



Low-carbon promises and realities: Lessons from three socio-technical experiments in Shanghai

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ABSTRACT

China's ongoing transition to a modern urban-centered economy is accompanied by ambitions of sustained economic growth as well as promises of environmentally sustainable futures for its cities. In this paper we critically assess how these two ideas are combined and translated into realities on the ground by examining three low-carbon development projects in Shanghai: Anting New Town, Dongtan Eco-City, and Hongqiao CBD's low-carbon transportation hub. By mobilizing insights from the academic field of Sustainability Transitions – specifically on expectations, experimentation and innovation journeys – we show how the original plans derailed and why until now there has been limited success in living up to the promises of sustainability. To realize the promises more fully in future projects we identify three broad lessons for the actors involved: they should nurture a set of parallel pathways, foster a more experimentalist mindset, and learn to embrace uncertainty.

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1. Introduction

The ancient painting *Qingming Shanghetu* has been the exemplar for what desirable urban life in China in looks like. Painted in the early 12th century, it depicts a mix of economic activities and a broad range of lifestyles that together symbolize the vitality, continuity and social and natural harmony of a compact city clearly defined within its city walls. Today, the reality is very different: the pace of urbanization accelerated over the past two decades and this is reflected not only in the physical reality of territorial and material growth but also in the emergence of a new political economy of urban expansion and the rising prominence of an ideology of urbanism. According to Hsing (2010) these three elements combined dominate the logic of China's transformation. This urban transformation is epitomized in many new towns, high-tech industrial parks and advanced transport hubs at the fringes of Shanghai and

other megacities (Den Hartog, 2010, 2017).

The advent of urban modernity has created many new opportunities, but simultaneously new problems have appeared in terms of the environment (Zhao et al., 2006; Economy, 2007). The emergence of 'urban headaches', such as CO₂ emissions, air pollution and environmental degradation have put new policy approaches on the agenda to foster green growth (Chang et al., 2016). One of the key solutions advocated are massive new construction projects endorsed by ambitious labels, such as 'eco-city', 'ecological model town' or 'low-carbon transportation hub'. These projects promise a decreased carbon footprint, a clean environment and a better quality of life in these new urban centers (Wu, 2012; Lu et al., 2017).

This paper investigates the promises and realities in terms of sustainability features in three promising urban development projects around Shanghai. We focus on Shanghai because it is a frontrunner city in China in terms of its ambitions for green urban renewal. We investigate three of the most ambitious and internationally recognized sustainability oriented development projects: Anting New Town, Dongtan Eco-City and Hongqiao CBD's low-carbon and transportation hub. For each case we critically assess how initial visions were translated into outcomes on the ground. We also identify overarching patterns across the cases and

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formulate broad lessons on how such projects can contribute to a more sustainable urban future.

The paper is structured as follows. Section 2 introduces three key concepts (expectations, socio-technical experimentation and innovation journeys) that are useful tools to help assess the promises and realities of sustainable development projects. Section 3 elaborates on our methodological approach and the selection of the three cases. Section 4 describes the dynamics for each of cases. Section 5 synthesizes the findings and identifies overarching patterns and concludes by formulating lessons for practitioners.

2. Theory: expectations, experiments and journeys

This paper is concerned with the transformation toward radically more sustainable future cities, and in particular how urban development projects imbued with environmental promises might contribute to this goal. To conceptualize this contribution we draw on insights from the field of Sustainability Transitions. Scholars from this field investigate major shifts toward sustainable socio-technical systems of production and consumption. The study of socio-technical transitions to sustainability draws on a wide range of literature and lines of thought (such as neo-institutional theory, evolutionary economics and Science and Technology Studies) and a variety of frameworks and approaches (such as the Multi-level Perspective, Strategic Niche Management and Transition Management) to express how promising visions of a sustainable future can become a material reality in experimental development projects and how these can be empowered in order to transform the unsustainable incumbent order (Grin et al., 2010; Markard et al., 2012).

To investigate the promises and realities of green development projects, we mobilize three core concepts from the Sustainability Transitions field. They serve as ‘sensitizing concepts’ for the empirical analysis and structuration of our argument (Blumer, 1954). The concepts are: (1) expectations, (2) socio-technical experimentation and (3) innovation journeys.

To investigate how actors are bound together in green development projects that harbor a particularly appealing vision of the future, scholars from the field of Sustainability Transitions often mobilize the concept of *expectations*. Expectations can broadly be defined as “statements about the future – uttered or inscribed in texts or materials – that circulate” (Van Lente, 2012: 772). The main idea here is that expectations are not merely descriptive statements that are either true or false, but that they ‘do’ something. Expectations lead to action when they are articulated – spoken, written, drawn or otherwise rendered visually – in a particular context or situation through a particular medium by a particular actor. In other words, they are ‘performative’ in the sense that they help create a new reality by providing heuristic guidance (Rip and Kemp, 1998); by coordinating roles and activities amongst actors (Konrad, 2006); and by legitimizing certain investments (Borup et al., 2006). The articulation of expectations is one of the key processes in facilitating or managing sustainable innovation journeys and to do this successfully the expectations should be robust (shared by multiple actors), specific (if expectations are too general they do not give guidance), high-quality (the content of expectations is substantiated by ongoing hands-on projects) (Schot and Geels, 2008).

