Book:

China's Urban Century: Governance, Environment and Socio-Economic Imperatives

Chapter:

The 'eco' and 'low-carbon' promise: a critical review of China's experience

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Abstract: The scale and speed of China's urbanization translate into major challenges for sustainability. Could the 'eco-city' and 'low-carbon' agendas, and the promotion of related pilot cities drive Chinese urban practice towards more environmentally sustainable solutions? We explore this question through a critical review of experience in China, identifying problems relating to the development of *space*, the treatment of *scale* and the pursuit of *efficiency* (the 'space-scale-efficiency nexus'). China seeks sustainable solutions through eco and low-carbon agendas, but our review finds that current efforts fall short of expectations, and problematic patterns are repeated. We propose that a geo-administrative notion of functional regions could provide a strategic framework to address the range of design, physical and administrative planning problems, ensuring that eco-city and low-carbon city pilots result in comprehensive solutions that can be effectively replicated.

KEYWORDS Eco-cities, low-carbon, urbanization, sustainable development, urban planning, urban design, functional region, pilot cities, China, URBACHINA

Introduction

'We project that China will build almost 40 billion square meters of floor space over the next 20 years... the equivalent of up to 10 New York cities' (MGI 2009, p.18)

Without a doubt, Chinese urban development in the last three decades has combined scale and speed in unique and unprecedented ways. Overall energy demand in China is expected to more than double between 2015 and 2025, with urban demand reaching 85 to 90% of total demand (Bina et al 2013). Each year, 10 million people migrate from rural to urban areas, a flow predicted to add up to 350 million new residents in urban areas by 2030, leading to an urban population of 900 million by

2050 (OECD-CDRF 2010). Urbanization and economic growth have become almost synonymous in contemporary China's public discourse, thus Premier Li Keqiang champions urbanization as a 'huge engine' that will 'usher in a huge amount of consumption and investment demand, increasing job opportunities, create wealth for farmers, and bring benefits to the people' (Shen and Loo 2013). Indeed, China's urbanization process has progressed faster than economic growth since 2004 (Chen et al 2013).

Against this backdrop, the Chinese government subscribed to broad notions of sustainable urban development, and rapidly accumulating social and environmental problems (notably air and water pollution levels) have contributed to push this high on Chinese leaders' agendas (NPC 2011). Urban sustainability encompasses the basic values of environmental quality, economic dynamism and social justice, and requires their application to areas including transportation, land use, urban morphology, urban design, architecture and building construction practices (Wheeler and Beatley 2009). In the Chinese context, this is being translated into the need to combine ecological priorities with the economic imperative of growth: growth should be 'healthy' and 'scientific' (MGI 2009) and urbanization should be 'smart, green, low carbon, and inclusive' (OECD 2013).

However, there are formidable challenges ahead. In this inquiry we seek to critically review Chinese policy and practice of promoting 'eco' and 'low-carbon' cities (ELCC), viewed as the latest search for answers to persistent problems associated with three closely interdependent aspects of urbanization: development of *space*, treatment of *scale* and pursuit of *efficiency* (hereafter: 'space-scale-efficiency nexus'). We examine this nexus through the disciplinary lens of planning and urban design, and sustainable development theories. First, we identify the challenges and

limitations of urban policy responses to the *space-scale-efficiency* nexus in China. We then discuss the Chinese agenda for ELCCs, aimed at addressing some of the challenges, and we find that key problems in the patterns of urbanization and planning systems persist. Finally we explore the recent ‘regional turn’, with a specific focus on the idea of functional regions, suggesting this might help Chinese ELCC pilot studies to address these persistent problems.ⁱ The analysis builds on an extensive literature review carried out for the European funded project ‘Sustainable Urbanization in China: Historical and Comparative Perspectives, Mega-trends towards 2050’ (URBACHINA).ⁱⁱ

Urbanization as a challenge to sustainability in China

Space: ‘Sprawling’ patterns and zoning preferences

In China, centripetal urban growth due to continuous rural-urban migration combines with growing centrifugal pressures resulting from the conversion of farm land into sprawling suburban sectors (Kamal-Chaoui et al 2009). Urban sprawl has become a serious issue in China, where megacities are merging with smaller cities and towns and forming vast regions of often disjointed urban, industrial and rural uses. Sprawl is almost invariably the side-effect of policies to promote economic development through urbanization without a proper definition of *where* it should take place (Couch et al 2007). This is usually coupled with weak planning regulation and/or unsustainable spatial development models, such as functional zoning.ⁱⁱⁱ In addition, at the interface between economic growth priorities and local and territorial governance, China’s fiscal incentives for land conversion, which make brownfield development and urban renewal less attractive (Lin 2009), can translate into a

disincentive for sustainable land use practices, and more generally for the efficient use of scarce resources.

Functional zoning – or the territorial disaggregation of a city's land use into large, specialised, single-use urban areas (e.g., residential zones, economic zones, green zones, commercial zones) assembled together in a master plan – has been applied to many Chinese cities as a way to manage urban growth (Yokoharia 2000). When coupled with extensive sprawl, however, functional zoning results in over-simplified urban environments distant from one another, increasing spatial segregation and automobile dependency, while aggravating socio-economic disparities by differentiated access to urban services (Leaf and Hou 2006). Thus, a combination of planning and governance is contributing to inefficiencies in the use of *space* in China (Bian et al 2005) and is exacerbating the negative externalities of sprawl, including social inequality.

