Ecological City Design and Planning: How China Expands Urban Ecology, Institutional Learning, and Cultural Shifts through the Evolving Eco-Developments

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ABSTRACT

As the concept of sustainability has become a global norm, industrialized and industrializing countries have sought to innovate their strategies for urbanization and modernization in order to set standards for sustainable development. In China, a pro-environmental movement has emerged with continued experimentation of eco-environmental approaches to urbanization. Through the lens of a series of high-profile eco-developments initiated by the Chinese state, this dissertation examines the transnational influences of eco-environmental ideas on urbanization policy and practice, as well as the meanings and impacts of experimental projects that demonstrate eco-environmental principles. These projects were conceived as replicable paradigms for urbanization and concomitant modernization based on the idea of growing the city in harmony with nature. The selected cases include four nationally promoted model eco-cities and two award-winning, locally initiated developments—Zhengdong New District and Nanhu Eco-City. A deep dive into the vicissitudes of the selected eco-developments reveals their limited eco-environmental effects and social influences constrained by the scale of these privileged developmental jurisdictions. Genuine eco-environmental considerations were undermined by growth-oriented developmental agendas of entrepreneurial local states. Eco-environmental rationality was adopted within an authoritarian regime to reinforce state legitimacy. Reflecting on these limitations, this study points to accelerant factors for pro-environmental sociopolitical transitions. The assessment and comparison of the examined eco-developments illuminates how ecological design and planning has stimulated eco-environmental ethics in local practices, which have pushed the boundaries of China's conventional approaches to urbanization. Various ecological perspectives embodied in China's eco-developments—whether scientific, technological, aesthetic, or philosophical—have made these projects stand out as demonstrations of a greener path to urbanization. Despite the limited achievements in these experimental projects, eco-developments are meaningful experiments that have stimulated institutional learning about eco-environmental values. Facilitated by the dissemination of ideas in China's political and professional networks, China's evolving eco-developments have created an ecological image of the nation's modernity, manifested by new landscapes, new infrastructure, new rhetoric, and new social life. These projects not only reshape the built environment but also influence culture, politics, and society.

Keywords: eco-development, green urbanization, ecological modernization, ecological design and planning, sustainable development, environmentalism, China

Table of Contents

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Chapter One: Introduction

The Premise of the Study

Nature has always been the ultimate inspiration for the development and transformation of science, technology, philosophy, culture, and politics in human societies. Concomitantly, societal evolution has been reshaping the relationship between human and nature. Discourse about modern society has stressed the importance of nature to human survival and societal prosperity. Accordingly, critiques on modernity from an ecological perspective view human-nature interaction as the fundamental cause of the environmental crisis. The intertwined processes of industrialization and urbanization in modern societies have engulfed massive areas of ecosystems on the planet, engendering rising environmental and public health risks. In response, a series of ideological and social movements that favor conservatism, environmentalism, and ecologism emerged in Western industrialized societies over the twentieth century. These pro-environmental movements have brought about "green" transformations in technology, culture, development, and politics in the West. Ecological and environmental principles have become increasingly incorporated into urban practice and public policy, shaping new values of modernity. Such a "greening" trend in the development and policy domain has spread its influence from more developed societies to newly industrializing or newly industrialized countries. The increasing globalization of markets, cultures, and governance networks has accelerated the worldwide dissemination of green, eco-environmental rationality during the twenty-first century. While pro-environmental movements have evolved substantially across the globe, debates remain heated with respect to normative positions on the human-nature relationship, the inherent complexion of environmental problems, and broader sociopolitical goals and tactics.

Formally introduced in 1987, sustainable development has become a globally recognized concept for reconciling urbanization and environmental protection. This concept emerged with heightened pro-environmental initiatives across the world. Since the 1980s, the world has seen the normalization of sustainable development and myriad ways of defining it. Scientists, scholars, and practitioners in developed countries have taken the lead to create green technologies and construct principles of ecological and equitable design and planning to set scientific and ideological standards for sustainability. Environmental and social values are incorporated into sustainability-based developmental concepts and implemented globally through national and transnational agencies. While urban development has become a crucial arena for social and environmental interventions, sustainable design and planning has become crucial areas of international connections for their cultural, social, and political influences. Adopting the tripartite principles of sustainability, shapers of development and policy making have experimented with the operationalization of eco-environmental principles, implementing them in different parts of the world. Yet the conceptual constructs of such sustainability-based development models have been chaotic; the operationalization of their underlying eco-environmental principles remains obscure; and the actual impact of such experimentation has been widely contested. This suggests that the evaluation of sustainable development initiatives must consider specific economic and sociopolitical contexts. Despite their often transnational nature, their actual impacts in implementation are first local before reaching a broader scale across regions or nations.

While the globalization of capital flows has exacerbated socio-environmental problems, growing transnational initiatives have pushed for pro-environmental transitions at the national and local

levels. Global environmental goals cannot be achieved without pro-environmental, adaptive transformations in developing countries, where the desire to modernize and grow remains paramount. Learning from the North/West, developing countries have begun to experiment with adaptive practice through eco-development. I use the term "eco-development" to encompass integrated attempts at greening the built environment while curbing the environmental impact of urban development. Whether labeled as eco-cities, low-carbon cities, green cities, or otherwise, an eco-development is inevitably conceived as a crucial component of local or regional agendas for economic and social transformations, and it typically adopts strategies for conserving or restoring ecosystems, remediating existing environmental damage, and reducing the long-term environmental impact of cities. An underlying assumption of an eco-development is to create synergy between economic development, social development, and environmental protection.

In developing countries, the paradox of continuing urbanization and reducing environmental impact seems to be a real contradiction. Despite this perplexing paradox, new eco-developments continue being proposed. Governments across the globe pool tremendous resources and concentrate efforts in underdeveloped areas to experiment with green growth strategies in the search of an optimal, scalable development model, one that would be both a motor for economic growth and a cornerstone of an environmentally responsible society. In particular, some of the world's largest developing countries are spotlighted for their high growth demand and unflagging desire to modernize through industrialization and urbanization. International agencies continue exporting green ideas derived in developed countries to developing countries, connecting eco-environmental worldviews with local practices of city making. These new developments are often proclaimed as "eco" and "low-carbon" cities and envisioned as engines of green growth. They are allegedly change-makers instrumental in the society's transition toward an environmentally friendly one. They have become the manifestation of green politics and the demonstration of green approaches to city making in the newly industrialized or newly industrializing countries. However, such eco-experimentation in urban practice and policymaking has been widely criticized as mere greenwash or doomed failure. Challenged by the dismal discourse about the environmental crisis and the critiques about environmentalism, I aspire to understand the impact of past eco-developments and draw insights about institutional barriers to and opportunities for green transitions in developing contexts.

Introducing the Dissertation

This dissertation is an attempt at interrogating how eco-environmental rationality has influenced processes of urbanization and modernization in developing countries. Thanks to global sustainable development initiatives, the call for pro-environmental policy and practice has greatly influenced socioeconomic development and urbanization in emerging economies. China, the world's largest emerging economy, has undergone economic opening and institutional reforms and is transitioning from a developing stage to a developed one while challenged by a phase of economic slowdown. It has been eager to learn from developed countries in North America, Europe, and Asia while inventing new solutions to environmental and social problems, largely through building new infrastructure and new ecologies. International designers have introduced various forms of eco-development to China, which were widely experimented with across the country. Confronting environmental risks and social discontent, China has begun searching for greener, more sustainable approaches to growth. While China's central leadership has called for an "ecological civilization" since 2012, China has increasingly become a significant part of the world's pro-environmental movement. With rising power in international relations, China's current administration has been applying its urbanization strategies to other developing contexts across the world, especially in

Southeast Asia and Africa. The "Global China" is expanding the footprint of the "Chinese approach" beyond its borders.

The ongoing ecological turn in Chinese politics and the nation's growing influence in global sustainability initiatives are inevitably intertwined with China's movement towards a greener path to urbanization. This green urbanization movement has intensified over the last two decades with rising globalization. During this period, China involved the world's leading experts in design, planning, and engineering and constructed some of the world's most ambitious eco-developments to explore approaches to sustainable development. Building on the global discourse, the dissertation examines China's recent endeavors at greening its urbanization and assesses some of the nation's demonstration eco-developments. Engaging global debates about development in modern society and the environmental crisis, this dissertation first examines key concepts that embody ecological and environmental worldviews, and draws on critiques about past attempts at pro-environmental transitions in urban practice and policymaking. The dissertation then taps into China's green urbanization movement and interrogates how state-initiated eco-developments enable the transnational exchange of knowledge and values while encouraging local appropriation of ecological ideas. Through extensive literature review and mixed-method case studies, the dissertation illuminates how eco-environmental rationality influences urban design and planning as well as the political economy of development. I position this study between the hyped state promotion and opponents' rejection of China's green or ecological development initiatives and parse the actual impact of eco-developments both locally and across regions. The study reveals how continued experimentation of eco-development has gradually fostered new institutions within China that bring ecology back to the city, create green infrastructure, enhance environmental management, and popularize ecological ethics. China's green urbanization movement has brought about meaningful transformations in the nation's economy, design and planning practice, urban ecology, local culture, and developmental politics.

Today's China has a growing ambition to expand its international impact. Greening its modernity through urbanization has become the nation's key strategy for advancing its growth while competing for global leadership in economic and political influences. China serves as a rich unit of study for the subject of green urbanization. To reveal varying approaches to and outcomes of greening its urbanization within the case of China, the dissertation includes four nationally promoted, most high-profile eco-cities—what I call China's "earliest model eco-cities" and two locally conceived, successfully implemented projects in China's underdeveloped regions awaiting economic and social transitions. Although all the selected projects were conceived and developed over China's era of peak urbanization (roughly 2000-2012)[1], the "earliest model eco-cities" were highly promoted by China's central government since their initial conception and hence were nationally and internationally known earlier than the locally conceived projects. The latter only grew to become demonstration projects and paradigms after their initial development received praises among the media and the public. These projects not only exemplify the testing grounds for China to experiment with eco-development, but they are also laboratories for operationalizing ecological worldviews in the global design and planning industry. The vicissitudes of these eco-developments reflect how China formulates and readapts its green urbanization strategies during an era of exponential growth,

[1] According to experience planners and real estate practitioners who have participated in China's urbanization over the last two to three decades, China's fastest urbanization and greatest real estate boom had occurred mostly between 2000 and 2012.

physical and industrial modernization, and rising globalization. Through greening local developments in a piecemeal fashion, China has gradually developed more sophisticated eco-environmental rationality and strategies for planning, design, and governance. By learning from and appropriating ecological and environmental perspectives, China is building its green development movement to address environmental problems during its continued urbanization and to concomitantly gain global importance. In this way, eco-development has become a key policy tool to facilitate the nation's growth ambition while addressing local demands for economic development and social engineering. It is also a crucial area of practice through which China continues absorbing innovative ideas and approaches from the world's best eco-environmental practices and politics.