Because the notion of expectations is very broad some scholars prefer more specific concepts to highlight how actors can engage with the transformation toward sustainable cities. Some have emphasized the need for setting up so-called Urban Transition Labs to deploy and learn about trajectories of sustainable urban development (Nevens et al., 2013). A key part in this process is the formulation of an explicit ‘transition vision’ (Loorbach, 2007). This is seen as a deliberative activity whereby a group of actors

(‘frontrunners’) formulate an overarching direction for future development together. The idea is that these actors agree on basic principles for longer-term development whilst leaving room for dissent on the details and the shorter term. In this deliberative process of envisioning the different actors involved learn about each other’s perspectives and values, about the complexity of setting up projects to achieve sustainable development, about the uncertainties regarding the future and about the possibilities of cooperation. Sengers (2016), on the other hand, emphasizes that envisioning is not necessarily a formal and deliberative process, but a more implicit process whereby ideas about the future gradually become more substantiated and specific. He argues that urban sustainability transitions are journeys that start out in the minds of individual actors (‘change agents’) as vague conceptual images inspired by far-flung ideals, which are later articulated as ‘urban imaginaries’ – defined as shared understandings of what constitutes a desirable future city. This implies that envisioning urban sustainability transitions are fundamentally about ‘re-imagining places’ (Hodson and Marvin, 2009), and that the actors involved have to some extent similar ideas about what the future ought to look like for a designated urban area and about what actions need to be undertaken to achieve this.

To turn visions into reality actors engage in a process of *socio-technical experimentation*. Ideas that look appealing on paper and sound good in words have to be applied in real-life settings in order to be tested and developed further. In the context of transitions in the urban environment, experiments are seen as important seeds of change that may eventually lead to a profound shift in the material and social organization of the city. The hope is that the learning and demonstration effects of small-scale experiments lead to larger-scale experiments and contribute to the overall momentum of the main principles behind these experiments in eventually replacing established principles of urban development (Sengers et al., 2016).

Scholars from the field of Sustainability Transitions argue that the notion of experiment has a rather distinct meaning, unlike the way the term is used in the natural sciences and more akin the term pilot project (Weber et al., 1999; Vergragt and Brown, 2007; Van den Bosch and Rotmans, 2008; Berkhout et al., 2010). We could say that experimentation in the natural sciences takes place under strictly controlled laboratory conditions as a way to find hard objective truths about the reality out there, but that experimentation for sustainability takes place in a real-world environment without strict laboratory conditions whereby a variety of societal actors commit to the messy engage with the introduction of alternative socio-technical systems in order to purposively reshape material realities in a desirable direction. In this sense it might be more accurate to talk about a ‘socio-technical experiment’, which can be defined as: “an inclusive, practice-based and challenge-led initiative, which is designed to promote system innovation through social learning under conditions of uncertainty and ambiguity” (Sengers et al., 2016: 9).

It should be noted that there are six key concepts in this definition and that these can be interpreted in a normative way, in the sense that they prescribe how an experiment would contribute more meaningfully to a sustainable innovation journey. First, an experiment should be inclusive. In order to mobilize the necessary resources and legitimacy projects have to be firmly supported by a number of directly and indirectly involved parties (a deep coalition). A recurring observation in the literature is that the involvement of more active participation or more diversity in the coalition of supporting actors and the perspectives they bring to the table increases the potential for success and to meaningfully learn from the experiment (a broad coalition) (Schot and Geels, 2008). Second, an experiment should be practice-based. It should not be treated as

detached mental exercise or as a test in a perfectly shielded laboratory, but as a material intervention in the real world of the city where some conditions cannot be controlled (Karvonen and Van Heur, 2014). Third, an experiment should be challenge-led. It should be geared to address the societal challenge of achieving sustainability and to do this meaningfully the actors involved should be willing to deviate from vested technological and economic paradigms and give priority to their sustainability goals (Loorbach, 2007). Fourth, an experiment should foster social learning. The actors involved should not merely try to accomplish a pre-determined objective, but they should be willing to engage in an interactive form of learning to get to know each other's interests and perspectives and about the social situation at large (Vergragt and Brown, 2007). Fifth, an experiment should promote system innovation. Socio-technical systems – such as the private car system or a fossil-fuel based energy system – are highly obdurate and deeply entrenched in cities (Hommels, 2005). The actors involved should be willing to question and challenge core-principles of incumbent socio-technical systems and champion alternative socio-technical systems – such as non-motorized transport or renewable energy systems. Finally, an experiment always involves ambiguity. It is assumed that a project contributes to sustainability, but the environmental and social impacts are never fully known in advance (uncertainty). More fundamentally, the question should be asked what sustainability is and for whom (ambiguity – e.g. are the priorities environmental or social and how are the ideas and interests of governments, companies and citizens reflected in the project?). The actors involved in an experiment should be reflexive and conscious of these considerations (Stirling, 2010).

It should be added that the application of a novel solution through experimentation in the urban environment is not an isolated event, but an unfolding *innovation journey*. The notion of 'innovation journey' (Van de Ven et al., 1999) and in particular the notion of 'sustainable innovation journey' (Geels et al., 2008) highlights the open-endedness and uncertainty involved in conducting projects geared toward sustainable development. A journey implies a narrative and agency: the actors involved have to navigate strategically and struggle their way forward whilst a sequence of events with intended and unintended consequences unfolds over time. In other words, action and the task of aligning social, technological, political and cultural elements are contingent upon the emergence of appropriate conditions. At any moment in the journey, the actors must not only make sense of what has already transpired and coordinate what is currently unfolding, but they must also imagine what might happen in the future (Garud et al., 2014). Addressing the innovation and experimentation process through the metaphor of the journey has methodological consequences: whereas some researchers would investigate urban change and experimental developments in a quantitative way through the relationship between a dependent and an independent variable, we investigate this a sequence of events leading to certain outcomes by using qualitative methods and an explanatory narrative style.¹

3. Case study selection and methodological approach

Much previous research on China's green ambitions in newly built urban areas has focused either on individual projects (e.g. see De Jong et al., 2013 on Pingdi low-carbon city; Caprotti et al., 2015 on Tianjin eco-city; Chang and Sheppard, 2013 on Dongtan eco-city; Lu, 2005 on Anting New Town; Jiang, 2014 on Hongqiao

CBD's low-carbon and transportation hub); or on developments in large urban regions (e.g. see Zhou and Ping, 2010 the Bohai Rim; Lu et al., 2017 on the Pearl River Delta; Wang, 2012 on the Yangtze River Delta) or it has a nation-wide scope (e.g. CSUS, 2011 on existing eco- and low-carbon cities throughout China, Fu and Zhang, 2017 on China-wide green new town planning; Chang et al., 2016 on the ecological urbanization experiments as strategic state policy). The scope of this paper, on the other hand, is set at the metropolitan level, in this case the direct-controlled municipality (in status equal to a province) of Shanghai. Our approach is to compare a set of promising projects in a single metropolis and to position this in its wider geographical and political context. In conducting this comparative case study research (Yin, 2003) we draw on qualitative methodological approaches for geographers (Limb and Dwyer, 2001).