Space: Patterns of density

A common response to these mounting problems has been to endorse a 'denser' or 'more compact' use of *space*, which promotes energy efficiency (Couch et al 2008). However, Chinese cities are already characterised by high density, thus increasing it will just aggravate problems like air pollution and loss of green space, while having only a relative impact on sustainability. It is even possible for denser urban areas to be less energy efficient if they serve only one purpose (e.g., residential) and urban dwellers depend on other, distant urban areas to satisfy different needs (e.g., work, shopping, leisure) which are only accessible by car or other motorised means of transportation (Kenworthy 2007).

Land use mix and the concentration of diverse activities (the opposite of zoning), are critical to what Jane Jacobs refers to as the ‘life’ of cities (Jacobs 1961), and are now common elements of urban sustainability. Sprawl and functional zoning, on the contrary, increase the need for motorised transportation, thus also increasing energy consumption and CO2 emissions. The combination of sprawl and zoning, arguably the result of planning systems heavily biased toward the Modernist-Functionalist paradigm (Balula 2010), has been the source of countless unsustainable uses of urban *space*, first in Europe and the USA – which today are facing and trying to counteract the externalities and diseconomies of this model – and now in China.

Space: Urban form preferences

Besides density and zoning, and the fiscal incentive for land conversion, issues of urban form are also major factors affecting the sustainability of *space*, and thus of urban mobility and transport, energy use and GHG emissions. At regional scale, urban form takes into consideration natural features, urbanization density and its spatial distribution, transportation corridors, travel patterns and modal choices (Zhang et al. 2012), as well as open space, residential areas, public facilities and activity centres. At the local scale, urban form deals with street and block layouts and the design of the public realm (Calthorpe and Fulton 2001).

Even though traditional downtowns of Chinese cities are partly comparable to their European counterparts in terms of urban form (see example of downtown Beijing, figure 1), the layout of most new urban development in China tend to follow the model of the single-use superblock, which poses a serious challenge to sustainability, as we will see. Figure 1 contrasts the urban fabric/form of parts of several world cities with a new urban area in Huangshan, Anhui province, depicted

here as example of the ubiquitous superblock pattern of new urban development in China. One such typical superblock, measuring about 400x250 metres, is equivalent to five Manhattan's large blocks, or between 10 to 20 urban blocks of central areas of European cities like Paris or Rome. The street connectivity of a Chinese neighbourhood made of superblocks is thus 5 to 20 times lower than that of these cities.^{iv} This is problematic because street connectivity, together with the presence of diverse activities, is what promotes urban vitality and makes a neighbourhood walkable (Jacobs 1961). Just like many European cities, which in the 1960s and 1970s embraced the Modernist canon of free-standing high-rise single-use buildings on a park (see example of Warsaw suburb, figure 1), Chinese cities are being developed according to car-dependent patterns of urban form and land-use allocation.

Figure 1 – The Chinese superblock compared to other cities' urban fabric (all maps are at the same scale) Adapted from a figure appearing in Blog 'bricoleurbanism', <http://www.bricoleurbanism.org>

Single-use skyscrapers and high-rises surrounded by multi-lane freeways promote compact urban form and convey an image of modernity. These are urban landscapes that are symbolically identified with fashionable images of city living and entrepreneurial success (Shen and Wu 2012). Nevertheless, such patterns of development may prove unsustainable in the long run because they generate functionally segregated over-simplified urban environments, which lead to the many problems discussed. European cities are now struggling to counteract the problems generated by fifty years of mismanaged *space*: this should offer a stark lesson to rapid urbanization in countries like China, yet imperatives of growth appear difficult to overcome (Couch et al. 2007).

Scale: Planning systems and governance obstacles

Further challenges relate to the overall issue of *scale* in planning and decision making. Most sustainability issues are regional in scale and holistic by nature: this goes against the grain of institutional and sectoral structures of government and governance, and China's drive for growth exacerbates what is a widely shared problem (OECD 2013). Urban development entails decisions from multiple levels of government, sectoral agencies and planning departments, each one with its own scalar and partial approach (Liu et al 2014). Concurrently, city governments tend to follow their own local agenda, often driven by short-term objectives in order to meet the central government GDP targets (Ren 2012), at the expense of environmental performance and efficient integration with the plans (and problems) of neighbouring cities and regions. On a positive note, several recent initiatives linked to spatial planning, infrastructure investment and political-economic coordination at the mega-city region level are bringing together different jurisdictions,^v a trend that leads to what Xu and Yeh consider a 'regional renaissance' in the PRC (Xu and Yeh 2011).

Dysfunctional administrative divisions and overlapping jurisdictions lead to disjointed action on issues that transcend administrative jurisdictions, such as watershed management (EEA 2011) or the planning of metropolitan transport networks. These problems emphasise the significance of the territorial dimension of policy integration, and the need for new concepts and governance tools that can understand and manage urban space with a clear connection to its wider geographical context (ISOCARP 2010).

Efficiency: Combined effects and the promises of efficiency

The *space-scale* challenges produce negative effects on efficiency in two ways: (i) diseconomies and negative externalities, including those related to energy, pollution and health; and (ii) lock-in effects arising from urban form and infrastructure that leads to high-energy and high-carbon paths (OECD 2013). China's unprecedented investments in infrastructure and real estate are shaping urban environments that will endure for years to come – and urban form is largely irreversible and virtually impossible, or very costly to modify (Baeumler et al 2012). China's urbanization trends are driving cities into high-energy, high-carbon trajectories, and entire regions into urban form and infrastructure lock-in. Yet, at the same time, responses to the challenges of *space* and *scale* reviewed above are converging towards the ubiquitous goal of 'greater *efficiency*'. We identify four categories of efficiency-driven propositions: (1) land-use related efficiency (2) transport related efficiency; (3) energy related efficiency; and (4) environment related efficiency. The *nexus* between space, scale and efficiency, thus characterises both the nature of the problems and their likely solutions.