The dissertation investigates an eco-development as a process of experimentation, during which a comprehensive set of eco-environmental strategies evolve in a specific economic and sociopolitical context. This view rejects the notion underlying many discussions about sustainable development or the eco-city that any authority could lock down the definition of an eco-development or prescribe a one-size-fits-all model for such processes. Rather than generating another deterministic framework for replication, this study focuses on finding transferable lessons that could be learned from the implementation process. According to this distinction, an eco-development should be viewed as a dynamic, plural, and open-ended process, rather than a singular, close-ended project. The processes of trial and error in China's eco-developments provide insights into both failures in and accelerant factors for pro-environmental and inclusive transitions. The varied interpretations of "eco" approaches by different decision-makers and stakeholders also reveal entrenched power dynamics that shape discretionary meanings of being "eco" and corresponding, diverse eco-environmental strategies.

With the increasing severity and frequency of environmental hazards, the world has been calling for a new wave of ecological and environmental movements that would entail not only new knowledge in science and technology but also renewed values, theories, institutions, and politics that embody ecological ethics. While eco-environmental endeavors aim to address root causes of the environmental crisis in contemporary societies, the experimentation of eco-development on the ground could seed green, pro-environmental reform. Structural reforms of existing institutions necessitate the transformation of values, principles, and paradigms in the field of city design and planning, for the latter greatly shapes the physical and natural landscapes and determines the economic, social, and political geographies. Situated in variegated top-down, state-driven contexts in a transitioning authoritarian state like China, this dissertation contributes to the larger pro-environmental dialogue by parsing the successes and failures of renowned eco-experiments of contemporary city making through context-specific, in-depth assessment. It interrogates the conventional top-down, expert-driven, and technocratic approach to standard-setting and city making, and challenges the fixed, uniform-metrics-oriented approach to greening urbanization, or pursuing sustainable development more broadly.

Many critics condemn China's eco-cities as mere greenwashing or eco-branding, attributing their failures to the inherent contradictions underlying a green-utopian ideal and a technocratic approach to ecological modernization. This research acknowledges the limitations of these eco-developments caused by systemic issues in China, such as the neoliberal political economy of space production, a fragmented authoritarian regime, structural barriers in political systems, the growth-oriented mindset, a consumerist culture, and the neglect of social equity. However, tracing the evolution of China's green, pro-environmental approaches to development, this study finds that despite the failures, eco-developments so far have performed as China's innovation incubators. These places

have implemented, and continue demonstrating, new practices and policies that promote green technologies, decarbonization, ecological restoration, and environmental stewardship. Moreover, China's expanding digital infrastructures and public services have increased information transparency, public awareness, the intensity of collective sentiments, and the accountability of state authorities. Administrators have begun to realize the transformative capacity of ecological placemaking and civic participation in pro-environmental development and management. Despite China's authoritarian regime, strong political support alone is insufficient for systemic change. Addressing eco-environmental problems in China today—and elsewhere in the world—is deeply entangled with sociopolitical challenges. It increasingly depends on the mobilization of public engagement and the effectiveness of inter-governmental and inter-constituency cooperation. China's green transitions increasingly depend on the mobilization of public engagement and the cooperation among governmental bodies and various stakeholders.

Currently, constrained by an authoritarian regime and its internal structural barriers, China's green transitions largely occur within processes of urbanization at the neighborhood or district scales in a patchwork manner, either facilitated or hindered by concomitant physical and social transformations. Demonstration eco-developments have concentrated resources within their jurisdictions while worsening social disparities externally and intensifying inter-city and inter-region economic-political competition. Therefore, China's eco-developments are a form of place-bound green policy, creating privileged development zones with an identity of ecological modernity. These zones only improve a small, "lucky" portion of the long-standing populations who were originally low-income rural populations while most marginalized populations, especially migrants, are being replaced by more desired (such as more skilled or more affluent) populations who can facilitate local developmental needs. Constrained by the political economy of development at the local level, China's eco-developments so far largely remain products of state-coordinated social engineering, resource concentration, and environmental appropriation.

Eco-developments not only are China's testing grounds for practical and policy innovations that incorporate eco-environmental rationality but also popularize ecological ethics through tangible improvements in ecosystem health, social life, and environmental quality. Trial-and-error through conceiving, implementing, and adjusting eco-developments educates decision-makers about the value of ecosystem services, environmental governance, and climate adaptation to the city's economic prosperity and the society's overall wellbeing. Such processes disseminate eco-environmental perspectives and normalize a green mindset among officials, experts, and citizens. Such an emerging pro-environmental shift in local culture and politics further enables institutional learning, encourages pro-environmental policy, reshapes city politics, and forges professional and social networks with ecological ethics. These emerging transitions, although occurring in a piecemeal fashion and in many cases limited to rhetorical and ideological changes, suggest that experimenting with eco-development has a catalytic effect on greening urbanization in China. They evince the institutionalization of various forms of sustainable development at the local level in China. Continued eco-developments have become standard-setters for China's green urbanization agenda, symbolizing the nation's "statecraft" in engineering new territories, new ecologies, and new societies. China's authoritarian, eco-environmental rationality in urbanization and modernization promotes the Chinese state's legitimacy during a phase of economic slowdown and facilitates the power expansion of "Global China" in international affairs.

China in 2020 confronted challenges on multiple fronts: mainly, 1) environmental degradation and climate disasters; 2) infectious diseases and pandemic risks; 3) socioeconomic disparities and

sociopolitical instability; and 4) destabilized global trade and international relations. These challenges certainly do not pertain only to China but rather are global. The country seeks to find solutions through reforming its environmental governance systems, investing in green technologies, and heightening its prevailing approach of digital surveillance. China's ongoing attempts, amid its volatile relations with other parts of the world, are worth further investigation. The concept of development and its production mechanism must be fundamentally questioned.

A Study on Design and Planning Innovation

This dissertation is an attempt at investigating forces that seek to innovate the formation and transformation of the built environment. The built environment serves as the infrastructure of human societies and encompasses artifactual and natural elements that can be networked or disintegrated due to various societal choices and volatile power dynamics. The development of the built environment, as well as the resulting impact on the wellbeing of both humans and nature, has been the core concern of city design and planning (Cuthbert, 2003). City design and planning are both reactive and creative practices which both shape, and are shaped by, sociopolitical and environmental changes. Although the invention of forward-looking ideas, techniques, and technologies brings opportunities for improving the built environment, innovative design and planning should engender normative evolution and systemic change by transforming development processes. The latter necessitates collective action, institutional reform, and cultural shift. Based on such understandings, ideas for development innovation must facilitate creative problem-solving that, in principle, can systemically transform human society for collective betterment. In reality, development innovation has variegated impacts on different members of the society and, therefore, the collective betterment is experienced differentially by different individuals or communities. The improvement in quality of life is relative to different people's and different communities' preexisting conditions. At a collective level, betterment entails a reciprocal relationship between human societies and the environment. At the local level, how such a reciprocal relationship performs and how much it generates impact at a collective level is worth nuanced investigations. This dissertation explores innovative urban interventions that transcend preexisting paradigms in order to address social and environmental problems in tandem while stimulating societal progress. Parsing the meaning and impact of attempts at developmental innovation reflects entrenched norms and reveals what issues actually matter.

Eco-development can be viewed as a product of the ongoing environment movement which has sought to innovate paradigm shift in the development of human societies by incorporating eco-environmental rationality in city design and planning. In modern history, planners and designers have proposed visions of future cities in response to urban problems in industrializing and industrialized cities. Model cities such as the Ecological City, the Garden City, the Metabolic City, and the Sustainable City embody eco-environmental ethics and exemplify forward-looking visions that seek to reconcile the conflicts between urban development and natural processes. Through global flows of capital, knowledge, and ideas, the models of future cities are operationalized across the world, leading to a paradigm shift in development policy and practice as well as a cultural shift in societies. While processes of capitalist growth and globalization have been criticized for homogenizing the built environment, cultures, and values across the world, city design and planning can play an important role in facilitating or reversing such trends due to its direct and indirect impacts on both the built environment and the society and on both the present and the future.

Background of the Study

The following sections introduce the brief histories of how ontologies of nature have evolved, how popular eco-concepts such as sustainable development, green growth, and the eco-city have emerged, and how such notions on nature and the city have shaped development strategies, norms, and policies. The background information presented in this chapter situates the dissertation in the histories of how key ideas and events have evolved both globally and in China. The intellectual debates and critiques about the notions and theories underlying such historical evolution are further elaborated in Chapter Two.

Evolving Ontologies of Nature and Rising Environmental Movements

The relationship between the built and the ecological has drawn increasing intellectual debates. Since the late nineteenth century, the rise of industrial cities has brought both material prosperity and new forms of social and environmental problems to human societies. Modernist urban practices focused on addressing the urban illnesses of the industrial city through engineering urban systems, expanding urban realms, and beautifying the built environment. Nature was viewed as aesthetic components contained in the urban. Over half a century later, environmentalists and planners condemned the damages of urban development and insisted on viewing cities as part of nature (McHarg, 1971; Spirn, 1985). Their progressive stance favored natural rules as fundamental restrictions on urban growth.