We focus on Shanghai with three projects in Anting, Dongtan and Hongqiao as our case studies. Within China, Shanghai is considered the economic 'head of the dragon', an internationally oriented 'global city' and a 'pioneer' in terms of experimenting with innovative green urban design and building solutions (Den Hartog, 2010). The case of Anting New City is part of Shanghai's previous 'One City, Nine Towns' development strategy with as main targets spatial decentralization and attracting (upper) middleclass residents and international investment to the new towns; Dongtan Eco-City was the first promising pilot of Chongming Eco-Island, a national and provincial policy to search for sustainable ways of development; Hongqiao CBD's low-carbon and transportation hub is currently one of the key projects in Shanghai's regional development in the context of the wider Yangtze River Delta region.

The three cases are similar in terms of their location (Shanghai's urban fringe), in terms of their contribution to regional development goals (key projects geared to contribute to Shanghai's spatial de-concentration strategy), in terms of articulated ambitions (to be pioneers that set inspiring new standards regarding sustainable urban development) and in terms of the involvement of international actors (there has been an essential input by international firms and organizations during the concept development and planning process). However, there are also key differences between the cases in terms of function, geographical scale, and policy level. Anting New Town is primarily a local residential project. It is a local-level project within a wider city-level project (the Jiading district and Anting Township developed it in the context of Shanghai Direct Controlled Municipality's 'One-city, Nine-towns development plan'). Dongtan Eco-City is primarily a typical eco-city project to foster 'green' living and features with strong input from the national-level and the city-level (being planned on Chongming Eco-Island in the estuary of the Yangtze River in Shanghai, there is strong input from the Shanghai Direct Controlled Municipality as well as from the central government in Beijing due to its eco-island policy). Hongqiao CBD's low-carbon and transportation hub is primarily a regional commercial project with a central focus point in the context of the wider Yangtze River Delta Urban Region and city-to-city competition. It spans the borders of four districts and is one of the key development plans by the Shanghai Direct Controlled Municipality. Fig. 1.

Our findings are based on multiple site visits, observations and interviews (see Table 1 for an overview of the data collection process). Interviews were conducted with the main stakeholders; both with experts (i.e. officials, developers, planners, architects and other specialists) and with non-experts (i.e. people who live or work in the three project areas, in other words the intended 'low-carbon subjects' of these spaces). For each case in-depth interviews were conducted with one or two developers, one or two local officials, two or more entrepreneurs, and three or more involved planners and architects. They were asked about their role and

¹ See Van de Ven and Poole (1995) on the difference between 'variance theory' and 'process theory'.



Fig. 1. Case study locations.

experiences during the design and development process and about their judgment on the results so far. During the site visits, small surveys and in-depth interviews were conducted with residents, real-estate agents, office workers and farmers.

The first author visited each of the three case study sites more than once every year over the last ten years and worked for more than half a year in the Hongqiao CBD. The entire research team together also conducted two collective site visits for each of the case study sites during the last year. It should be noted our team is diverse in terms academic background and expertise (urban design, social sciences, public policy) and in terms of cultural background (Chinese and European) and that our collective visits and

discussions during and after these visits provided additional reflection on our findings. This has helped in our eventual aim, which is the analysis and synthesis of the similarities, differences and patterns across these three cases.

4. Three promising projects in Shanghai

4.1. Anting New Town

Anting New Town, located in Shanghai's Jiading district, is a district-level project with the initial premise to build here a town with "German qualities" and several advanced sustainable

Table 1

Figures on data collection.

	Interviews	Grey literature	Individual site visits	Collective site visits
Anting New Town	Residents (25) Urban planners (1) Architects (1) Local gov officials (1) Developers (2) Real estate agents (5) Knowledge institutes (2)	Official policy docs (1) Governmental website (1) Expert meetings (7) Knowledge institute reports (3)	Anting New Town (20)	Anting New Town (2)
Dongtan Eco-City	Farmers and residents (40) National gov officials (1) master plan expert committee (3) Shanghai gov officials (1) Local gov officials (2) Urban planners (5) Architects (2) Developers (2) Real estate agents (3) Knowledge institutes (6)	Official policy docs (5) Governmental website (1) Expert meetings (9) Knowledge institute reports (5)	Chongming Island (30) Dongtan Eco-City (8)	Chongming Island (2) Dongtan Eco-City (1)
Hongqiao CBD's low-carbon transportation hub	Office workers (30) Shop owners (5) Urban planners (1) Architects (3) Developers (2) Real estate agents (1) Knowledge institutes (1)	Official policy docs (3) Governmental website (1) Project website (1) Expert meetings (1) Knowledge institute reports (1)	Hongqiao CBD (100+)	Hongqiao CBD (2)

'German' features regarding building technology and urban design. During the process of implementation some unexpected changes occurred, and currently the new ambition is adjusted but even higher and promising – and partly already successful realized, opposed to previous failures – by making the project into an 'Ecological Model Town'.