The promise of eco-low-carbon cities

A broad consensus seems to be emerging around the notions of eco-city and low-carbon city as policy responses to the challenge identified above, and the Chinese ELCC agenda, boasts hundreds of pilot experiments. There is no standard definition of either concept (Wu 2012) and we found that they are used interchangeably. However, given the weight of ELCC agendas, it is important to clarify some distinctions. Based on key references (UNEP 2012; Wong and Yuen 2011; Yue and Nan 2011, among others), we suggest that eco-cities are spatial and technological materialisations of the principles of low-carbon development and the

term ‘eco-city’ should be more properly used for larger new urban developments (which include in their programme, necessarily, low-carbon goals). Conversely, low-carbon should be used for ‘initiatives,’ also in existing cities, towards an eco-city agenda. Nevertheless, this distinction is often blurred in the literature. In this paper, we will always refer to the broader eco-city agenda unless otherwise specified.

In China, the notion of ‘eco-city’ was first advanced in 2003 by the Ministry of Environmental Protection (MEP) and has evolved to include low-carbon considerations. The concept of ‘low-carbon eco-city,’ with a focus on energy efficiency, emissions reduction and environmental protection, was formally promoted by the Ministry of Housing and Urban-Rural Development (MoHURD) in 2009, as an approach to the idea of ‘ecological civilization,’ as imparted in the official discourse of 2007 by former president Hu Jintao (Liu et al 2014).

Especially since the approval of the 11th Five Year Plan, the country’s leadership has made significant efforts to address the interdependency between environmental quality and economic growth (Bina 2010). Then, under the broad objective of ‘protecting the environment and improving energy efficiency’ the 12th FYP set strict targets for a low-carbon economy (NPC 2012). With respect to ‘Sound Development of Urbanization,’ the Plan advocates, among others, the key goals of ‘optimising urbanization layout and form’ and ‘strengthening the comprehensive management of cities.’ A regional strategy is also broadly delineated around the objectives of ‘optimising the development structure of land and space’ (NPC 2012).

Following a first pilot program for national ‘low-carbon’ province and city development, launched in 2010, the concept has been rapidly incorporated into municipal policy agendas (Ren 2012). Municipal and provincial achievements towards low-carbon targets in China are evaluated by the ‘eco-city’ and ‘eco-garden

city' indexes, developed by the MoHURD and the MEP respectively (Zhou 2012). Both systems establish a set of national or regional-specific standards, or targets to become an 'eco-city' or an 'eco-garden city.' Thus, the concepts of low-carbon city and eco-city became effectively interchangeable in the Chinese context.

By 2012, more than 100 Chinese municipal governments had announced plans to build eco-cities or eco-towns (Wu 2012) and in 2013 it was estimated that more than 200 eco-city projects have been proposed, were under construction, or had been partly or fully implemented (Shiuh-Shen 2013). Such numbers place China at the forefront of eco-city planning and have turned the country into one vast laboratory for experiments in sustainable city development (Liu 2014). An important characteristic of these 'pilot' projects is that they are predominantly large-scale greenfields developments (new cities and new towns built from scratch) in the suburbs of large municipalities; only a few are infill or retrofits on central areas, less prevalent in China given current fiscal incentives to rural land conversion (Wu 2012).

Falling short of addressing the space-scale-efficiency nexus

Many pilot eco-city projects in China are reportedly developing and applying the latest 'green' technology for infrastructure, building and transport, and are expected to provide valid lessons for urban development in China and elsewhere (Energy Foundation 2011). However, despite all the rhetoric and publicity, the results of eco-city projects have been quite mixed. Although some have been praised by their efforts in reducing CO₂ emissions, many have been criticised by their high-carbon costs, as they are likely to introduce highways and superblocks which, combined with a rising middle-class aspiring to have a car, will lock entire cities into high-carbon paths (Shiuh-Shen 2013). 'Low-carbon' is very often used just as a label, loose

enough to fit high-carbon projects (Leaf and Li 2006) and, in spite of claims of more than 200 cities having set targets to become ELCCs, independent estimates say only about 20 percent of those claims are genuine (Yue and Nan 2011).

We argue that the lack of a clear definition for ELCC agendas that includes a focus on the space-scale-efficiency nexus is partly to blame, and explore the guidance provided to local and provincial governments by current ‘eco-city’ and ‘eco-garden city’ indicator systems in order to illustrate the problem. Finding solutions that can improve the quality and performance of pilot eco-city projects is crucial given central government’s intention to scale up and apply to other cities and regions those pilots that prove to be successful models of low-carbon development (Zhou 2012).

Table 1 summarises current indicator systems, which allow for target setting, comparison and evaluation, eco-city planning and management. These need to be better qualified and quantified (Wong and Yue 2011), while the range of sectors and challenges needs to be significantly expanded in order to address the space-scale-efficiency nexus (table 2). Many pilots have failed to address the range of spatial planning and regional governance challenges identified in the previous section for various reasons, including the limited reference to these dimensions in the indexes of table 1.