The environmental movement in modern societies has led to a generation of environmental practitioners (including architects, landscape architects, urban designers, and planners), who are increasingly aware of the impact of urban development on ecological degradation, global warming, and catastrophic climate events. Environmental practitioners often face the contradictions between growth demand and environmental degradation. Their practices are nested in entrenched problems of existing spatial, economic, and sociopolitical structures. Inspired by eco-environmental rationality, different schools of theorists and practitioners have problematized the binary view of the urban and nature and aspired to construct new principles that connect the quality of urban life with that of the environment. For example, Landscape and Ecological Urbanists have expanded the view of nature to include resource-depleted, derelict urban landscapes and assert the importance of safeguarding habitat and the urgency of pollution mitigation for creating socially productive places (Mostafavi & Doherty, 2010; Waldheim, 2006, 2016). New Urbanists have sought to codify urban forms that optimize human experiences while minimizing environmental impact (Congress for the New Urbanism, 2013; Ellis, 2002; Moule et al., 2008). Economists have begun to assess environmental and social costs of economic growth and urban development, internalizing socio-environmental costs in economic considerations (M. S. Ho & Nielsen, 2007; Nielsen & Ho, 2013; The World Bank, 2007a). In addition, waves of scientific and technological dialogues have advocated the paramount importance of environmental conservation, waste management, clean energy sources, and green building technologies. All of these considerations and approaches have been incorporated into various development models that aim to promote the co-flourishing of human societies and the environment through comprehensive strategies.

The environmental stance in urban development has been normalized globally since the United Nations began its sustainable development initiatives in the 1980s. In 1987, the United Nations first

published the Report of the World Commission on Environment and Development, commonly known as the *Brundtland Report*, which first introduced the concept of sustainable development to the world and underpins the mainstream definitions of sustainability today (WCED, 1987). The Report advocates that sustainable development should accommodate urban growth without sacrificing the need of future generations. There were two landmark events led by the United Nations that popularized the concept of sustainable development internationally. In 1987, the Brundtland Commission published the report *Our Common Future*, which first articulated that sustainable development must "meet the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). This definition contains two key concepts: first, the overriding priority is given to "needs," in particular, the essential needs of the world's poor; second, the concept introduced the idea of "limitations," which are imposed not only by the state of technology and social organization but also, more importantly, by the environment's ability to meet present and future needs. Thus, sustainability originated as a concept embedded as much in the Earth's environmental capacity as in societies' sociopolitical and technological capacities. In 1992, at the United Nations Earth Summit held in Rio de Janeiro, the member nations adopted *Agenda 21*—a global, comprehensive action plan for sustainable development. This conference led to a period of local and national experimentation with urban practices that incorporate economic, social, and technological solutions for environmental sustainability.

The paradox of continuing urbanization and reducing environmental impact seems to be a real contradiction, especially in developing countries. In an era challenged by rising risks from globalization, social conflicts, and climate change, many developing nations have joined global environmental coalitions and committed to "green growth." The United Nations' Organization for Economic Cooperation and Development (OECD, 2012) defines "green growth" as a path of economic growth that ensures the continued provision of natural resources and environmental services on which our well-being relies. This concept was proposed as an alternative to conventional industrial growth in modern societies. In the last decade, many national and international organizations and political administrations in the developing world have adopted green growth as their objectives of socioeconomic transformation. With strong political commitments, "sustainable" and "green" initiatives herald a new wave of explorations for pro-environmental technologies, institutions, and development paradigms that would nurture a green economy along with new institutions for environmental protection and urban governance.

In the twenty-first century, the environmental stance in urban development has further evolved with climate change. More and more scientific research has warned of climate change catastrophes in the near future, projecting alarming economic and social damage with continued growth. Political leaders, environmental scientists, practitioners, and activists have sought to communicate the urgency of addressing climate change to the public to encourage development reforms and foster collective actions. The environmental discourse has turned towards discussions about an apocalyptic view of the environment and the need for degrowth theory and praxis. Such changing views and progressive actions have facilitated the world's most ambitious transnational coalition in environmental initiatives during the twentieth century. In 2015, world leaders adopted the United Nations' *Sustainable Development Goals* as part of the *2030 Agenda for Sustainable Development*, aiming to build societies that are inclusive, safe, resilient, and sustainable. The concept of urban sustainability

has been diversely interpreted to incorporate principles of climate adaptation, resilience, and social equity and has become increasingly elusive and perplexing.

One of the most recent global environmental coalitions is the Paris Agreement, which is an agreement adopted in December 2015 within the United Nations Framework Convention on Climate Change (UNFCCC). It encourages the joint force of member countries to deal with greenhouse gas (GHG) emissions. Under the Paris Agreement, each member country will design its own strategies to mitigate global warming. By 2016, the world's largest GHG emitters had acceded to the agreement, including China, the U.S., the European Union, and India. As of 2018, the member states and regional organizations of the agreement represented more than eighty-seven percent of global GHG emissions. Despite its success to draw members to the force at the beginning, critics remain skeptical about the real impact of such an agreement. It is a bone of contention whether the world's high polluters will drive down their emissions voluntarily and assiduously if the agreement remains promises without institutionalized action plans (Nicolas & Firzli, 2016). In fact, the U.S. officially withdrew from the Paris Agreement in 2020 under the Trump Administration, marking the world's first country to take this action. Despite the challenges of forging inter-governmental cooperation and collaboration at the transnational level, sustainable goals continue to guide local development initiatives.

Despite the chaotic discourse about sustainability, urban designers, planners, and politicians continue to propose and experiment with comprehensive paradigms for sustainable, adaptive, and equitable development. The resultant programs and projects, although incomplete, experimental, and sometimes Utopian in nature, serve as the demonstration of forward-looking approaches to development and governance. As sustainability-focused programs and projects have become a fad in the national and international domains of development and policy, the complexity and richness of such progressive experimentation is worth close examination within specific local contexts. The impacts of these initiatives are multi-faceted—including economic, social, cultural, institutional, political, and environmental dimensions—and remain highly contested.

Cities as a Key Arena for Global Environmental Initiatives

In the domain of urban development, sustainable development initiatives and environmental initiatives are often discussed separately, which understates the linkage between environmental governance and urbanization, especially in industrializing regions and developing countries. Urbanization, and the concomitant industrialization and physical densification of urban areas, has been a key determinant driving up energy consumption, air pollution, and carbon emissions (Anwar et al., 2020; Churkina, 2016; Yazdi & Dariani, 2019; N. Zhang et al., 2017). While the development of modern societies has been blamed for worsening the environmental crisis, it has also become a crucial arena for global environmental interventions. A key aspect of sustainable development is the need to protect the environment in processes of industrialization, rampant urbanization, and climate change. In modern societies, the world continues to face a twin challenge that hinges on the economy-environment dynamic: on one hand, economic opportunities should be expanded for all, especially currently disadvantaged and marginalized populations in underdeveloped regions; on the other hand, environmental risks must be addressed since environmental problems undermine opportunities for economic prosperity and social development (OECD, 2012). In the context of a growing global population and continued industrialization and economic development in developing countries, the relationship between urbanization and the environment has become increasingly

important for the long-term wellbeing of the planet and all human beings. Urbanization and environmental sustainability are increasingly viewed as opposing forces, with environmental capacities constraining economic development and urban growth (WCED, 1987).

Transnational organizations, such as the United Nations and the World Bank, have advocated that *cities* can provide opportunities to reconcile urbanization and environmental sustainability through sustainable development. Since the 1980s, sustainable development has been an overarching goal for urban development across developed and developing countries in the world. Especially since the 1992 United Nations Conference on Environment and Development, various paradigms for sustainable development emerged as models for new urban developments in highly industrialized and post-industrial countries. Many countries have designed sustainable development agendas and established demonstration projects according to ideas and frameworks of sustainability established by international organizations. Responding to national initiatives, many local states have also established local *Agenda 21* programs and identified key development goals and key environmental quality indicators for developmental and environmental governance. These national and local programs have stimulated a series of experiments with city design and planning as well as comprehensive implementation strategies that incorporate eco-environmental principles. These programs are often high-profile and state-initiated. They have established demonstration projects that integrate international and local perspectives. The implementation of such projects involves plural, iterative processes that reshape power relations and institutions across geographic and political scales.

The Notion of Greening Growth in Developing Countries

While developed counties have witnessed how urban development exacerbated environmental degradation, it is paramount that developing countries also chart a greener roadmap for their urbanization. The 2012 G20 Summit underscored the need for G20 countries to move onto a growth path by taking resolute policy action to address rising environmental challenges and foster "green growth" (OECD, 2012). Accordingly, despite their desire for economic growth and social development, developing countries have been urged to better conserve natural resources, use natural assets sustainably, minimize pollution and environmental impacts, account for natural hazards and climate change, and provide the resources and environmental services for human well-being (Fay & World Bank, 2012). This growth approach incorporates the notion of a green economy and emphasizes the integration of environmental and social considerations into economic pursuits (UN ESCAP, 2010). Green growth agendas also promote low-emission urbanization, socially inclusive and equitable development, as well as reduced environmental risks and ecological damage (UNEP, 2011).

The notion of green growth carries the mission to transform developmental mentalities in developing contexts, for it recognizes that focusing on GDP as the main measure of developmental progress overlooks the contribution of natural assets to economic progress, public health, and social well-being. Accordingly, a green approach to growth must rely on a broader range of measures of progress on economic, social, and environmental dimensions, which should encompass, but not limited to, the physical quality and socioeconomic composition of the development and how its implementation affects people's wealth, health, and welfare. Green growth strategies focus on expanding economic opportunities that are subject to environmental capacity and minimize

environmental cost while incentivizing environmental remediation, energy saving, and ecosystem conservation. In support of green growth, governments often promote green financing by increasing financial flows from the public, private, and non-profit sectors to initiatives of sustainable development. Green growth initiatives often open up new markets for green goods, services, and technologies. Green growth initiatives also necessitate environmental governance, which mobilizes governments, businesses, and civil societies to advocate sustainability through socio-ecological systems-based management. Accordingly, urbanization initiatives embodying the notion of green growth have been conceived and implemented at a variety of levels in developing countries, ranging from a factory to a national strategy. They often lack clarity and vary greatly across regions due to differences in constituent expertise, local conditions, and political positions. Countless studies have sought to encourage technological and organizational reforms in developing countries that would enable transitions towards a greener path to long-term growth. While theories of political ecology have pointed out the limitation and ineffectiveness of popular notions of green and sustainable development, such notions have generated practical influences that continue expanding and evolving. While green and sustainable development initiatives have been widely discussed at international and global levels, their appropriation and impact on a finer urban scale remain understudied.

