Towards A New Paradigm in Development Control - Low Carbon City Zoning Codes for Beijing

The Climate Change Challenge to Cities

The United Nations Intergovernmental Panel on Climate Change (IPCC) has issued the Fourth Assessment Report (AR4) as the latest assessment of the impact of climate change ***(IPCC, 2007).*** The report stated that the warming of the climate system is **unequivocal**, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level. Global greenhouse gases (GHG) emissions due to human activities have grown since pre-industrial times, with an increase of 70% between 1970 and 2004.

In response to these challenges, the Kyoto Protocol reached in 2005 requires the developed nations to reduce the GHG emissions by 5.2% from the 1990 level, between 2008 and 2012. It has however been pointed out now that much more radical reduction is necessary in order to ensure the survival of the humanity (Loh et al, 2008, Hansen et al 2008; Stern, 2008; Socolow et al 2006).

Managing and Reducing Global GHG Emission

To reduce the global GHG emissions, strategically there are four major groups of abatement opportunities (McKinsey & Company 2009):

a. **Energy Efficiency**: Improving the energy efficiency of vehicles, buildings, manufacturing and industrial equipments;
b. **Low Carbon Energy Supply**: Shifting energy supply from fossil fuels to low carbon alternatives such as wind, hydro power, solar; equipping fossil fuel plants with carbon capture and storage (CCS); and replacing conventional transportation fuel with biofuel;
c. **Terrestrial Carbon** : Increasing or protecting forests and soils and natural sinks for carbon by stopping deforestation and reclaiming marginal lands for forestry;
d. **Behavioural Changes**: Changing fundamental behaviours of our society such as reducing business and private travel, shifting road transport to primarily rail, accepting higher

domestic temperatures comfort variations (reducing heating and cooling), reducing appliance use and meat consumption.

The Roles of Cities

Cities are the key arena to address the issues of climate change (Betsill, M. M. 2001; Bulkeley, H and Betsill, M.M. 2003; Lindseth, 2004; ICURR, 2008). Cities and the associated local governments have important roles to play in managing the climate change challenge for three reasons:

(1) Cities are particularly vulnerable to the impacts of global warming in terms of sea level rise and extreme weather conditions;
(2) Cities and urbanization account for significant proportion of the energy consumption and emissions; and
(3) Cities are also where most cost effective means of abatement opportunities are identified, and where means of influences (such as land use planning, waste management, energy use, transport, building design and management, public education and awareness building could be initiated.

Cities are important territory to combat climate change also because they are where a significant proportion of the global energy is consumed Data from different cities show that local authorities control policy measures that deal with 30–50% of national GHG emissions. Buildings represent approximately 40 to 50% of the total national energy consumption in fast urbanizing countries such as China.

The Basis of City Strategies: Mitigation and Adaption

Managing the threat of climate change on our cities has recently triggered off a series of new thoughts and debates around the world on what planners should do. Our cities, our economies and our infrastructure will all need to be changed in order to adapt and mitigate the impacts of climate change. One key focus is on how planning decisions will help on reducing carbon emissions and stabilizing greenhouse gases. Specifically, city leaders, politicians and planners will need innovation, if not revolution, in the approaches and standards on how to plan, design, construct and manage our cities. Actions for cities to manage climate change generally fall under two major strategies: Mitigation and Adaption.

a. **Mitigating Climate Change:** Actions include policies setting standards, regulations and incentives to lower GHG emissions. To address global warming, standards and regulations used in planning practice will need to be revised or expanded. In addition, new standards, processes, incentives and regulatory structures will be required to meet GHG targets. Policies in this section discuss changed needed to reduce emissions related to transportation, buildings, electricity generation, industrial uses, landfills, and agriculture.

b. **Adapting to Climate Change:** These policies acknowledge that some level of climate change is inevitable, and communities must to adapt and prepare for the impacts. Such policies include avoiding development in hazardous areas like flood plains or fire prone dry areas

Adaption is an important focus. In response to the strategies, the Institution of Mechanical Engineers recommended that "only by adapting our behaviour can we hope to secure long-term human survival" (IMechE, 2009).: The impacts of rising sea levels and increased flooding will require serious consideration of the viability of the existing settlements, transport routes and infrastructure in our cities. They are subject to serious damages and re-planning, re-building, retrofit actions are needed.