Sector (Challenge)	Eco-Garden city indicators (MoHURD)	Eco-city indicators (MEP)
Land, landscape and ecosystems	(1) green space coverage in built-up area; (2) public green area per-capita in built-up area; (3) proportion of pervious surface in roads and squares in built-up area; (4) forestation coverage in built-up area; (5) species diversity index; (6) native plant index; (7) citizen satisfaction with environmental quality	(1) urbanization rate; (2) urban public green area per-capita; (3) forestation coverage; (4) proportion of protected area in total land area; (5) citizen satisfaction with environmental quality
Energy	(8) proportion of energy-efficient and green buildings	(6) energy consumption per unit of GDP
Transportation	(9) average speed of major and secondary roads; (10) Proportion of trips by public transport	N/A
Air quality	(11) number of days per year of air pollution meeting or exceeding China’s National Ambient Air Quality standards	(7) ambient air quality meeting stipulated standards for different functional zones; (8) intensity of major pollutants emissions

		(CO ₂ , SO ₂)
Water use	(12) treated water utilization rate; (13) extent of tap water coverage	(9) consumption of fresh water per unit of industrial value added; (10) industrial water reuse rate
Water quality	(14) quality of water bodies meeting national surface water quality standard; (15) quality of water from pipe network meeting national drinking water quality standard; (16) urban sewage treatment rate	(11) quality of water bodies meeting stipulated standards for different functional zones; (12) quality of centralized drinking water meeting national surface/groundwater standard; (13) urban sewage centralized treatment rate
Solid waste	(17) domestic solid waste non-toxic treatment rate	(14) urban domestic solid waste non-toxic treatment rate; (15) industrial solid waste treatment rate
Sonic environment	(18) noise pollution levels meeting national noise standard in built-up areas	(16) noise pollution levels meeting stipulated standards for different functional zones
Thermal environment	(19) urban heat island effect	N/A
Services and infrastructures	(20) urban infrastructure good condition index; (21) number of hospital beds per 10,000 people.	(17) district heating (or central heating) coverage
Industry and economy	N/A	(18) rural net annual income per-capita (differentiated for developed and underdeveloped areas); (19) share of tertiary industry in GDP; (20) share of GDP invested in environmental protection; (21) passing rate of enterprises that are required for clean production

Adapted from Zhou et al 2012. Original source: Chinese Society of Urban Studies

Table 1 - Chinese eco-city and eco-garden city indicators systems by sector

Table 2 lists 22 indicators with the potential to address the space-scale-efficiency nexus, covering such matters as local and regional spatial structure, regional mobility, housing and transport infrastructure, regional service delivery, and the structure of regional governance. This listing is based on key indicators advanced by OECD for functional regions (OECD 2011) and others with territorial/spatial expression included in the guidelines of the Low-Carbon Eco-City Strategy of the Chinese Society for Urban Studies under MoHURD (Baeumler et al 2012). The list is by no means exhaustive, and the diversity of Chinese regions does not recommend the adoption of a rigid set of indicators, as these must be tailored to each region's specificities. However, it provides an initial set of ideas on how to better integrate general ELCC-type indicators with the much-needed focus on the space-scale-

efficiency nexus, and on the regional dimensions of urbanization, in line with the stated aspiration, and urgent need to achieve low-carbon development.

Urban Form and Functional Region Challenges	Indicators
Local spatial structure	(1) building density in FAR (floor-area ratios) (2) neighborhood land-use mix (3) accessibility to urban services and amenities* (4) proximity of transit stations* (5) strength of activity centers (6) jobs/housing ratio (7) block size* and street connectivity (8) network of pedestrian paths and bicycle lanes*
Regional spatial structure	(9) degree of polycentricity** (10) degree of spatial concentration of activities**
Regional mobility, housing and transport infrastructure	(11) share of people who work in a different municipality from that in which they live** (12) average commuting time and distance* (13) share of population living within a certain distance from a public transport station** (14) share of mass transit users* (15) share of green transport trips (16) share of population living at more than 45 minutes from work (17) share of population living at more than 45 minutes from a large city
Regional service delivery (education, health)	(18) share of people living within a distance of 2 km from the closest primary or secondary school** (19) share of people living within a maximum distance of 5 km from the closest health service**
Structure of regional governance	(20) number of local authorities per 1,000 inhabitants** (21) presence/absence of strategic planning experiences carried out at a supra-local level** (22) presence/absence of smart growth developments integrating transport, land use and housing policies

*Indicators included in the 2009 city planning guidelines of the Low-Carbon Eco-City Strategy by the Chinese Society for Urban Studies (CSUS) under MoHURD (see Baeumler et al 2012: 41); **Indicators advanced by OECD for functional regions (OECD 2011)

Table 2 - Key indicators for addressing the space-scale-efficiency nexus in a Functional Region context

The examples of Tianjin, Kunming and Chongqing

The flagship Tianjin Eco-city, a Chinese–Singaporean project for a new-city located 45 km from Tianjin, a city near Beijing, claims to have the required conditions for what is effectively low-carbon development, including: TOD principles,^{vi} high density and public transport, mixed land uses, in-situ jobs and mixed-income housing, parks and plenty of public services such as schools and hospitals, as well as renewable energies and energy saving buildings (Yang and Deng 2013). However, configuring the city layout using the typical grid of 400x250 meters superblock might fail to generate the envisioned walkable urban environment

(Baeumler et al 2012). As many of the plan's approaches are yet to be implemented, it remains to be seen if all the other positive features will be enough to balance this specific problem of urban form.