China's Rising Impact on Global Environmental Sustainability

As the Nobel laureate Joseph Stiglitz has predicted, two transformative forces will most impact global prosperity in the 21st century: one is technological innovation in the United States (U.S.), and the other is urbanization in China. Through transnational collaboration and knowledge exchange, the two transformative forces have interacted tremendously in the realm of city design and development. New technologies and new ideas developed in the U.S. and in other developed countries have greatly shaped China's approaches to urbanization. With China's growing impact on the world stage, its urbanization has increasingly facilitated and shaped the global explorations of sustainable development. The global interconnectedness, accompanied by volatile power dynamics, has imposed great challenges on solving urban and environmental problems. Lessons from China's urbanization bridge knowledge and values across North/West and South/East and constitute an important component of the global search for sustainability.

In 2020, China rose on the global stage to energize the world's climate ambitions. It pledged to peak emissions by 2030 and reach carbon neutrality by 2060. With both European Union and the U.S. pledging carbon neutrality by 2050, the world's three largest economies are expected to set a new global pace for carbon-neutral pathways. While Europe and the U.S. largely include post-industrial societies, China remains an emerging economy with a strong desire for economic growth and urbanization. With existing environmental degradation induced by China's rapid urbanization, its environmental governance must entail not only rapid decarbonization but also massive environmental remediation in water, soil, air, and ecosystems. Such transformations have inevitably been, and will increasingly be, carried out as part of China's urbanization plans. As China increases its climate ambition, it has been searching for a greener path to growth. In the domain of economic growth and energy consumption, recent research suggests that China aims to deploy ever-cheaper renewables and other clean energy technologies and export clean energy-based technologies to accelerate decarbonization, drive technical innovation, improve the competitiveness of Chinese companies in international markets, and transition towards a greener economy (Marcacci, 2020).

This points to the potential to integrating economic and environmental benefits in China's climate adaptation through clean energy transitions.

However, what has been understated, or largely frowned upon, is the country's continued search for a path towards greening its urbanization. Although attempts at sustainable development and ecological civilization building have been ongoing over the last two to three decades in China, their achievements remain obscure and difficult to quantify. In 2015, in addition to China's commitment to reducing GHG emissions under the Paris Agreement, the Chinese central government issued the Thirteenth Five-Year Plan (2016-2020) which officially incorporated principles of ecological civilization, green development, and social equity into its national development objectives. The new political emphasis on environmental sustainability has stimulated the ambition in a comprehensive overhaul of planning practice and has furthered the enthusiasm in experimenting with low-impact, low-carbon, or other eco-projects. According to the Plan, China's new urbanization would use land, water, and natural resources efficiently, consume cleaner energy resources, integrate marginalized regions into the urban systems, and allow for balanced, socially inclusive development. In 2020, China once again announced to comprehensively promote greener economic and social development while pursuing high-quality urbanization—an ambition aligned with its continued attempts at sustainable development and ecological civilization building (Marcacci, 2021). Yet China's plan to achieve the new goals remains undefined. Embracing the technology-focused transformations alone, such as the faster, wider adoption of renewable energy, will be insufficient for the comprehensive greening of China's urbanization. The latter entails fundamental, structural changes in its infrastructure and institutions. China's past eco-environmental (*shengtai huanjing*) initiatives of urbanization can illuminate the uniqueness and the global connectedness of the "Chinese approach."

Environmental Actions in Modern China

In the development of modern China (founded by Mao Zedong in 1949), population growth, industrialization, and urbanization have imposed compounding—and in many cases severe—damage on the environment, resulting in problems such as water and air pollution, deforestation and desertification, and decreasing biodiversity. However, degradation of China's environment had started long before 1949. Rhetoric on the need for a better environment and healthier ecosystems in China has emerged in the 1950s when the nation began its industrialization and modernization. During the 1950s and 1960s, the postwar reconstruction and economic development plans had led to massive ecological destruction. In particular, the Great Leap Forward (1958-1961) and the Cultural Revolution (1966-1976) were two major periods of accelerating environmental degradation, worsening pollution, and neglecting infrastructure (Elvin & Liu, 1998). Since the 1950s, China's economic development had largely occurred based on the rationale that humans should exploit natural resources and can conquer nature—a notion armed with Mao Zedong Thought and the rise of modern science. In the 1950s, development-induced environmental exploitation was evident in the clearance of massive ecosystems such as hillsides and wetlands to create farmland. During the Great Leap Forward, with its emphasis on economic growth, numerous trees were felled to fuel steel production and massive wetlands were destroyed by land reclamation projects, exacerbating flooding, soil erosion, water and air pollution, and biodiversity loss. Although China enacted its first nature reserve and wildlife conservation laws in 1956 and designed policies to increase agricultural production and conserve soil in the 1960s, environmental matters were largely neglected before the 1970s (Edmonds, 1999).

In the early 1970s, international contacts gave birth to environmental consciousness in China. Around 1972, a Chinese delegation attended the First United Nations Conference on the Human Environment in Stockholm. In 1973, China incorporated environmental planning into its national plans and created a national environmental protection agency. Although the exploitation of land and natural resources continued in China, environmental debates intensified during the 1970s and 1980s. While those intellectuals and politicians who were informed by Western worldviews had begun arguing that economic growth could not be sustained at the cost of the environment, others insisted that China must follow the "pollute first and clean up later" growth rationale. Amidst such debates, the central government established the national Environmental Protection Law in 1979. By the early 1980s, China had promulgated the concept of "harmonious development" (*xietiao fazhan*)—an idea similar to sustainable development—as an objective of its national policy (Edmonds, 1999). Nevertheless, the implementation of China's environmental policies had fallen short of their enactment during the following two decades, giving priority to economic and urban growth. By 1998, when China upgraded its National Environmental Protection Agency to the State Environmental to strengthen its environmental action, investment in environmental production had remained very low. By the end of the twentieth century, despite some attempts at tree-planting and nature conservation, China had been suffering from increasing environmental issues growing in geographical scales. These issues included severe pollution (e.g. air, water, and soil pollution, and growing industrial and domestic waste), natural disasters (e.g. floods and landslides) and resource degradation (e.g. cropland shrinkage, water shortage, vegetation coverage decrease, deforestation, and soil erosion). In 1999, the Washington-based World Resources Institute reported that nine of the ten cities with the world's worst air pollution were in China (Edmonds, 1999).

During the over-three-decade-long rapid urbanization (1978 to 2010s), the tremendous economic and social cost of China's environmental degradation has caught the world's attention. For example, according to a report on China's cost of pollution, published in 2007 by the World Bank and China's State Environmental Protection Administration, the total cost of air and water pollution in China in 2003 was estimated to be 5.78 percent of GDP (The World Bank, 2007b). As early as 1984, the Chinese government was shocked by a report estimating the country's annual cost of environmental pollution to be about RMB 40 billion (USD $6 billion). Since then, China has incorporated environmental protection into its national policies. Over the subsequent three decades, the State Environmental Protection Administration has issued 200 regulations and 500 national environmental standards, approved over five multilateral or international environmental conventions, and has overseen more than 1,600 regional or local environmental regulations (Williams, 2017). Most of these policies lacked enabling legislation, but many have set the scene for future environmental developments. China was one of the first countries in the developing world to strategically introduce sustainable development on a national and regional policy level and has been using it to promote a new trajectory for urban development (Williams, 2017). China was the first country to publish a national-level "Agenda 21" strategy after the 1994 Rio Summit. Nevertheless, China's continuous urbanization remains a major cause of the country's environmental damage.

Since the start of the twenty-first century, China has become more integrated into the international community, especially in the aspects of economic development and environmental protection. International commentaries continue warning China of the compounding risks of economic slowdown and environmental degradation. By 2007, China had overtaken the U.S. to become the world's biggest carbon dioxide emitter (Vidal & Adam, 2007). Since then, China's environmental issues have drawn heated contention both domestically and internationally. Foreign media has

widely criticized the Chinese government for obdurately valuing economic development at the cost of socio-ecological wellbeing, sacrificing its citizens' health, ecosystem health, cultural heritage, and the quality of life of individuals and traditional communities. The foreign criticism has been coupled with a public outcry within China due to growing evidence of pollution-induced health risks, such as "cancer villages" as well as respiratory diseases and birth defects caused by heavy, toxic smog over many cities. Environmental quality has become intertwined with economic growth: urban dwellers involuntarily move to environmentally safer places, and enterprises choose to relocate to and invest in less polluted areas. China's mounting environmental challenges have endangered its economic growth, social stability, the legitimacy of the ruling party, and its international relations (Albert & Xu, 2016). In the face of combined international and domestic discontent, compounded by an increasing demand for green products on the global markets, the Chinese government has escalated environmental regulation and mitigation action in the country by expanding environmental monitoring, tightening pollution control, and restricting industrial emissions. In the meantime, it has also been exploring "quality urbanization" by integrating measures of ecological restoration and environmental mitigation into urbanization plans (Li, 2018).

While China has imposed a huge environmental impact on the globe, international media anticipates that cooperation from China is crucial to the progress and effectiveness of the world's environmental endeavors. However, economic and ideological disparities between developing and developed countries have been barriers to international cooperation in environmental initiatives. For instance, the Chinese government once considered poverty the main cause of environmental degradation in developing countries and resisted the idea of reducing emissions (Edmonds, 1999). In response, developed countries acknowledged their contribution to global environmental problems and agreed to transfer funds and technology to assist with pro-environmental initiatives in developing countries. The increased accountability towards environmental problems across the world has encouraged China to participate more in global pro-environmental programs. As China's environment has continued to deteriorate along with industrialization and urbanization, resource degradation, and depletion in some areas, has greatly threatened China's economic development. In response, the country has called for the green transformation of its growth model to enhance economic efficiency, social stability, and the country's competitiveness in global markets. China's environmental action today is integrated with infrastructure modernization. The latter includes transitions towards clean and renewable energy, the upgrading of telecommunication technologies, transportation infrastructures, and the greening of general urban development. Foreign critics have observed that the greening process of China's infrastructure modernization has occurred without original technological innovation and, instead, replicated development models in other countries, especially those in Europe, North America, and Northeast Asia (Cannon, 1998). Edmonds (1999) questions China's lack of confidence in conceiving modernization and argues that it is a mistake for China to follow the paths of developed countries while neglecting its own socioeconomic and environmental conditions. Indeed, China's modernization has involved processes of Westernization and the impact of the latter has yet to be critically discussed in popular discourse. Edmonds cautions that along with infrastructure modernization China must formally give environmental protection high priority, control its population, extend environmental education, and evolve into a more open society in order to avoid an ecological down-spin during the twenty-first century.