The initial ideas for building Anting New Town were part of Shanghai's 'One City, Nine Towns' development strategy (2001), an experimental policy of the direct controlled municipality to brand a series of new towns around Shanghai with international themes and give them 'western standard qualities' meant to attract higher income groups to these new towns, which make part of a larger spatial deconcentration strategy to facilitate the rapid growth of this metropolis (Den Hartog, 2010). Since Shanghai International Automobile City is located in Anting, with Volkswagen as main representative, the German firm AS + P was commissioned to work on the detailed urban design of Anting New Town, with a projected population of approximately 50,000 citizens in 2020. AS + P's design was made in 2001 and the new town was scheduled to be finished before 2020. According to AS + P a real German Town has to reflect everyday life, including "integrating open spaces into the urban fabric". For this reason perimeter blocks – which are common in most of Europe – and a limited building height were introduced in the plan, and also a hierarchical system of public spaces with a central public market square, and semi-public neighborhood squares connected with relative small streets and pedestrian routes. The ambition was to reduce the energy consumption with at least 50%, without giving up comfort levels. However, the proposed cogeneration plant, the insulation, natural lighting and ventilation of all buildings, the water-treatment system, the energy production based on biomass, solar thermal plants, and other features haven't been realized in the first phase of the project. Most of these promised low-carbon measures have been cancelled, and the general building quality was rather poor and contrasted sharply with the envisioned 'German quality'. "Our task was to design an eco-town of German quality, but the client didn't know what German quality was," said the chief designer of AS + P in 2008. The project came to a halt in 2008, due to bad management, budget limitations, inexperienced developers, miscommunications and additional governance problems.

The main problem during the sustainable innovation journey of this project was the lack of transparency, lacking inclusiveness and indirect communication during the development process: "The most efficient method is to involve all participants during whole the process and explain to them, for example, what sustainability means," says the chief designer of AS + P. "Using the creativity of a team instead of leaving problem-solution to isolated operating units will lead to more sustainable solutions." Another main factor was the lack of experience in project development by the former developer. A new and very experienced developer took over in the second phase, with significant better results so far.

Until recently not many people lived in Anting New Town, most houses remained empty, although bought by individual families, usually for speculative reasons. As a result almost no shops or other services and facilities have been opened yet. 'It looks beautiful and green, but it is a dead city quarter that will collapse...', said the project architect in 2008. In international media Anting New Town has been widely dubbed as a 'ghost-town' and a sample of failing planning practices in China (Den Hartog, 2010). However, this might turn into an unexpected opposite direction now thanks to recent changes and new experiments.

Nevertheless the negative media reports, some components of the initial promises have been realized, such as pedestrian friendly areas, open spaces, green belts and a working water system with canals, and also a central heating system and waste separation system. Thanks to a special permission of the local authorities, about 30 percent of the apartments in the first phase are facing east or west. This is a remarkable decision for reasons that are energy saving (houses facing south benefit more from sunshine and likely use less energy), cultural (there is a long tradition and preference for south facing houses) and financial (houses not facing south are more difficult to sell). However, allowing for east or west facing buildings does increase the possibility to create attractive urban spaces with perimeter blocks, courtyards and squares. This caused a main conflict between the designers and developer and during the implementation of the first phase of the project the decision was made by the developer to drastically reduce the perimeter block urban structure.

In 2009 the project got a restart, with a new and more visionary developer. AS + P was chosen again, and having learned from the

previous failures the ambitions were adjusted with as new aim to create an 'Ecological Model Town'. Additionally in November 2010 a metro station opened nearby, with some positive effects on the liveliness of the town.

A share of the new phase has been built already with significantly better quality and indeed several water- and energy saving features integrated. Promising new experiments have been implemented, including a water catchment park to store, filter and recycle rainwater and some of the new housing is fitted with better insulation and other energy-saving technologies, such as solar energy units on roofs. However, according to a real estate agent on site most of these units are disconnected and only decorative, thus signaling compliance to certain sustainability standards but not quite living up to them. Nevertheless, according to the chief designer of AS + P Anting New Town can become the most outstanding project their office has ever made worldwide, because the conditions and promises in this new phase have the potential to implement most of their planning ideals and mission.

Currently the first phase of the project is also being upgraded and renovated, with the potential to finally realize some of its initial promises, but in a slightly different way than projected. Especially the central square and surrounding buildings have been redesigned and renovated since late 2016, with as result the opening of many new shops and facilities, more permanent residents and thus more urban vitality.

Simultaneously Anting New Town became a pilot zone of Jiading's EV-car a socio-technical experiment in the district, in cooperation with Tongji University, with multiple charging points and renting point for EV-cars. While the initial plan for Anting New Town was aiming on foreign managers and middle-class, a group that owns a house and a car, after the restart a more general target group is aimed for.

Although the project is relatively small of scale and in an uncommon low-density it contains several lessons. First of all blueprint planning is not feasible in the context of a fast changing society with changing demands and needs. The case of Anting New Town proves that new towns can be adjusted over time and need a certain degree of flexibility to deal with uncertainty, whereas the main framework of the plan needs to be resilient enough to maintain the initial ideas and promises. In the context of China's urban planning practice this is urgently needed. Secondly, the case of Anting shows that running several experimental trajectories simultaneously will increase the chance of satisfying results, even if only one experiment is successful. In the first phase of the project most essential sustainable features failed due to the dependency of one (unreliable) factor, namely un-experienced stakeholders with communication barriers, while in the second phases this problem was tackled and multiple small sub-projects were implemented independently by different stakeholders, such as the EV-car experiment on district level, the regeneration of the central square area on a local level together with a new ambitious and experienced developer, and the energy saving and water recycling installations in the new housing area by another coalition. Each of these three experiments appears to be successful so far. [Fig. 2.](#)

4.2. Dongtan Eco-City

The initiative for Dongtan Eco-City is directly interlinked with the decision to transform Chongming Eco-Island into a national-level project since 2001, which embodies the promise of a pristine ecologically sustainable island right at the doorstep of an expansive bustling megacity. Chongming Eco-Island as a whole promises to become China's national model for sustainability, energy efficiency and environmental awareness and a nursery for