The Search for a Planning Model for Sustainable Cities in China

The concept of sustainable development has recently attracted growing attention of the central and local governments, the planning profession as well as the development industry in China. Various efforts have been undertaken to search for sustainable development model for China and to pursue a solution to manage the unprecedented speed of urbanization in the country (Yip, 2008c).

In fact, the application of sustainable development principles to city planning has been part of the research and policy issues in China over the last 20 years. Since late 1980s, the idea to adopt ecological principles in the planning of cities in China has gained attention. At the same time, China is also one of the earliest developing countries that announce the adoption and the implementation of sustainable development strategy. In 1994, China announced her "Agenda 21" and explicitly stressed the importance of building sustainable settlement based on the policy areas of environmental improvement, appropriate housing, urbanization and settlement management, sustainable building industry and energy saving building, as well as enhancement of settlement energy efficiency. By 1996, the then State Environmental Planning Agency issued the policy document "Guidelines for the Building of Eco-Communities (1996-2050)". The intention was to promote the planning and construction of eco-communities across the country. From the end of the 1990s, under this directive, many cities have engaged in the setting up of pilot projects or plans for

"Eco-Cities" in China. By 2003, there have been 135 cities or local municipalities commencing on planning for "ecological settlement" at different scales and localities.

Over the recent years, there have been growing trends and interests in various Chinese Cities to call for the planning and development of sustainable cities based on energy efficiency, emission reduction and ecological principles. A number of proposed 'demonstration projects' have been put forward by local governments, developers and also inter-governmental joint effort. These projects have common goals in the striving for a model to build low emission and energy saving cities. These include: the Dongtan Eco-City at Chongming Island in Shanghai, the Tianjin Sino-Singapore Eco-City, the City of Tangshan Caofeidian Eco-city, as well as other similar projects in Shenzhen, Zhuzhou, Beijing, Baoding, Changsha.

While these projects vary in terms of their scales, scope, approaches and focus, typically, they have adopted the following general planning and design approaches (Yip, 2008a, 2008b, 2008c):

- Strong focus on energy consumption demand management and reduction
- Increasing energy efficiency by combined heating and power generation facilities
- Maximum usage of renewable energy (such as wind, solar, biomass)
- Supported by integrated resource management strategies covering energy, water and waste management
- Adoption of passive building design principles
- Enhancement of the energy efficiency of building through higher building code standards
- Promotion of use of walking, cycling and transit as modes of movement, and discouraging the use of cars
- Reduction in heart island effects and maximum microclimate comfort

Over the last 20 years, the concept of applying ecological principles to the planning of the cities has steadily gained momentum and attracted the attention of the public and private sectors. However, the visions are in place but the specific pathways leading to the implementation of these concepts are yet to be laid down.

Conventional Planning Approach in China and the Need of New Mindsets

Unfortunately, the current conventional statutory land use planning systems under the Urban and Rural Planning Law in China may have put strong emphasis on physical and spatial planning elements as the key drivers for plan making, and thus have fallen short in integrating low carbon planning principles into the process.

While the Chinese planning systems encompass a hierarchy of plans from city-wide Master Land Use plan, to District Master Land Use plan, to Detailed Plans. The detailed Plans include both regulatory Plans (zoning plans)as well as Site Plans. The Detailed Plans are the tools employed to manage and control site specific development form and also act as the fundamental basis for the preparation of planning conditions which in turn form part of the land use right transfer (land lease) contracts.