Despite the contested environmental problems in China, the country is regarded as a role model for fast-developing regions for its legendary growth history. During the first half of the twenty-first century, Africa and Asia are expected to lead urban population growth in the world (UN report, 2012). Commentators have observed that African cities look increasingly like Chinese cities (Weller,

2015). Facilitated by its "One Belt One Road" initiative, China has begun to export its experiences of economic development and infrastructure modernization accumulated over the past forty years to other developing contexts, such as those in Africa and Southeast Asia (Ma, 2018; Weatherley & Bauer, 2021). China's new global initiatives often involve state-led infrastructure projects conceived with green, eco-environmental features, shaping the next phase of growth in both China and other developing contexts. Lessons from China's green transitions in modern development have become increasingly intertwined with the world's environmental endeavors.

A Rising Environmentalist Nation: Building An Ecological Civilization

Ecological approaches to innovating urbanization flourished after China highlighted "ecological civilization" on its political agenda, heralding a turn towards green politics after three decades of environmental degradation. China became the world's largest CO^2 emitter in 2007. In the same year, the concept of "ecological civilization" was first introduced at China's Seventeenth National People's Congress. In 2012, at the Nineteenth National People's Congress, the Communist Party of China (CPC) set "ecological civilization building" as a top priority in order to build a "beautiful China" and realize "sustainable development" (C. Zhang, 2015). President Xi Jinping emphasized that energy saving, environmental protection, and ecological restoration must be the fundamental principles of ecological civilization. He also called for a new "ecological ideology," which prioritizes environmental sustainability while promoting the co-evolution of the economy, politics, culture, and society (Huang, 2018). This means to use land, water, and natural resources efficiently, consume cleaner energy resources, integrate marginalized regions into the urban systems, and allow for socially inclusive development. The political campaign to construct ecological civilization suggests that the CPC has resolved to lead the country to transition towards green growth. It has triggered a series of institutional and legal reforms that mandate pollution mitigation, environmental protection, environmental planning, and ecosystem-based management. Environmental protection has become an important indicator for assessing local officials' performance. National programs and subsidies increasingly promote ecological innovation in economic and urban development (Pow & Neo, 2013; Shiuh-Shen, 2013). The campaign also includes the "cultivation of good social morals" by inculcating environmental consciousness in schools, local communities, and governments (Williams, 2017). In 2015, China submitted its new climate action plan to the United Nations Framework Convention on Climate Change (UNFCCC) and committed to reducing greenhouse gas (GHG) emissions under the Paris Agreement (UNFCCC, 2015). In the same year, the Chinese central government issued the Thirteenth Five-Year Plan (2016-2020), which further promotes "green" development models. The Plan enlisted 165 key projects that would foster technological innovation, green economy, eco-environmental protection, and social equity. China's "ecological civilization building" campaign features the emergence of a degrowth mindset in tandem with the promotion of ecopolitics. This marks the nation's ambition to comprehensively overhaul urban practice from within while being a global leader of the world's decarbonization initiatives. It has led to widespread experimentation with policies and practices that operationalize eco-environmental principles in myriad ways. The results of such experimentation are typically reported by the Chinese state and have been otherwise understudied.

China's current administration has realized the imperative to go green and has invested tremendous efforts to redress the negative environmental consequences of rampant urbanization. Green urbanization is regarded as the process of restructuring economic regimes and growth models to minimize environmental impact and accelerate sustainability. China's path to green urbanization

faces the fundamental dilemma of sustainable development: the search for more material prosperity by more people undermines the sustainability of human life. This dilemma exemplifies challenges of green growth in developing contexts, where development is the path to enhanced material quality of life but it can also negatively impact the environmental quality of life and endanger the health of humans and ecosystems. In 2015, China announced plans to realize the *United Nations 2030 Agenda for Sustainable Development* and to implement a national plan to tackle climate change. President Xi regarded ecological and environmental security as an important component of national security and stressed "ecological civilization building." Increasingly, environmental policies have become integrated into infrastructure and urban development plans across administrative levels, shaping urban management and financing programs in local developments.

China's resolution in building an ecological civilization has invited a positive outlook on the country's ability to address environmental problems. In an article titled *Beijing Wins Accolades As Green Leader*, Ho (2018) predicts that "China's current stance on environmental protection should make it possible for the country to leave its more polluted past behind as little more than a hazy memory." Although this view sounds rather like a stretch, it suggests optimism about China's recent experiments with pro-environmental measures. First, China has increased its investment in advanced, green technologies to enhance environmental protection while continuing economic development. With its resolution to cut down carbon emissions and utilize cleaner, renewable energy resources, China is predicted to be one of the world's largest consumers of green products in the future (Chiu, 2017). The International Energy Agency forecasts that nearly 40 percent of total renewable power capacity growth will come from China by 2020 (IEA, 2019). Second, China has exercised a top-down approach to tighten environmental quality monitoring and pollution control by holding local authorities accountable. In 2015, the central government conducted a two-year-long, nationwide audit on environmental quality and reprimanded over 2,000 governments and state enterprise officials. Some officials even faced criminal charges. Cities and provinces have pledged to beef up anti-pollution efforts and "resolve all environmental problems by 2020" (D. Ho, 2018). Third, China has strengthened its environmental laws and generated a series of environmental regulations to control air, water, and soil pollution and to provide clear guidelines for industries, which are the major contributors to environmental problems. These measures have established: 1) tax laws and licensing for pollutant discharges, 2) environmental rules on governmental construction projects, marine management, and air pollution, and 3) remediation and compensation systems for environmental damage.

China's new environmental policies have incentivized industrial innovations to incorporate advanced environmental technologies and to find solutions to waste management and recycling. The country's aspiration to move towards a greener economy is manifested by its national roadmaps—the Five Year Plans. In its Eleventh Five Year Plan (2006-2010), China set targets such as energy intensity and SO^2 and COD pollution. The "Green Development" section of China's Twelfth Five Year Plan (2011-2015) set priorities regarding China's future socioeconomic development, and provided guidelines and targets for local policymakers. It included six themes: climate change, resource saving and management, circular economy, environmental protection, ecosystem protection and recovery, water conservation, and natural disaster prevention. It established new binding targets such as carbon emission per unit of GDP to be reduced by 17% and NOx and nitrogen air emissions to be reduced by 10% by 2015. The Plan also provided detailed policy guidelines to demonstrate energy-efficiency technology and to establish diffusion programs that promote energy-saving opportunities. In the subsequent five years, China aimed to produce 16% of its primary energy from renewable sources by 2020.

As eco-environmental rationality has become increasingly prominent on China's economic and political agendas, the progress of China's environmental efforts remains obscure and under-assessed, especially considering their entanglement with China's urban growth plans and their path dependency in the Chinese sociopolitical and cultural systems. Emerging attempts at advancing environmental protection in tandem with continuing urbanization suggest that China has been learning from both developed countries' experiences and lessons from its own drastic transformations. China is gaining a reputation as a rising global leader in both infrastructure development and pro-environmental transitions. Aiming at advancing urbanization and environmental sustainability in tandem, it has collaborated with other countries in shaping exemplary urbanization projects that would enable transitions towards a greener economy while creating an ecological environment. For example, the Sino-Singapore Tianjin Eco-City, a project launched in 2008 and developed jointly by China and Singapore, is regarded as a successful development for attracting about 5,000 companies and 80,000 residents and for incorporating environmentally friendly and resource-efficient technologies. Since then, China and Singapore saw growing collaborative opportunities for governments and industries to develop advanced environmental technologies, share practical experiences, and identify scalable solutions to address environmental challenges. Such opportunities are also expected to grow in number and geographic scope with China's "One Belt One Road" initiative and related infrastructural projects. In 2017, China announced a *Plan for Eco-environmental Protection Cooperation under the Belt and Road Initiative*, which sets goals and plans to promote environmental protection and cooperation for Belt and Road projects by 2030 (MEP, 2017). It includes multiple dimensions, including policy communications, facility interconnection, trade flow, capital and financing, ideology promotion, and capability building. This initiative is regarded as a way for China to export its goods, technologies, services to the Belt and Road countries and expand markets for new industries; it is also a way for China to apply its urbanization models and modernization strategies to other developing contexts (Weatherley & Bauer, 2021). In many cases, China's influences in other developing countries have carried the self-proclaimed banner of "greening urbanization" and been realized in modernized housing communities, infrastructural projects, and manufacturing zones.

How have eco-environmental rationality shaped China's urbanization so far? How have achievements of green urbanization initiatives been assessed, and how should they? While China considers continued urbanization a must, the country's crucial role in global environmental initiatives suggests the importance of understanding the conception, evolution, and impact of China's existing initiatives in its green urbanization movement, especially projects that have engendered combined physical, socioeconomic, environmental, and political influences, as examined in this dissertation.

The Eco-Environmental Turn in China's City Design and Planning

With the rise of environmentalism across the world, ecological and sustainable ideas of design and development have evolved rapidly with a constant stream of innovation in entrepreneurism, design ideas, and technologies. Unfortunately, innovation in sustainability-inspired design faces obstacles such as outdated building codes and planning policies and conventional attitudes resisting change. The innovation of design, planning, and development practices is subject to structural problems in

political systems. Therefore, progressive designers, planners, and other change makers must work around economic, social, and political challenges in order to innovate urban development.

Urban planning in China involves the development of separate plans by different ministries and agencies. Lack of coordination across agencies has led to inconsistency and incoherence in policies and practices. In recent years, the search for more comprehensive urban development strategies calls for more integrated planning across agencies so that economic development, industrial advancement, housing provision, infrastructure provision, and environmental policies are spatially consistent. The government's stated objective for urban development has been broadened from merely fostering economic growth to additional dimensions such as environmental sustainability and enhanced quality of life. Environmental policy and planning has emerged as an important component of China's political agenda and in its urban development today. Centrally initiated goals to go green have led to various responses of local policy design and specific environmental planning in urban developments.

