu, was imprisoned on corruption charges in 2008.

Participation by, and consultation with, the local community was also lacking in the process, although this problem is not unique to the Dongtan project. The land use regulations also posed some difficulties as the land on Chongming Island, originally intended as compensation for agricultural land, was lost to urbanization in Shanghai, and should have been used for agricultural production rather than further urban development.

The Future of Eco-City Development in the PRC
Eco-city development in the PRC is still very much at the experimental stage. As can be gleaned from the case studies, appropriate management and policies to drive and support eco-city development are at least as important as—if not more important than—technology or financing factors. For example, managerial failure was the key contributing factor to the situation in Dongtan.

In contrast, the SSTEC has strong political backing as well as a clearly defined administrative and operating structure, with the project being driven by a joint-venture enterprise. The project also leverages expertise from both the PRC and Singapore. This advantage could also turn into a potential weakness, should such collaborations fall apart.

At present, the eco-city projects in the PRC are largely stand-alone greenfield developments which may be sited close to existing cities or industrial developments. While an eco-city project might prove to be successful within its existing geographical confines, how it would be integrated into the surrounding areas...
is unclear. Moreover, as greenfield projects are being constructed on undeveloped or underdeveloped land, this raises the larger question of how eco-cities can be replicated in existing cities which are already well established.

The relationship between the eco-cities and the industrial zones also appears to be an ambivalent one. For example, in the case of the SSTEC, the TBNA can be expected to serve as an economic hinterland for the eco-city, at least to some extent and especially in the initial stages. In this larger context, it seems questionable as to how a geographically and functionally smaller eco-city can contribute to the environmental and social sustainability of the larger industrial and urban zones.

References