The pilot eco-city projects for Kunming (Chenggong) and Chongqing (Yuelai) offer yet another valuable perspective. The new city of Chenggong was planned for a population of 1.5 million and construction started in 2003. In 2010, the Energy Foundation and the China Sustainable Cities Program commissioned a revision of the city's master plan to incorporate TOD and sustainable urban design principles. The new plan broke down the superblocks into smaller blocks and narrower human-scale streets, with a hierarchy of densities and mixed-uses related to the ease of access to the public transportation system. The same approach is being tested in Yuelai, a 2.5 km² new district in the hills north of Chongqing. Large single-use areas, pedestrian-unfriendly superblocks, and a lack of co-ordination with public transport stations in the allocation of land uses were revised following TOD principles favouring 'walkable, mixed-use transit centers in and among the rolling topography' (Energy Foundation 2011: 14).

Chinese eco-city trials are very recent and it is too early to assess their impact. However, given the extraordinary scale of the ongoing eco-city experiment and the shortcomings identified in previous eco-city trials, it is urgent to formulate a comprehensive policy and technical measures capable of addressing the space-scale-efficiency nexus.

Functional regions: a policy approach to the space-scale-efficiency nexus

The affirmation of 'space' in regional policy

Most conceptualisations of metropolitan or regional systems emphasise, one way or another, the relevance of the space-scale-efficiency nexus for city-making, so that all that takes place in a city's hinterland is part of the same 'urban' system (METREX 2010). This implies major shifts: a shift from sectoral to territorial approaches to development; a scalar shift from both the national level and the local scale of the municipality to the sub-national level of the region; and a shift towards governance structures capable of ensuring both vertical integration (between levels of government and scales of intervention) and horizontal integration (between policy sectors) (Rodriguez-Pose 2008). Crucially, the aim is that policy-making at the regional level adjusts to the diverse contexts, and the 'city-region' becomes a critical geographical unit for 'place-based' approaches and 'place-specific' policies (ESPON 2010).

The space-scale-efficiency nexus becomes instrumental to competitiveness and growth.^{vii} It is in this context that the concept of 'functional region' gained particular pre-eminence (Barca 2009). Functional regions may be defined as large spatial sub-regional units, non-overlapping with political-administrative boundaries, which include interdependent urban, rural and natural areas internally linked by functional relationships. The demarcation of a functional region may reflect: (i) an urban-rural perspective (e.g., commuting patterns, employment markets); (ii) a rural-urban perspective (e.g., access to public goods and services in rural areas); or (iii) a crossover perspective (e.g., integrated management of ecosystems that cross urban and rural territories) (Ferrão et al 2012). Some of these considerations can be captured by the indicators used by ELCCs (table 1); however, many can be only measured by indicators suggested in table 2.

Rising notions of 'functional regions' in China

We find that China is making progress in a direction of spatially and regionally oriented urbanization that echoes several of the characteristics mentioned above. In Wen Jiabao's words, the country needs to 'promote the sound development of urbanization by making plans scientifically, balancing geographical distribution, coordinating urban and rural development, using land economically and tailoring measures to local conditions' (Xinhua 2012). Indeed, a recent wave of policies and practices confirms the re-emergence of regional governance in China, with a significant level of regional coordination already taking place at city, prefecture and regional level. After decades of fragmentation driven by the downscaling of governance that began in 1978, leading to intense inter-city competition, the central government has been actively promoting over the last decade regional policies and plans to address regional inequalities and boost regional coordination (Yi and Wu 2012). While the 'mega-city region' is increasingly recognised as the appropriate level to manage local and regional economic policies, strongly linked to spatial planning and urban infrastructure investment (Xu and Yeh 2011), local governments are seeking greater cooperation through inter-city associations, regional planning or regional policies with the aim of resolving region-specific crises or problems (Li and Wu 2012). Well-established examples, include, the Pearl River Delta Economic Zone, and the coordinated mechanism to cooperate in air pollution control for Beijing, Tianjin and Hebei (Jinran and Xin 2013).

The new national urbanization plan announced in March 2013 at the opening of the 12th NPC (Jingli 2013), should offer a more elaborate spatial perspective, capable of addressing the issues of urban form identified above. According to Yang (OECD 2013), the plan includes the following key goals: i) promoting the large

spatial form of city clusters; ii) adopting instruments that affect urban spatial form (e.g., urban boundary, urban planning standards); and iii) putting in place a better urban management governance mechanism. This last point is of particular relevance since in China local governments and provincial agencies have great discretionary decision making powers over urban development but this is often accomplished at the expense of cooperation across sectoral and jurisdictional boundaries (Baeumler et al 2012). Jurisdictional fragmentation often implies functional diseconomies and detrimental intra-regional competition, which is perhaps the greatest expression of the tension between growth and the environment. Major challenges to regional policy and spatial integration also arise from the structure of fiscal revenues of local governments (Lin 2009), which are generated through land transactions and property development and are the core driver behind urban sprawl.

Spatial-geographical and administrative conceptions of the region

Chinese urbanization theory and practice has been informed by North America's experience, where important propositions relating to the space-scale-efficiency nexus have been developed for over two decades. Affirming itself as a major paradigm shift in urban planning, the theory and practice of New Urbanism and Smart Growth highlights many of the elements present in eco-city notions, such as transit, walkability, environmental sustainability and social integration (Wong and Yuen 2011), while emphasising the idea of a formal and functional continuum from the larger region to the building site (Duany and Talen 2002) that needs to be properly understood in order to achieve sustainable patterns of urban development.