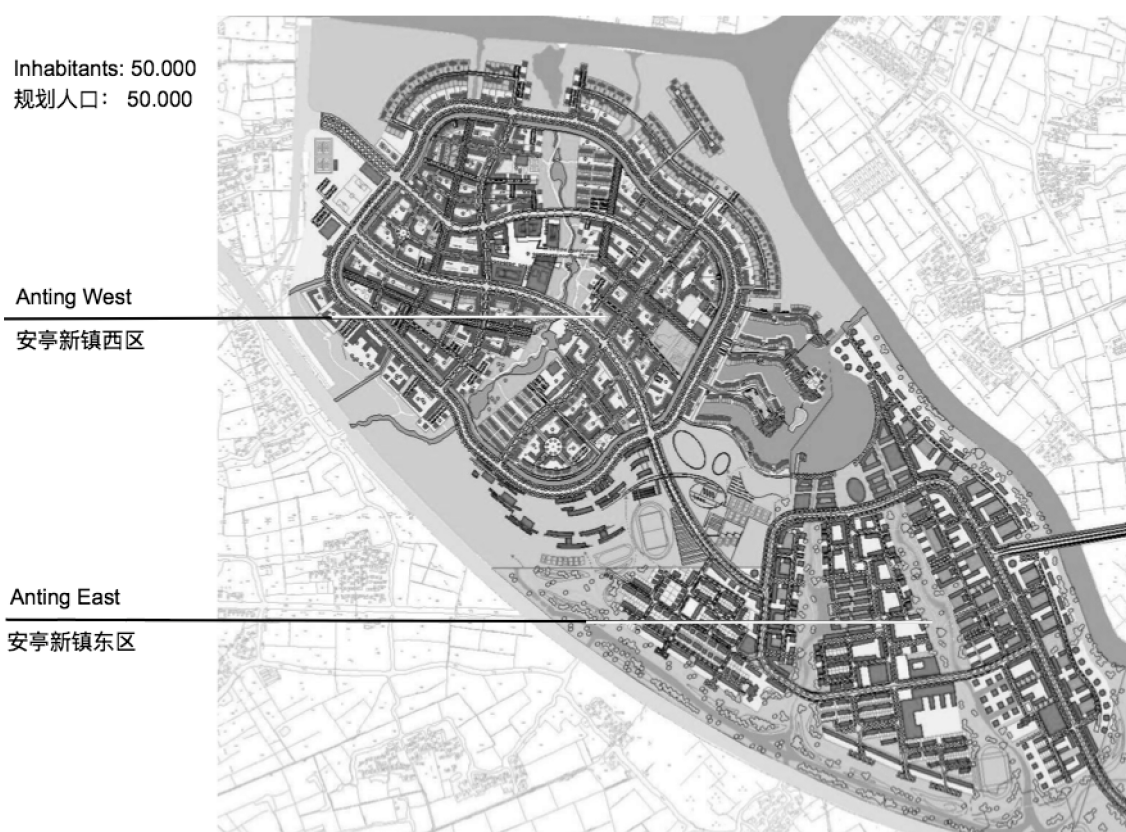


Fig. 2. Master Plan Anting New Town (Source: adapted from AS + P 2009).

sustainable spatial development (SHDRC, 2010; Ma et al., 2017). According to the Shanghai Municipal City Master Plan 1999–2020, short-and-midterm plan this eco-island policy is mainly about creating more green space (including afforestation) and wetland conservation. In 2006 a master plan has been made for the island itself, partly based on a winning design competition entrée by the American firm Skidmore, Owings & Merrill's that proposed to transform the island into a combination of advanced agriculture – especially agribusiness-oriented eco-farming by corporate actors, but also some space for grassroots actors – and seven compact eco-cities. Dongtan should be the first one of these seven cities: a zero-carbon development for 500,000 people to be completed in 2020, following a development strategy by McKinsey & Company and Arup. With Dongtan Eco-City Shanghai and the national government wanted to make a firm statement that China is willing and able to achieve sustainable solutions in the context of rapid urbanization. A first phase of Dongtan was planned to be ready as showcase during the Expo 2010 in Shanghai. Referring to the Kyoto agreement this project would celebrate that China, and not a Western developed country, realized the world's first a largest true eco-city. However, the project contains some ambiguity since it borders directly to a very vulnerable RAMSAR zone for migratory birds.

The main target for Dongtan was “minimizing CO2 emissions and maintaining social and economic sustainability” (Den Hartog, 2010) by making Dongtan car-free, and based on a transport system over water and hydrogen busses. Also high-rise was banned in the plan, since it is supposed not to match the desired ‘image’ of an eco-island. Advanced urban food-production units would surround the residential areas, and renewable energy would be made from biomass. Besides there were ideas that inhabitants could possibly use electrical or hydrogen vehicles, which were at that moment in an initial phased of development by the Jiading-based SAIC (also see the case of Anting New Town).

However, as a direct result of a corruption scandal the project was set on hold in 2006. Except a part of the main infrastructure nothing of the initial plan has been realized so far. In 2010 SIIC, a state-owned developer that owns all land-use-rights restarted the project. New designers were hired to make a new plan. Based on the original road structure an elderly community for 13,000 persons – later more, but the central government strictly limits the numbers of housing units and the new planning horizon for Dongtan City is 2040 – is under construction now, to be completed in 2020, with luxurious estates, horse-riding facilities, lush green, and some health amenities that match with the life of the happy few. The new keywords of the developer are “low-impact development” and “eco-plus”. The developer explains the latter one as a combination of ecological values and economical benefit. The new target group is high-end elderly. Shanghai is a rapidly aging city, with more than 25% of its population above 60 years (REF *Statistical Yearbook of Shanghai*, 2015), and there is a growing demand for luxury and comfort. The proximity of Shanghai combined with healthy and rustic environment makes Chongming an excellent location to retreat. SIIC took this as an opportunity to make a restart of the Dongtan site into a commune for elderly and to create “a reliable and charismatic elderly living environment where elderly residents are healthy, energetic, and safe with all necessary support”. This new ‘Continuous Nursing Retirement Society District’ is advocated as an innovative model that makes a significant difference in comparison to existing retirement care communities in Shanghai.