The Detailed Plans (Regulatory Plans) under the current Chinese planning system has put great focus on setting out site specific development parameters such as density, plot ratios, setback requirements etc. as means to control development forms and scale, in terms of physical dimensions. These mandatory day to day planning standards and site specific planning parameters in the Regulatory Plan (zoning plans) usually include:

- Land use types;
- Building coverage ;
- Building height ;
- Plot ratio ;
- Green space coverage
- Vehicular access and egress ; and
- Parking and other facilities

This list of mandatory planning parameters do not have the adequate breadth and depth that make them fully relevant to planning issues relevant to low carbon cities such as: energy usage reduction, use of renewable energy sources, rain water re-cycling, storm water management best practices, waste management as well as water treatment and re-use. We may need to consider adopting a new mindset and an innovative institutional approach to planning and development control mechanisms in China.

The key challenges in the planning for low carbon cities in China, under the current planning systems would include the following key aspects:

- How can we assess the performance of the master plan in terms of carbon emission and reduction ---- an audit of performance in carbon terms?
- How can the development projects be guided or requested to provide “renewable energy supply” as part of the plan approval proves?
- How can resource management concepts such as reduce, reuse, and recycle be incorporated into the preparation of development plans?

Planning for Low Carbon Cities: Principles and Tools

The author stresses that the fundamentals of the low carbon city planning concept is reflected in the following principles:

a. City itself is a system of social, economic and environmental processes, with resources input and output characteristics
b. Cities are part of the global ecological system and they are interdependent with the natural ecological processes. Changes to this relationship may or may not be reversible.
c. One needs to incorporate the goals of reducing unnecessary use of fossil fuels in ALL aspects of city's social and economic processes; recycling the energy, waste and water resources within the city systems; and minimizing the output of carbon emissions through use of renewable energy, innovative spatial planning and appropriate technologies.
d. As part of the city planning processes, comprehensive planning tools such as the followings should be adopted: overall city carbon footprint audit, quantifiable measurement of energy supply and demand, carbon emission indicators, modeling of climate change effects, as well as building carbon emission/reduction assessment standards.

The next section of this paper uses a project recently undertaken in Beijing, China to illustrate the adoption of new zoning codes as part of the statutory Regulatory Plans to facilitate the building of low carbon cities in China.

The Changxingdian Eco-Community Planning Project, Fengtai District, Beijing

The Fengtai – Hexi District Master Land Use Plan (2006-2020) was prepared by the Beijing Municipal Institute of City Planning & Design (BMICPD) on behalf of the City Government, in accordance with the policies and objectives of the Beijing Urban Master Plan. A team of planners and related professionals led by the author has subsequently been commissioned by a local developer (who acts on behalf of and in partnership with the Fengtai District Government) to review the existing statutory District Plan, and to produce a "low carbon" concept master plan for a 500 hectares site (the Changxingdian Project Community) within the District, based on sustainable development principles.

The Changxingdian Low Carbon Community is located in Fengtai's Hexi District, within the south-western region of Beijing. The project site is approximately 17 kilometers from the center of Beijing and is one of the most important development areas along the south-western corridors of

Beijing city, to accommodate the city's growth. The proposed project is 500 ha in area and includes future residential, commercial, open space, research industrial park. The site will be served by a Light Rail Transit (LRT) line as part of the city-wide mass transit system. The future community will have a population of approximately 70,000 people (**Figure 1, Figure 2**).

Figure 1: Location of the Beijing Changxingdian Eco-Community

Figure 2: The Beijing Changxingdian Eco-Community Existing Condition and Proposed Land Use Plans

The planning objectives of this low carbon community include:

- To prepare a mixed-use community concept plan (for a residential district, commercial and a future research industrial park served by a LRT station) that is guided by a sustainability framework and performance indicators; and to establish a low carbon, economically viable, socially inclusive, environmentally friendly and resource efficient community.
- To pioneer the preparation of a set of innovative “Low Carbon Zoning Codes” that incorporate these sustainability indicators, and that are implementable as statutory zoning plans to manage climate change impact.

The project has specific energy related performance indicators to encourage the final plans to meet the low carbon goal. These energy targets are:

- 50% reduction in CO2 emission compared to BAU including carbon neutralization through tree planting standards.
- At least 15% of energy supply from renewable energy.
- 20% reduction in energy demand compared to BAU.