The current Chinese administration is not only directly involved in the development, but it has also paid more attention to regulating the externalities of urban development. The centrally announced green initiative has led to various national and local actions. In response to the centrally initiated green transition, local governments generated environmental protection goals, environmental planning guidelines, and environmental regulations. These emerging local policies and practices are the microscale reality of China's ongoing green transition. Cities are constantly learning from the top, from elsewhere, and, more importantly, from their own past experiments to continue with their exploration, experimentation, and adaptation in developing a greener future.

The eighteenth People's Congress of the Chinese Communist Party in 2012 highlighted ecological civilization as the key to a "beautiful China," which entails economic, political, cultural, and social development, and to the sustainability of the entire nation (Tao et al., 2014). The goal of "building a beautiful China" marks a progressive shift in China's administrative thinking in a new era of economic and social development. It is also a response to the Chinese citizens' rising desires for an enhanced quality of life (*meihao shenghuo*) after four decades of urban transformation. The ecological civilization initiative has led to urban policies and projects that seek to remediate environmental pollution and protect the environment from further destruction in urban development. New master plans and concomitant management plans are designed to incorporate environmental and ecological considerations. The new designs of urban development include ideas for alleviation of poverty, revitalization of resource-depleted areas, treatment and reuse of brownfields, enhancement of energy efficiency, utilization of renewable energy, integration of low-impact technologies, and institutionalization of environmental capital. The conception and implementation of these new ideas demands new relationships between the agencies of design and urban practice, as well as reforms of supporting policies and regulations.

Different approaches to eco-developments either focus on environmental protection and remediation or climate change adaptation. The former includes pollution reduction and waste treatment. The latter includes developing low-carbon, low-impact projects with cleaner energy resources and higher energy efficiency. Another dimension of eco-developments is the integration of advanced technologies—the smart city ideal—for both production and management in cities and businesses. The increasing awareness of environmental protection and remediation does not hold China back from its ambition to develop further. The central government is reforming its political regimes to mandate environmental considerations in urban governance and development. It also

calls for new ideas for and innovative approaches to city making. In response to the centrally devised shift in urban development, different levels of local governments, especially those of areas that have been industrialized, are experimenting with new development models with environmentally friendly strategies for business management and financing. China has launched a nationwide initiative to explore how "green ideas" can reform urban development strategies and how future cities should be built and managed. These attempts under the umbrella of "green urbanization" encompass, but are not limited to, establishing new environmental regulations, adopting new urban design ideals, collaborating new development agencies, restructuring industrial ecosystems, incorporating new technologies in urban systems management, building smart infrastructure as the catalyst of city making, and nurturing new urban cultures. An underlying attempt is to discover a new source of productivity in future urban developments that do not sacrifice the wellbeing of the environment.

China has reached a turning point in its development. Many commentaries liken China's economic slowdown and its emphasis on ecological civilization to the post-industrial turn and the emergence of environmentalism in Western societies. For example, as countries in Europe and North America were challenged by resource depletion, their development shifted from massive expansion to urban rehabilitation, with growing attempts of environmental conservation and historical preservation. Since then, Western design ideologies and development experiments have greatly diversified. A similar shift has been centrally promoted in China today concomitant with an unprecedented emphasis on urban design. In the meantime, the Chinese central officials and their think tanks are searching for innovative approaches to urbanization and recently initiated an ambitious, transnational research project to promote "Green Urbanization." This initiative seeks to fundamentally rethink urban development by incorporating environmental considerations. "Green Urbanization" reflects Chinese officials' unflagging enthusiasm for sustainable development.

China's recent focus on design-empowered, green development reform is best manifested in its supreme new development—the Xiongan New Area. Announced on April 1, 2017, Xiongan is currently China's most politically promoted development as "a strategy crucial for a millennium to come" (Liangyu, 2017). It claims to incorporate the most sophisticated green approaches to city making. Although details of its development have been classified from the start, tremendous resources and agencies from both within and beyond China have been mobilized. Xiongan's administration committee invited global firms to enter its schematic design competition; major planning and design institutes in China have been involved in its planning and design development; many technology companies have flocked to Xiongan to experiment with new technologies and digital management techniques; various research programs and demonstration projects have been established to explore themes of the eco and smart city. Some participates of Xiongan's initial development reflect that the lofty aspirations from all of the various actors have led to a bias towards action even when this action is not fully reasonable yet. While China's new green development initiatives exhibit even higher ambition after its decade-long eco-movement, its early eco-developments remain poorly understood. This line of continued green experimentation merits further research.

China's Model Cities and the Promotion of the Ecological City

Since China began its urbanization, the central government has promoted a series of concepts of the model city to encourage environmentally sustainable and socially harmonious city-making strategies.

The evolution of these models reveals the central government's rising concerns for the quality of the urban environment and urban life. These concepts of the model city include the National Civilized City (1980), the National Hygienic City (1990), the National Garden City (1992), the Ecological Demonstration Zone (1994), the Healthy City (1994), the National Environmental Protection Model City (1997), the Ecological City (2003), the National Ecological Garden City (2004), the Livable City (2005), the Low-Carbon City (2008), the Sponge City (2012), and the Double-Repaired City (including Ecological Restoration and Urban Regeneration, 2015) (Table 1, Zhao, 2011). These models increasingly emphasize the integration of ecological rationale in economic and social development in order to support the national political goal of building a "beautiful China" and an "ecological civilization." Accordingly, later models increasingly deemphasize growth while prioritizing resource efficiency, energy saving, pollution mitigation, and ecological restoration as a crucial way to support economic, political, cultural, and social development.

Table 1. China's models of the Sustainable City promoted since its economic reform began in 1978

Year Introduced	China's Models of the Sustainable City	Institution for Policy Implementation
1980	the National Civilized City	Spiritual Civilization Development Steering Commission
1990	the National Hygienic City	National Patriotic Health Campaign Committee
1992	the National Garden City	Ministry of Housing and Urban-Rural Development
1994	the Healthy City	National Patriotic Health Campaign Committee
1994	the Ecological Demonstration Zone	State Environmental Protection Administration *
1997	the National Environmental Protection Model City	State Environmental Protection Administration *
2003	the Ecological City	State Environmental Protection Administration *
2004	the National Ecological Garden City	Ministry of Housing and Urban-Rural Development
2005	the Livable City	Ministry of Housing and Urban-Rural Development
2008	the Low-Carbon City	National Development and Reform Commission
2012	the Sponge City	Ministry of Housing and Urban-Rural Development
2015	the Double-Repaired City	Ministry of Housing and Urban-Rural Development

* The State Environmental Protection Administration was reformed as a department of the State Council of the People's Republic of China in 2008, named the Ministry of Environmental Protection in 2008. The latter was further reformed as the Ministry of Ecology and Environment in 2018.

In particular, the goal of the Ecological Demonstration Zone and later the Ecological City (including municipalities, counties, and districts) aligned with those of global sustainable development. The fundamental objective of this program was "to rationally organize and actively promote the coordinated development of the regional social economy and environmental protection, thus setting up a virtuous circle of the economic–social–natural complex ecosystem to achieve rational exploitation of natural resources and improvements of the ecological environment at the same time as ensuring socioeconomic development and meeting the growing material and cultural needs of the people" (Zhao, 2011). The assessment of Ecological Cities was based on a quantitative evaluation of economic growth indicators, ecological environment protection indicators, and social progress

indicators. In the last two decades, China saw emerging innovation in urban development that sought to shift the prevalent, growth-machine-like urbanization toward a low-carbon, environmentally sustainable path. Building eco-cities had once become China's most high-profile, comprehensive experiments nationwide. China's eleventh and twelfth Five-Year Plans (2006-2015) designate eco-cities as the key mechanism to transform economic production and urban development to build an environmentally, economically, and socially harmonious society (Williams, 2017).

Building upon the initial eco-city initiatives, China's eco-strategies for urban development have continued evolving to incorporate low-carbon technologies and green city planning. In 2008, China's National Development and Reform Commission and the World Wildlife Fund for Nature (WWF) jointly designated Shanghai and Baoding as testing grounds for low-carbon cities. This initiative heralded China's nationwide attempts to build low-carbon cities and districts. In 2010, the National State Council announced a list of low-carbon cities, which would test key strategies to tackle challenges of climate change. Low-carbon development entails the utilization of renewable and clean energy, the adoption of technologies that allow for clean-energy transitions, as well as green city planning. The latter mainly includes building a green economy (which necessitates industrial upgrading), promoting green transportation, constructing green buildings, and fostering green consumption (among individuals) (NDRC, 2015). In 2012, dialogues about low-carbon cities expanded to include the concept of the Sponge City, which was initially introduced to promote low-impact development and green infrastructure. In 2015, after officially designating sponge cities across China, the Ministry of Housing and Urban-Rural Development (MOHURD) designated Sanya as a model sponge city. Sanya has also carried out ecological restoration during its urban regeneration. Its practice heralded the approach of the Double-Repaired City (*chengshi shuangxiu*, meaning to restore ecosystems and regenerate the city in parallel)—a design and planning approach that has originated in the field of Landscape Urbanism. These evolving models signify China's green transitions in city making. Cities have increasingly become the main innovators of green urbanization, which carry the mission of conceiving and implementing experimental eco-developments. Today, numerous "eco," "low-carbon," and "smart" strategies for environmental protection, pollution mitigation, climate change adaptation, and green technology integration have been incorporated into the design and planning of Chinese cities.

Linking China's Ecological City with Sustainable Development

China's earliest promotion of ecological, low-carbon cities has followed the popularization of pro-environmental concepts such as sustainable development and the eco-city. The concept of the eco-city is a sub-concept of sustainable development and has been operationalized as a comprehensive and transferable model for urbanization in developing countries.