The initial ideal to realize a car-free new city has been cancelled. Roads have been built, and on the master plan more roads are visible with in front of every building multiple car parking places. “Arup's plan is not easy to achieve and a hydro-fuel bus technique is

not possible yet”, says an interviewee from SIIC, “our new plan is perhaps better than the old plan cause there will live less people and in lower density, thus disturbance for the birds.”

Although Dongtan Eco-City has not been build elsewhere on the island some local projects have been implemented that are directly related to the Eco-Island policy such as a large series of wind turbines, the cleaning and optimization of waterways, a strict limitation on urban development and the preservation of wetlands. Simultaneously there is a parallel – although marginal – grassroots movement by eco-farmers, attracted to the island since it is supposed to be safeguarded from urbanization. Currently there are 17 family based farms that can be regarded as eco-farms. These community-level food initiatives are on the one hand driven by rising environmental and food safety concerns and on the other hand inspired by a global movement grounded in local communities, encompassing eco-farmers, environmental organizations, social movement groups, and consumers.

Today the island faces increasing urban pressure by a new bridge that connects the island with Shanghai since 2009, resulting in booming real estate prices. Although the bridge brings new job opportunities and economic benefit it also increased car transport – sometimes even causing traffic jams – and thus carbon-emissions.

A very recent new master plan for Chongming Island took clear notice of the gap between ambitions and promises so far. This plan introduces a convincing new green planning framework with clear guidelines for future developments. It offers more space for local ambitions to create small-scale opportunities for enterprises and new jobs, without adding more buildings or infrastructures, thanks to compensation strategies and easier possibilities to change functions.

The ambitions for Dongtan in the first phase were very high, perhaps even too high given the complex context and extremely high development pressure. This case also shows that open endedness is needed during planning and implementation of this type of large-scale experiments. Fig. 3.

4.3. Hongqiao CBD's low-carbon transportation hub

Hongqiao CBD's low-carbon transportation hub (HCBD) is a provincial-level project with regional pretensions promising connected mobility, pleasant urban space and high eco-friendly impact. It is branded as “low-carbon experimental area (Jiang, 2014) and aims to contribute to a “low-carbon society” (Yang, 2010). To realize this a low-carbon indicator system has been set up especially for this project.

The initial ideas and plans date from 2009 and have largely realized already. The low-carbon concept is implemented in the project's urban spatial layout, transportation organization, energy utilization and architectural design (Yang, 2010).

Compared to conventional new urban areas the area differs in the fact that the urban blocks are smaller and better accessible for pedestrians, with shorter walking distances and green decorated relatively small streets, partly car-free, resulting in a more intimate green-looking pedestrian friendly environment (Yang, 2010). The area is well accessible via all means of transportation, this in sharp contrast to similar CBD areas as Lujiazui and others.

Many other low-carbon aspects can be found in the high implementation requirements of the individual buildings that have to match local energy rating standards. Several innovative building materials have been used; external-shading systems, water saving systems, and intelligent energy management equipment has been installed. Additionally, facilities for low-carbon transportation (pedestrian space, shared bike system, electric car, smart road information system) have been built here. In the parts of the project



Fig. 3. Master Plan Dongtan Eco-City (Source: adapted from Arup, 2005).

that have been there are charging units for electric cars and bike sharing facilities, although the latter ones can be found all over Shanghai nowadays. Last but not least the Railway Station and a nearby gigantic clover-leaf-shaped congress and exhibition center have gigantic solar panels on their roofs that supply a large part of the needed energy.

The project has a pivotal and strategic regional role in the Yangtze River Delta Urban Region – which accounts for more than 20 percent of China's GDP and about one-third of China's imports and exports – and promises to become “the Shanghai of tomorrow” (SHHQBD, 2017). In Shanghai's 12th five-year plan the project is identified of strategic importance: it plays a key role in Shanghai's ambition to become an ‘excellent global city’ and the estimation is that more than 650,000 employees will find a job here by the end of 2020 (SHHQBD, 2017). Shanghai's ‘global vision’ for this case is to attract large private enterprises and Fortune 500 listed multinational companies, higher educated and higher income groups. To make this happen several luxurious residential communities have been constructed and more are in preparation, however, mainly focusing on comfortable living in a green-looking environment but without ecological values or low-carbon features. Additionally ten international schools, seven hospitals, and eight five-star hotels are in progress of being built as part of the project.

The project advocates “low-carbon living and green transport”, “pleasant working and living spaces”, and a “high eco-friendly impact” according to the project's website (SHHQBD, 2017). Shanghai's Direct Controlled Municipality (the city government, equal to a province) presented the master plan in 2009 covering 86 square kilometers that extends across four districts: Minhang, Changning, Qingpu and Jiading. Its core area of 4.7 square kilometers with Shanghai's second airport and main high-speed railway station is located in the Minhang district.

During the experimental design phase of HCBP there has been international input by developers and designers for several parts of the project. Since 2009 via international design competitions and biddings for individual building projects, input has been given, especially for the Hongqiao Xintiandi area – with a lot of

entertainment – but also for other parts. Shui On Land, an ambitious developer from Hong Kong, developed Hongqiao Xintiandi, and received an international LEED label for this complex.²

The energy rating systems will be used “to attract new tenants, build a healthier community and scale up the value and market demand for healthier, higher-performing green buildings across China” (SHHQBD, 2017). Within the area currently nine projects target for LEED certification and the administrative committee of the HCBP also explore possibilities for a LEED Neighborhood Development rating and a LEED City rating. The vision is to “create an environment where businesses thrive, commerce flows easily, jobs are created, people's health improves and the environment is protected” (SHHQBD, 2017). These ambitions are integrated into the master plan, as well as into the design, construction and operational phases is promised.