The city-region provides additional answers to China's challenges described above. Transit Oriented Development (TOD)-based regional strategies^{viii} are being

adopted by an increasing number of cities throughout the world and promoted, amongst others, by the World Bank in China. ELCC cases have focused on TOD, while cities like Beijing, Shanghai, Shenzhen and Guangzhou have been gradually accepting it as an important concept for urban transport planning (Jiang and Zhenyu 2010). It must be noted, however, that given significant structural differences of speed and scale of urbanization, New Urbanism ideas have been approached quite differently in China and in Europe. While in Europe their influence on planning systems has been incremental, in China they are strongly associated with a recent policy shift (at least rhetorically) towards low-carbon development.

In order to address the space-scale-efficiency nexus, ELCC development needs to be grounded in strategic visions for entire polycentric regions. It is in this context that regional strategic planning is gaining traction in China, as a mechanism of economic development based on territorial development that acknowledges place-specific socio-economic assets (Xu and Yeh 2011). The two examples of Kunming and Chongqing show some progress towards these objectives, by addressing, at least in part, the challenges of the spatial-scale-efficiency nexus, but far more needs to be done if the objective of replicating and scaling up ELCC pilots is to make a real contribution to sustainable urbanization in China. Eco-city initiatives need to operate in a multi-scalar, multi-policy context so as to achieve the goals of ‘optimising urbanization layout and form’ and ‘strengthening the comprehensive management of cities’ as stated in the 12th FYP and in reviews of practice (Baeumler et al 2012b).

Our review of policy and practice suggests that, given the complexity of sectoral and administrative arrangements required for large-scale ELCC pilot projects, these would benefit from being embedded in what might be called a *geo-administrative strategic framework*, drawing on the Functional Regions concepts

revised above. In figure 2 we propose the key dimensions of an approach based on the functional region concept, including: (1) a *spatial (geo) dimension* focusing on physical planning and issues of urban form, land use, urban design and the quality of natural and built environments; and (2) a *procedural (administrative) dimension*, focusing on governance and concerned with policy integration, intermunicipal cooperation and multi-level governance.

Figure 2 – Functional region as geo-administrative conceptual framework

To work, an ELCC *Geo-Administrative Strategic Framework* would have to be defined at the highest level of government (e.g. National Development Reform Commission), acting as a forward-looking programme that provides the regulatory and financial means to push the boundaries of current ELCC pilots, finding innovative solutions that integrate all dimensions considered in figure 2. The Framework would promote a flexible agenda, allowing for place-specific policy responses and adaptable to local experimentation, inherent to ELCC projects, while promoting comprehensive solutions for the natural and built environment, from the larger region to the building

site. In order to counter political and spatial fragmentation in China, the Framework could actively promote channels and means of intermunicipal cooperation, within pilot multi-level governance arrangements involving intermunicipal partnerships and central state departments (e.g., Ministry of Transports, Ministry of Environment), among other stakeholders, to deliver spatially coherent, and resource efficient city-regions.

Finally, in terms of monitoring performance and identifying best practice for scaling up, we recommend changes to the existing systems so as to better address the space-scale-efficiency nexus. Table 2 proposes several key indicators to address both the *spatial* and the *procedural* dimensions of urbanization. Among them, the number and type of strategic planning experiences carried out at supra-local level, for example, could be used as proxy to measure the effectiveness of regional cooperation.

Conclusion

In China, the 21st century will be shaped by the process of urbanization, driven by economic priorities and inextricably linked to resources and ecological constraints. For this to be sustainable, we have argued that current practices must do much more to address the *space-scale-efficiency* nexus. Our critical review of theory and practice shows how government and practitioners struggle to embed policy-making in holistic visions of the territory, but equally, we find clear signs of shifting agendas, partly triggered by economic and ecological necessity. The Chinese pilots for ELCCs attest to the political will to change the course of urbanization towards more sustainable paths. However, the combination of speed, scale, the imperative of GDP growth, and the related fiscal-land-property bind for generating local government revenue to promote economic development, too often neutralises the impact of the ELCC agenda

in China. As a result, the risk of lock-in for most decisions implying a spatial and physical change is raised to exponential levels, meaning that the window of opportunity to shift towards a more ecologically and socially sustainable direction is closing fast.

Given the strategic importance of ELCC pilots, the risks of lock-in, and the prospect that they might serve as example for hundreds of cities throughout the country (and the World), a significant improvement in ELCC practice is somewhat urgent. Thus, based on the premise whereby an effective policy response must be, at the very least, commensurate with the challenge(s) it claims to focus on, we have proposed that ELCC pilot *projects* be embedded in a *geo-administrative strategic framework* that gives municipalities within city-regions the means to identify and implement innovative solutions to address the space-scale-efficiency nexus, and the underlying political and economic drivers of current rapid urbanization, including its intrinsic conflict with ecological priorities. The recent policy and political developments in China suggest that the time is ripe for engaging in new approaches to sustainable urban development.

References

- ADB (2008), *Urban Development Experience and Visions. India and the People's Republic of China*, Asian Development Bank, Manila, available at <http://www.adb.org/Documents/Reports/Urban-Visions/default.asp> (accessed: 12/11/09).
- Baeumler, Axel, Mansha Chen, Kanako Iuchi, and Hiroaki Suzuki (2012), 'Eco-Cities and Low-Carbon Cities: The China Context and Global Perspectives', in Axel Baeumler, E. Ijjasz-Vasquez and S. Mehndiratta (eds), *Sustainable Low-Carbon City Development in China*, World Bank Publications, pp. 33-62.