While the master land use plan has been put in place, the implementation of this low carbon community plans faces challenges and required an innovative approach. As discussed above, the current China statutory planning system has focused on setting out site specific development

parameters such as density, plot ratios, setback requirements etc. at the local detailed plan level --- the statutory "Regulatory Plan" (similar to zoning plans). This list of mandatory planning parameters does not have the ability to manage and control the implementation of the low carbon planning objectives. Innovative alternative Regulatory Plan and low carbon zoning codes were prepared to address this gap.

The Approach – The Formulation of Low Carbon Urban Design Guidelines & Zoning Codes

During the formulation of the planning and design proposals for this project, all the energy related performance targets and technical requirements were modeled at individual sites and street block level to ensure that the sustainability targets as a collective whole for the entire site can be met through the implementation of enforceable zoning codes for each site.

The results are the incorporation of new and non-conventional site specific zoning codes into the statutory Regulatory Plans. These new site specific zoning codes include:

- Energy reduction levels
- Renewable energy utilization levels
- Storm water infiltration levels
- Roof top space required for solar PV panels,
- Waste management facilities
- Water reuse and saving facilities
- Green open space and roof garden area requirements

The images provide examples of the low carbon zoning guidelines, diagrams and plans prepared for the Residential sites of the project (**Figure 3**). Similar zoning codes were also prepared for the Commercial/ Public Buildings as well as Open Space sites of the project.

This was the first time that the low carbon zoning codes of energy, water and waste parameters were experimented to be incorporated as part of the China statutory planning system. It is anticipated that this new approach will greatly improve the feasibility and the enforceability of implementing the low carbon planning concept in China. This pilot project would demonstrate the need of institutional reform in the China planning system in response to the challenge of climate change.

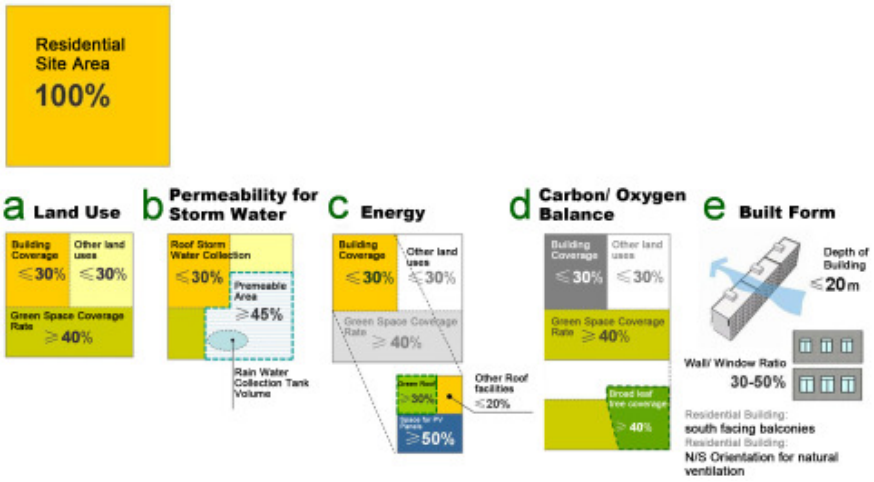

Figure 3: Proposed Low Carbon Zoning Codes for Incorporation into the Statutory Plans

Concluding Remarks

This paper will first provide an overarching view on the impacts of the climate change challenge on the cities, and the reasons why this is posing a historical challenge (and opportunity) for the city planners and decision makers. The discussions will then move on to identifying the barriers for the planning and implementation of low carbon cities in China under the current statutory planning system in China, as well as the need of new planning decision making tools. The paper then proposes an innovative approach in the development of a set of new 'low carbon city' zoning codes as a tool for plan making and development control for the City of Beijing, China. A case study based on a recently completed project in Beijing will be used to illustrate the proposals.

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