The results so far have led to mixed reactions. Compared to other business areas the daily life pattern of users doesn't seem to be that different. Most of the interviewed respondents seem not to be aware of the low-carbon aspects of the area and the buildings. In general the appreciation of the area is positive, but mainly aimed on the level of comfort and its more ‘human’ appearance in comparison to Lujiazui, the projects direct competitor. Respondents used terms like “it is quite and green here”, “there are not so many people here”, “there is less traffic”, and “the scenery is good here”.

The following anecdotes illustrate the huge gap between promise and realities. “With features such a shower – for people who come by bike, which are not many cause it is far away from residential areas – heated via solar heating this building gets its credits for a green energy rating. Meanwhile we can see that the building has a glass façade with windows that cannot open. This means – seen Shanghai's harsh climate during summer – that this building is very much dependent on air-conditioning”, says an anonymous worker in one of the rated buildings. Chief designer of

² LEED stands for ‘Leadership in Energy and Environmental Design’ and it is one of the most popular green building certification programs used worldwide.

the Hongqiao Xintiandi Ben Woods adds: “I don't know how these buildings got their certificates, but everyone can see that those buildings cannot be sustainable.”

“We integrated special coated glazing in all buildings; this is one of the requirements to reach the LEED standard and meant to filter sunrays and keep the heat outside. However, most of the shops and restaurants here replaced these glasses after they moved in by clear glass to optimize their visibility and attract customers to come inside”, says Woods.

During the half year that the first author of this article worked on the 9th (top) floor of one of the buildings that targets for a LEED certification, all hundred workers on that floor had to be relocated to another lower floor during summer cause the indoor climate was unbearable due to lack of natural fresh airstreams and insufficient sun shading features. Also more than a few other buildings in this new business area (most of them with rating) showcased several technical deficiencies.

All these anecdotes and observations showcase that it is essential to communicate ambitions also during the implementation and operation phase. Many micro-scale adjustments have been made and more will be needed coming years to make HCB into a workable sample of low-carbon ambitions. Although the main frame with small-scale pedestrian oriented development has been completed the missing change of life-style of its users and moreover the missing urban mix (there are no residential buildings nor daily life facilities; there are only malls and offices here). When the experimental approach in this project was extended and communicated to all stakeholders and end users it would probably more satisfying and convincing. For the moment it is just another working area where people arrive at 09:00 and leave at 18:00 though cozier and accessibly located.

Besides the emission of the many airplanes on the nearby airport, also the many large-scale automobile shows that are organized in the adjacent congress and exhibition center, and even the sales of luxurious cars in several malls right in the core area of the project, certainly do not contribute at all to the low-carbon image of this ambitious project.

The cases of Anting and Dongtan also make it very clear that it is crucial to communicate the ambitions clearly with all stakeholders

including the end users and operators for successful implementation of experimental innovative projects. Fig. 4.

5. Discussion and conclusion

Given the rapid pace of urbanization in China and the ambitions to foster a much greener mode of urban development, it is crucial for policymakers, planners, architects and other professionals to learn from the many sustainability-oriented projects that are being constructed. In this paper we specifically enquired how green promises were translated into realities on the ground in and around Shanghai by examining three sustainability-oriented development key-projects: Anting New Town, Hongqiao CBD's low-carbon transportation hub, and Dongtan Eco-City. We mobilized insights from the academic field of Sustainability Transitions on the articulation of expectations, on socio-technical experimentation and on sustainable innovation journeys to interrogate how these three projects have fared. By comparing the findings from the three cases, several over-arching patterns can be identified and broad lessons can be articulated.

A number of general similarities stand out. The projects all exhibit a strong focus on lowering the energy consumption of buildings. This is a feature of projects throughout China, often capped with impressive green building labels. What especially the case of Hongqiao CBD demonstrates is that the rigid implementation of such labels is no guarantee for sustainability: green space requirements resulted on unused grass lawns on roofs, and the coated glass that had to be installed in shop windows to comply with the label was immediately replaced by users to install brighter but less 'green' windows. A rather peculiar feature of the projects is their focus on low-rise development. For each case high-rise buildings were viewed as 'not matching' with the setting (in Hongqiao because of the airport, in Anting because of the German exemplar it followed, and in Dongtan it was seen as not fitting with the wider eco-island idea). Yet, from the point of view of environmental sustainability this is a disputable feature since dense high-rise construction can be considered as an efficient solution to create more compact cities and prevent urban sprawl. In terms of urban form and infrastructure, the projects all feature small-scale urban

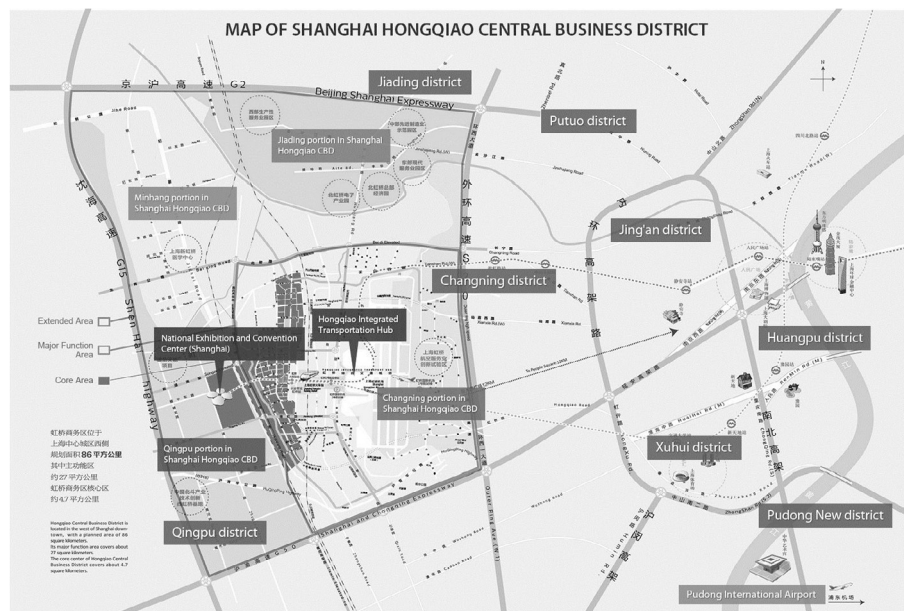


Fig. 4. Plan of Hongqiao CBD (Source: adapted from Shanghai Hongqiao Central Business District, 2016).

blocks, attractive and usable green- and public space, sustainable mobility ambitions with electric vehicles and at least some pedestrian-oriented environments. These elements are now an integral part of the planning discourse in China and part of the new 2016 development guidelines (Xinhua, 2016), but they were new and unusual when the initial plans of the three projects were formulated years ago.