- Baeumler, Axel, E. Ijjasz-Vasquez and S. Mehndiratta (eds) (2012), *Sustainable Low-Carbon City Development in China*, World Bank Publications.
- Balula, Luis (2010), *Urban Design and Public Policy: Theoretical Foundations for a European New Urbanism*. Saarbrücken, Lambert Academic Publishing.
- Barca, Fabrizio (2009), 'An Agenda for a Reformed Cohesion Policy. A Place-Based Approach to Meeting European Union Challenges and Expectations', available at http://www.dps.tesoro.it/documentazione/comunicati/2010/report_barca_v0306.pdf (accessed: 14/1/12).
- Bian, X. F., Q. Wu, and W. N. Liu (2005). 'Relationship between Urbanization and Urban Land Use Structure Change in China', *Resources Science*, **27** (3), 73-783.
- Bina, Olivia, L. Balula, A. Ricci and Z. Ma (eds.) (2013), *State of the Art Report: Sustainability Dimension of Urban Infrastructure and Services*, URBACHINA Project Report no. D4.1, *unpublished*, 28 February 2013, Lisbon.
- Bina, Olivia (2010), 'Environmental Governance in China: Weakness and Potential from an Environmental Policy Integration Perspective,' *The China Review*, **10** (1), 207-240.
- Calthorpe, Peter and William Fulton (2001), *The Regional City: Planning for the End of Sprawl*, Washington, DC, Island Press.
- Chen, Mingxing, W. Liu, and X. Tao (2013), 'Evolution and Assessment on China's Urbanization 1960–2010: Under-Urbanization or Over-Urbanization?,' *Habitat International*, **38**, 25-33.
- Couch, Chris, G. Petschel-Held and L. Leontidou (2007), *Urban sprawl in Europe*. Oxford: Blackwell.
- Duany, Andres and Emily Talen (2002), 'Transect Planning' *APA Journal*, **68** (3), 245-266.
- EEA (2011), 'River Basin Management Plans and Programme of Measures,' European Environment Agency, available at <http://www.eea.europa.eu/themes/water/water-management/river-basin-management-plans-and-programme-of-measures>
- Energy Foundation (2011), 'Meeting China's Urban Design Challenge,' Annual Report.

- ESPON (2010), 'New Evidence on Smart, Sustainable and Inclusive Territories', First ESPON 2013 Synthesis Report, Results by summer 2010
- Ferrão, João, J. Mourato, L. Balula and O. Bina (2012), *Regiões Funcionais, Relações Urbano-Rurais e Política de Coesão Pós-2013*, Instituto de Ciências Sociais, Universidade de Lisboa, Relatório para o Conselho Económico e Social de Portugal.
- ISOCARP (2010), *Livable Cities in a Rapidly Urbanizing World*, International Society of City and Regional Planners, Singapore July 25-31, 2010.
- Jacobs, Jane (1961), *The Death and Life of Great American Cities*, New York, Random House.
- Jiang, Y. and L. Zhenyu (2010), 'Practices and Policies of Green Urban Transport in China,' *Journeys*, **May**, 26-35.
- Jingli, S. (2013), 'National Urbanization Plan to Come Out in H1,' *China Daily*, 06/03/2013, available at http://www.chinadaily.com.cn/bizchina/2013-03/06/content_16284813.htm (accessed: 30/7/13).
- Jinran, Z. and Z. Xin (2013), 'Action for Air Quality Control Under Review,' *China Daily* 05/06/2013, available at http://www.chinadaily.com.cn/china/2013-06/05/content_16567113.htm (accessed 24/12/13)
- Kamal-Chaoui, Lamia, E. Leman and R. Zhang (2009), *Urban Trends and Policy in China*, OECD Regional Development Working Papers, No. 2009/1, OECD publishing.
- Kenworthy, J. (2007), 'Urban Planning and Transport Paradigm Shifts for Cities of the Post-Petroleum Age,' *Journal of Urban Technology*, **14** (2), 47-70.
- Krier, Léon (1984), *Houses, Palaces, Cities*, Architectural Design, AD Editions.
- Leaf, M. and L. Hou, (2006), 'The 'Third Spring' of Urban Planning in China: The Resurrection of Professional Planning in the Post-Mao Era' *China Information* **20** (3), 553-585.
- Lin, George C.S. (2009), 'Scaling-up Regional Development in Globalizing China: Local Capital Accumulation, Land-centred Politics, and Reproduction of Space,' *Regional Studies*, **43** (3), 429-447.

- Liu, H., G. Zhou, R. Wennersten and B. Frostell (2014), 'Analysis of Sustainable Urban Development Approaches in China,' *Habitat International*, 41, 24-32.
- METREX (2010), 'Intra-metropolitan polycentricity in practice - Reflections, challenges and conclusions from 12 European metropolitan areas. Final report of the METREX - Expert Group on Intra-Metropolitan Polycentricity', available at http://www.eurometrex.org/Docs/Expert_Groups/Polycentricity/METREX_IMP_final_version.pdf (accessed on 22/10/13).
- NPC (2011), '12th Five Year Plan, by the National People's Congress', English translation by the British Chamber of Commerce, 2011, available at <http://www.britishchamber.cn/content/chinas-twelfth-five-year-plan-2011-2015-full-english-version> (accessed on 11/08/13).
- OECD (2013), *Urbanization and Green Growth in China*, OECD Regional Development Working Papers, OECD Publishing.
- OECD-CDRF (2010), *Trends in Urbanization and Urban Policies in OECD Countries: What Lessons for China?* Organisation for Economic Cooperation and Development and China Development Research Foundation.
- Ren, X. (2012), '“Green” as Spectacle in China,' *Journal of International Affairs*, **65** (2), 19-30
- Rodriguez-Pose, A. (2008), 'The Rise of the ‘City-Region’ Concept and its Development Policy Implications,' *European Planning Studies*, **16** (8), 1025-1046.
- Shen, H. and D. Loo (2013), 'China Urbanization to Hit Roadblocks Amid Local Opposition,' *Seattle Times*, 13/08/2013, available at http://seattletimes.com/html/nationworld/2021605072_chinacitiesxml.html (accessed: 30/8/13).
- Shen, J. and F. Wu (2012), 'The development of master-planned communities in Chinese suburbs: a case study of Shanghai's Thames town', *Urban Geography*, **33** (2), 183-203.