The concept of the eco-city emerged from the growing awareness of environmental limits during the 1960s and 1970s. The term was first coined by Richard Register, an architect and environmentalist, in 1987 (the same year when the Brundtland Report was released) and was defined as "an urban environmental system in which input (of resources) and output (of waste) are minimized" (Register, 1987). Eco-city initiatives in the 1990s adopted sustainable development goals under a tripartite framework entailing economic, environmental, and social factors. The popularization of sustainable

development and eco-cities altered the pessimistic environmentalist discourse of the 1970s (McManus, 1996), since these concepts suggest positive linkages between economic growth, environmental protection, and social equity. Such a notion is aligned with the theory of ecological modernization, which regards environmental degradation as an impetus for growth and promises that technological innovation can solve environmental problems in urban development (Dryzek, 2005; Hajer, 1997; Kirkby, 1995; Myllylä & Kuvaja, 2005). Accordingly, today's eco-city projects rely heavily on technical solutions to achieve sustainability goals (Downton, 2009; Joss & Mol, 2013; World Bank, 2009). They bear the promise of transcending ecological constraints and achieve environmental, economic, and social objectives.

As mentioned earlier in this chapter, the 1992 Earth Summit led to a period of local and national experimentation with sustainable development. Many projects demonstrating sustainable development were carried out under the banner of the eco-city. They were heavily subsidized by national or even supranational governments, and were conceived to be demonstrative, pioneering, and innovative (Williams, 2017). Within the two decades following the 1992 Summit, various eco-cities had been planned or built across the globe in countries such as the United States, the United Kingdom, Spain, Dubai, Jordan, Singapore, India, South Korea, Japan, and China. These eco-city projects were high-profile among political and professional networks and in media reports during the 1990s and early 2000s. They popularized the adoption of sustainable principles in urban development across the world. Building eco-cities has become a global phenomenon. It has become both a powerful way to indicate a commitment to sustainability and a way to differentiate a particular development in a competitive environment (Rapoport, 2014).

However, the widespread adoption of the term "eco-city" in urban development has led to a great variety of meanings associated with it and the consequent confusion about its definition (Williams, 2017). The lack of a clear definition of the eco-city has also drawn skepticism toward its value. Different eco-city initiatives around the world have sought to address this issue by establishing standards and sets of indicators to evaluate progress and measure the sustainability of a project (Ecocity Builders, 2011; Keeton, 2011). Yet the selection of the indicators and their measurements varies greatly. Projects adopting eco-city principles range from new developments, expansions of urban areas, to urban renewal (Joss, 2011). The diversity of the definition, application, and evaluation of eco-city projects has reinforced the challenge of such initiatives. Today, the eco-city has become an umbrella concept with no single accepted definition. Nevertheless, The term remains frequently used to encompasses diverse, environmentally progressive urban developments. The unflagging explorations of eco-city projects have fueled the enthusiasm for environmentally conscious urban practices and policymaking in the developing world. The most ambitious eco-city developments have been carried out in Asia (Joss & Mol, 2013; Williams, 2017).

In particular, China is at the forefront of such developmental experiments. So far, China's eco-city programs and projects have emerged both through centralized enactment of formal programs and through local initiatives conceived and implemented in a piecemeal, poorly defined manner. As a result, eco-cities in China vary greatly: For example, some carry a formal label designated by the top yet appear to be a generic city with limited pro-environmental measures, while others lack a formal

recognition yet have demonstrated tangible progress in greening the built environment, the infrastructure, the economy, and lifestyles. Despite the conceptual and definitional chaos, China has built some of the world's largest eco-cities. Official reports of these projects are mostly incomprehensive and outdated, failing to present the actual performance of these places. Chapter Three is intended to illuminate China's eco-city projects and will introduce some of China's most known model eco-cities.

The following sections introduce the methodology and research design for this study as well as the structure of this dissertation.

Methodology

This dissertation exemplifies research in the trans-territorial interaction of ideology, praxis, and policy, as well as their context-specific influences. I view nature and the built environment as both the infrastructure and change agency of human societies. Hence, the examination of eco-developments involves discourse about design, planning, policy, politics, and society. The dynamic interactions between the aforementioned dimensions must be examined in relation to time and broader societal trends occurring at the time. The goal is to weigh up the pros and cons of an emerging societal transformation and uncover conflicted and conflicting ideas and values underlying existing institutions that hinder pro-environmental reforms.

In China, eco-developments have been conceived, implemented, and adjusted as essential forces driving processes of urbanization, industrialization, and modernization. Industrial transformation is viewed as a disruptive force in Western societies historically due to its impacts on the economy, social structure, politics, and culture (Clarkson, 1985; Pula, 2017). Urbanization is viewed as processes that facilitate industrialization (Gollin et al., 2016). In modern history since the start of industrialization, eco-environmental approaches to urbanization have been everchanging. An eco-development, whether growing or declining, has become an inseparable part of an evolving city. Current discourses about past experiments, such as eco- and low-carbon cities, paint a generalized view that regards each development as a singular, standalone project that has been concluded in a close-ended, controlled, and definitive process. In reality, each eco-development involves plural, open-ended, and iterative processes that adapt to broader physical, socioeconomic, and political changes over a long period of time. While various ecological and environmental concepts, norms, and practices have become more sophisticated and increasingly institutionalized in developed countries, their application to urbanization in developing countries is still being explored and often constituted in an *ad hoc* matter. With rapid social and political transformations in the biggest emerging economies, the processes and impacts of their eco-experimentation have been poorly documented and hence obscured by the lack of information accuracy and transparency. A generalized critique glosses over the various ways of how eco-environmental rationality has been operationalized in specific sociopolitical contexts. It also neglects the intricacy in reasons causing mistakes, the adjustments after initial experiments, and the connection between the experiments and broader institutional and cultural changes.

The Chinese state has initiated a series of eco-developments as model urbanization projects which are built on the idea of growing the city in harmony with nature and which are conceived as replicable paradigms for urbanization and concomitant modernization. This study investigates four

early, nationally promoted eco-cities as background cases and two award-winning local developments—Zhengdong New District and Tangshan Nanhu Eco-City—as focused case studies (Figure 1). Located in China's underdeveloped regions awaiting economic and social transitions, China's earliest eco-cities represent a top-down, technocratic, and deterministic approach to imposing a one-size-fits-all, universal model of sustainable development. In comparison, Zhengdong represents a retentive, modernistic approach to greening urbanization, whereas Nanhu exemplifies a restorative, landscape approach to revitalize post-industrial development. While the earliest eco-cities have mostly failed to engender either economic growth or significant, tangible effects on greening urbanization, Zhengdong and Nanhu, although locally conceived, have grown in reputation as phenomenal eco-developments that have generated tangible achievements in greening their built environment and cultures while greening local economies and governance. This study assesses the aforementioned projects synchronically and compares their major strategies and development outcomes to illuminate the interaction between ecological worldviews and the local political economy. Examining the projects in parallel reveals the social, cultural, and political impacts, as well as the evolution, of China's approaches to greening its urbanization.

This study focuses on China for the reason that some of the world's most ambitious eco-developments have been carried out in China as a way to improve the country's urbanization. With increasing globalization, China has been eager to learn from abroad and to develop into a rising power in both economic and environmental domains on the global stage. China provides a unique case for examining the interplay between eco-environmental worldviews and local politics. The research design is informed by grounded theories, which are influential either to the "understanding" of decision-makers or to their "direct action" (Strauss & Corbin, 1975, p. 281). This study aims at the conceptualization of plausible relationships among various elements of eco-development, perceived as economic, social, and environmental elements and considered in urban planning and design strategies (Charmaz & Belgrave, 2015; Corbin et al., 2008). The study invites ethical reflections on interactions between the environment and human society and engages normative debates about innovating urban interventions with eco-environmental rationality.

This work is grounded in in-depth case studies that reveal insights with enduring significance about a broader society (Gerring, 2004; Meyer, 2001; Yin, 1994). Case studies are the preferred method for answering "how" and "why" questions, when we have little control over processes and connections and when we focus on imperative but incompletely comprehended phenomena in real-life contexts (Peattie, 1983; Yin, 1994). Case study-based research is often inductive in nature and can reveal nuance and intricacy with continuous rejection and generation of hypotheses (Kidder & Fine, 1987; Mukhija, 2010). Critics of case study research raise concerns of both internal validity—the ability to interpret causality—and external validity—the ability to generalize findings (Meyer, 2001). Case study researchers address the concerns by immersing in the literature, adding depth and richness to the narrative, and by subdividing a single unit into multiple observations (Mukhija, 2010). I adopt these strategies and focus on the single unit of China's eco-development but employ four background cases and two focused cases to represent various formats of eco-development in the transitioning regions within China. The selected cases exemplify unique, and politically and culturally influential, projects during a phase of rapid transformations of China's built environment, economy, society, and related development policy. The selected cases, although all incomplete, exemplify variegated and critical moments of China's path to greening its urbanization.

While controlling for the geopolitical conditions at the national scale, I have adopted the "within-case" strategy which allows for greater latitude in generalizing findings (Ayres et al., 2003; Gerring,

2004, 2007; Mills et al., 2010). The extended case method allows researchers to analyze a particular social situation in relation to the broader social forces shaping it, building the "macro foundations of a microsociology" (Burawoy, 1998; Burawoy et al., 1991). It searches for "societal significance" rather than "statistical significance" by telling us about "society as a whole" rather than about "the population of similar cases" (Burawoy et al., 1991). Acknowledging the fact that the single, representative case of complex societal phenomena often does not exist, Small (2009) suggests extending the extended case method, by using unique or deviant cases to improve on existing theories and pursue alternative epistemological assumptions. This approach generates case-based logic rather than sample-based statistical inference, and aims for saturation rather than the representation of the research; hence, it produces more logically sensible hypotheses and more transparent types of empirical statements (Small, 2009).

I blur the boundary between representative and unique cases by choosing unique cases with elements that represent eco-developments. The selected cases are unique scenarios of development that have been carried out to represent a type of practice. My conceptualization of these examples adopts the extended case method, which raises "reflexive understanding" of existing practices to the "level of explicit consciousness" in order to comprehend "the social processes and their wider context of determination" (Burawoy, 1998, 2009). The extended case method "extracts the general from the unique, moves from the 'micro' to the 'macro,' and connects the present to the past in anticipation of the future, all by building on preexisting theory" (Burawoy, 1998). I extend my observations "over space and time" and out "from process to force" (Burawoy, 1998).