To compare the three projects and to enquire about sustainability promises actors made in their project plans we first mobilized the concept of *expectations*. The initial plans for Hongqiao CBD promised low-carbon development in terms of urban form, architecture, energy and transport. These promises are to a certain extent realized: smaller blocks have been built (urban form), the environment is partly pedestrian-oriented, there are electric vehicles (transport) and the buildings are innovative and complied with green labels (architecture and energy). The initial plans for Dongtan promised a world-class self-sustaining/circular-economy eco-city, which was mixed use and car-free. At present only some of the basic infrastructure has been built there, but the luxurious senior citizen residences in a car-oriented neighborhood, which are currently being constructed on site, certainly do not fit the bill. The initial idea for Anting promised a new town with German-quality urban form and building technologies. With these ambitions in mind the German designers introduced various low-carbon features. Currently only a few of these features have been realized, though the next phase of the project which is currently under construction might be set to achieve even much more than the initial first phase promised. To summarize, the results of the three cases are mixed in terms of the extent to which initial sustainability promises have been realized so far.

Besides all of these deliberate project plans and their partial realization, a set of unplanned developments are occurring in parallel. These more bottom-up developments include the recent rise of new bicycle sharing systems, which are set to have big impact on the mobility patterns of for example the office workers at the Hongqiao hub. Another interesting development is occurring on Chongming Eco-island – the wider setting in which the Dongtan plan is situated. Besides the advent of intensive tourism and luxury elderly communities, eco-farms are also being established on the island (more than elsewhere around Shanghai). Even if their position is marginal at present, the reputation of clean and healthy food from Chongming's eco-farms is quickly extending and well-known all over Shanghai and beyond, especially amongst the urban middleclass, which helps to re-imbue the island with promises of sustainable future.

Expanding on this, our first piece of advice to planners is to *nurture and support such parallel bottom-up developments, or at the very least to develop the capacity to anticipate on such developments at an early stage and explore the possibilities for cross-fertilization and integration (lesson 1)*.

The second concept we mobilized was socio-technical *experiment* in order to highlight that the three projects are best conceived along the following lines. An experiment was defined as an “inclusive, practice-based and challenge-led initiative, which is designed to promote system innovation through social learning under conditions of uncertainty and ambiguity” (Sengers et al., 2016). A number of things can be said what the projects share in terms of these six dimensions of an experiment. Each project is framed as challenge-led in terms of moving toward a sustainable society. This is an important part of the formulation of all the projects, yet in their eventual form a comfortable and luxurious lifestyle seems to take clear priority. Pointing to the dimension of uncertainty and ambiguity, the question of what sustainability is and for whom should be raised. For Dongtan it is rather questionable why a new city needs to be build adjacent to an important

natural protection area (for people vs. for the eco-system) and for Anting and Hongqiao it is perhaps ambiguous that a small sustainability oriented project is part of and might legitimate a broader project such as the Automobile City or an aviation- and transport hub (for industrial development vs. ecological development).

Learning from these projects should have been a more important goal in and of itself, because sustainable innovation journeys require a sequence of such projects in order to achieve higher-level social learning. In order to do achieve this, our second piece of advice to planners is that they should *foster a more ‘experimental mindset’ by looking beyond individual projects and by keeping societal challenges as a clear goal in mind whilst taking into account the uncertainties and ambiguities involved (lesson 2)*.

The third concept we mobilized was the concept of *journeys* of sustainable innovation, in order to characterize the trajectories of the different projects. The evolution Anting can be characterized as initially envisioned from a German-themed town which is now envisioned as an ‘Ecological Model Town’; Dongtan can be seen as a failed eco-city project in the context of an aging society and the sustainability promises of Hongqiao CBD's low-carbon transportation hub turned into promises of lifestyle and comfortable living. The notion of journey also highlights that experimentation with sustainable development is unpredictable and can take unexpected turns as time progresses and actors struggle to achieve initial goals. In the case of Dongtan, the unexpected event of a corruption scandal – not related to the project – stalled the project and eventually pushed it to far less sustainable direction. The case of Anting, on the other hand, reveals that on the ruins of a failed project an extended project can be envisioned with even greater ecological ambitions. Furthermore, as each of the three projects unfolded a different audience became the end-user instead of those initially planned for. Anting aimed at expats and higher-income groups, but currently there is mostly Chinese middle-income residing there. Dongtan was supposed to be inhabited by all rungs of society instead of rich elderly who use it as their second home. In the case of Hongqiao it is too early to tell, but it might well turn out to be an audience not solely composed of employees of international companies.

This teaches us that *actors trying to navigate this process from plan to outcome need to be resilient and flexible, and expect – even embrace – uncertainty, especially in terms of who will be the eventual users (lesson 3)*.

Overall our case studies show that there are wide discrepancies between vision and reality on the ground, in every case with site-specific reasons but with as main common reason a mismatch between top down planning ambitions and daily realities of the end-users. One of the reasons for this is a lack of a clear definition and translation of low-carbon promises into usable and practical actions that are recognized by current and future users. It seems that ‘status’ and ‘comfort’ are often more valid goals than the actual saving of energy and other resources. However, all three projects are still ongoing and might be adjusted again or go into new directions over the course of time.

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