- Shiuh-Shen, C. (2013), 'Chinese Eco-cities: A Perspective of Land-Speculation-Oriented Local Entrepreneurialism,' *China Information*, **27** (2), 173-196.
- UNEP (2012), *21 Issues for the 21st Century*, United Nations Environment Programme, Nairobi.
- Wheeler, Stephen M. and Timothy Beatley (eds.) (2009), *The Sustainable Urban Development Reader*, second edition, New York, Routledge.
- Wong, Tai-Chee and Belinda Yuen (eds) (2011), *Eco-city Planning: Policies, Practice and Design*, Springer.
- World Bank (2010), *Eco2 Cities: Ecological Cities as Economic Cities*, World Bank, Washington, DC, available at www.worldbank.org/eco2 (accessed 18/08/13).
- Wu, F. (2012), 'China's Eco-Cities,' *Geoforum*, **43**, 169-171.
- Xinhua (2013), 'China Hoping 'Two Sessions' Balance URBANIZATION,' *Xinhua*, 02/03/2013, available at http://news.xinhuanet.com/english/china/2013-03/02/c_132203347.htm (accessed: 20/2/13).
- Xu, Jian and Yeh A. G.O. (2011), 'Coordinating the Fragmented Mega-City Regions in China,' in Jian Xu and Anthony G.O. Yeh (ed), *Governance and Planning of Mega-City Regions*, New York, Routledge, pp. 213-235.
- Yabar, H., K. Hara, M. Uwasu, Y. Yamaguchi, H. Zhang and T. Morioka (2009), 'Integrated Resource Management Towards a Sustainable Asia: Policy and Strategy Evolution in Japan and China'' *Journal International Journal of Environmental Technology and Management*, **11** (4), 239-256.
- Yang, W. and W. Deng (2013), 'Building Related KPIs in Sino-Singapore Tianjin Eco-City,' *APCBEE Procedia*, **5**, 112-115.
- Wang, Y. (2004), 'Environmental Degradation and Environmental Threats in China,' *Environmental Monitoring and Assessment*, **90** (1-3), 161-169.
- Yokohari, M., K. Takeuchi, T. Watanabe and S. Yokota (2000), 'Beyond Greenbelts and Zoning: A New Planning Concept for the Environment of Asian Mega-Cities,' *Landscape and Urban Planning*, **47**, 159-171.

- Yue, Z. and Nan, X. (2011), 'How to spot a fake eco-city,' *China Dialogue*, August 25, available at <http://www.chinadialogue.net/article/show/single/en/4488-How-to-spot-a-fake-eco-city?utm> (accessed: 09/09/11)
- Zhang, L., J. H. Hong, A. Nasri and Q. Shen .(2012), 'How Built Environment Affects Travel Behavior: A Comparative Analysis of the Connections Between Land Use and Vehicle Miles Travelled in US Cities,' *Journal of Transport and Land Use*, **5**, No 3, 40-52.
- Li, Z., S. Chang, L. Ma, P. Liu, L. Zhao and Q. Yao (2012), 'The Development of Low-Carbon Towns in China: Concepts and Practices,' *Energy*, **47** (1), 590-599, 593.
- Zhou, Nan, Gang He and Christopher Williams (2012), *China's Development of Low-Carbon Eco-Cities and Associated Indicator Systems*, China Energy Group.

ⁱ Although, note that the UK has recently dismantled regional planning, in part as a response to austerity planning, which suggests that economic imperatives continue to affect territorial management in rich, as well as emerging, nations.

ⁱⁱ See: <http://www.urbachina.eu/index.php/en/> and <http://urbachina.hypotheses.org/>

ⁱⁱⁱ For a critique of zoning see, for example Krier 1984.

^{iv} Street connectivity is mainly a function of block size. It is measured by counting the number of street intersections on a given urban area.

^v Among them, the Northeast Six City Coalition, the Yangtze River Delta, the Beijing-Tianjin-Hebei, and the Chongqing-Chengdu intermunicipal initiatives.

^{vi} Transit-Oriented Development (TOD) is associated to the idea of polycentric city. Its goal is to promote denser, functionally mixed, pedestrian-friendly urban 'nodes/places' around mass-transit stops – usually a light-rail connecting all the 'nodes' – which function as major activity centers for a surrounding, less dense residential area.

^{vii} See: http://ec.europa.eu/regional_policy/what/index_en.cfm

^{viii} In terms of regional planning, TOD strategies are matched with the concept of 'regional building blocks' - an integrated vision of the city-region and of the relations between the built and natural environments; and of the 'transect' - a planning tool that seeks to organize the physical elements and

typologies of the human and natural habitats along a territorial continuum with gradually different levels of urban intensity, ranging from ‘rural preserve’ to ‘high-density urban.’

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