Data collection for this study has relied heavily on archival research, direct observations, in-depth elite interviews, and randomized citizen interviews to reach information saturation. Data were collected during field trips, interviews, and ethnographic work which occurred between 2016 and 2021. I established contacts with both governmental and educational institutions and interviewed key designers, planners, and officials of the selected cases. I traveled to these areas in China, conducted spatial analysis, and interviewed major decision-makers and stakeholders. In particular, I adopted an ethnographic approach and spent a month exploring Zhengdong New District and another exploring Nanhu Eco-City. I attended local meetings in governmental offices, participated in local events, experienced daily life, interviewed residents, and distributed questionnaires in the central areas of the two focused cases. I also spent a month traveling to other cities to visit high-profile eco-cities, attend national and regional academic and political conferences on green urbanization, and interviewed key decision-makers about China's eco-development and green transitions. In total, I conducted 68 one-to-three-hour-long, in-depth interviews and received 100 questionnaire responses in Zhengdong and Nanhu, respectively. While conducting interviews and critical discourse analysis, I considered the power dynamics at play and acknowledged the implicit biases underlying each individual's opinions. In order to improve internal validity—the ability to interpret causality—and external validity—the ability to generalize findings, I triangulated data sources to add depth and richness of the narrative and to put individuals' opinions in perspective.

The fieldwork and interviews for the two focused cases have been carried out mainly in 2019 and 2020. The study, especially the assessment of the eco-developments, has been limited by data availability and transparency in China. Data accessibility was further challenged by the rising political tensions between China and the U.S. during this period. There are a few aspects limiting data availability and, hence, the scope of the study: First, local authorities in China had signed agreements to protect GIS data as classified information, which made it very difficult, if not impossible, to acquire data about an entire eco-development. Second, each development involved numerous

developers, investors, and design and planning institutes who worked on different patches of the development at different times. The fragmented and plural processes, plus the lack of sophisticated monitoring and evaluation systems, had led to the lack of accurate, comprehensive data on the actual physical, environmental, and socioeconomic changes of an eco-development. Third, even if certain data had been published or openly accessible, the statistics were often controlled, and even manipulated, by the state or a development agency. Hence, the numbers bore biases and lack credibility. For example, local environmental scientists confessed that the air quality data from the central state-installed systems and data from the local state-installed systems were barely comparable due to technical differences built in the different sets of equipment. Similarly, water quality data were largely contingent on which assessment agency carried out the quality test in which part of the city. In addition, the impact of an eco-development on the quality of water and air could hardly be measured directly within a changing district since the ecosystems extend beyond the geographic territory of a district and are connected and interacting with much broader ecological and urban systems. Therefore, the assessment of ecological and environmental change had been largely missing, or limited in scope, in China as of 2020. Although it would be very important to carry out rigorous scientific studies to generate primary data on the ecological and environmental changes in these districts, cities, and regions undergoing "green" transformations, such studies are not the focus of this dissertation.

Rather than generating assessment based on ecological and environmental sciences, this dissertation focuses on assessing the societal and political significance of China's phenomenal experiments of eco-development in order to reveal the interactions between changes of the built environment and ideological, cultural, and institutional transformations. The goal is to connect China's experiences with broader debates about the evolution of developmental mindsets that incorporate eco-environmental rationality, and to illuminate policy trends that would shape the next phase of urbanization in China and other developing countries. To do so, this dissertation is grounded in extensive literature review on China's development history, as well as the reflections and opinions of eco-development builders and residents collected during interviews, surveys, and ethnographic work on site. The perspectives from key decision-makers and residents, and the saturation of information from their discourse, not only suggest the political value and cultural meaning of China's evolving eco-experimentation but also point to the neglected dimensions of China's current effort on greening its urbanization. While environmental planning and scientific monitoring had been largely incipient in China as of 2020, China's enthusiasm in advancing the development of technology, aesthetics, modernization, and political competitiveness through greening its built environment and urban culture remains an important foundation of its subsequent environmental endeavors. Moreover, what is worth noting is that the dissertation does not focus on a single, top-down program of the Ecological City initiated by the central government. This is due to the fact that most designated, nominal ecological cities in China have made little or no effort to change their business-as-usual in development or governance. In contrast, some of the most influential eco-developments in China so far were not initially labeled by the top as an ecological zone/district/city. Therefore, this study presents China's various and piecemeal attempts at greening its development through synthesizing policy discourse and public perceptions in order to paint a broader picture of the ecological transformations in China's planning and design culture, policy, and practice.

Figure 1. Selected Cases for Study
(map by author)

Case Selection

China is a country with a culture of uniformity, yet it is full of contradictions. China's urban transformation has occurred with industrialization and led to a growing regional imbalance (Friedmann, 2005) (Figure 1; Table 2). As a developing country aspiring to continue its urbanization, the experimentation of eco-development in China has become a movement that is physically and ideologically reshaping China. Although this movement has disseminated eco-environmental ideas across the country, China remains a melting pot of complex local conditions and policy responses. In order to exhibit various approaches to eco-experiments of China's urban development, I select high-profile eco-developments in major economic regions in China and reveal the variations and impacts of eco-environmental approaches in localized contexts. I draw cases that were initiated (and main built) during the first decade of the twenty-first century, when urbanization was China's top priority and explorations of green development approaches surged. This period saw a drastic real estate boom, increasing foreign investment, growing market demand for improved quality of urban life, and heightened intercity rivalries to globalize. Influenced by international discourses about

sustainable development, China's urbanization boom occurred in tandem with a surge of eco-environmental experiments in urban development and policymaking.

China's economic geography features four major regions (NBSC, 2011) (Figure 2):

- Northeast China, a shrinking region with a central plan to *Revitalize Old Industrial Bases in the Northeast;*
- East China, China's coastal region with a tremendous economic boom and population increase;
- Central China, a region of economic stagnation and the target of the *Rise of Central China* plan;
- West China, the least developed area in China and the target of westward development plans.

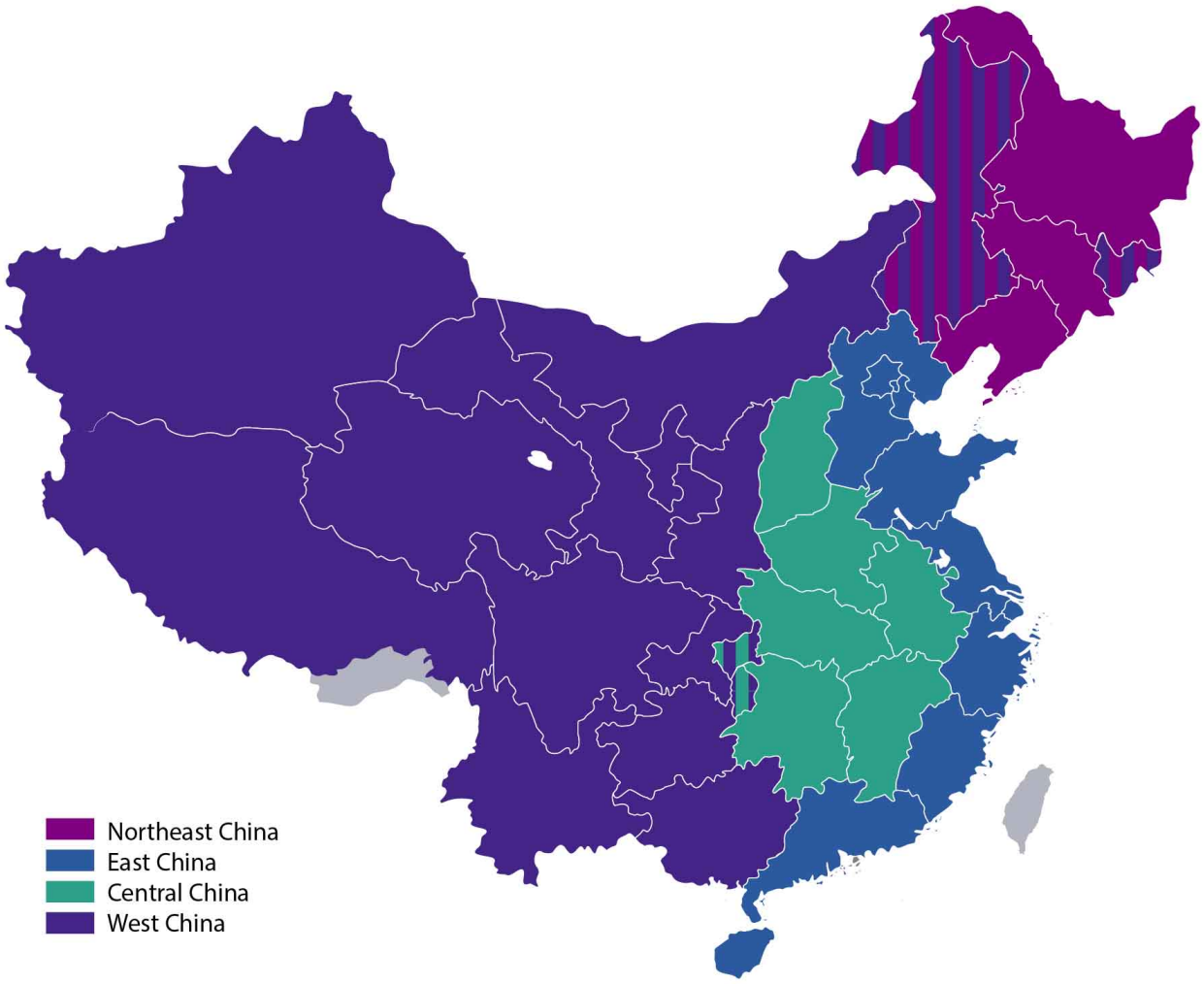

Figure 2. Geographical breakdown of the four economic regions in China.
(Source: Wikipedia.org)

Preceding its golden decade of real estate boom and urban sprawl, China could be divided into eight regions (NDRC, 2003) (Table 2):

Table 2. The Eight Socio-Economic Regions in Mainland China (based on statistics as of 2002)

Region	Included Provincial-Level Jurisdictions	Land Area (km^2)	Population (by the end of 2001)	Main Characteristics
Northeast China	Liaoning Jilin Heilongjiang	790,000	106,960,000	Old industrial bases, population, and economic decline
Northeast Coast	Beijing Tianjin Hebei Shandong	370,000	181,270,000	The Jing-Jin-Ji Region, the political center
East Coast	Shanghai Jiangsu Zhejiang	210,000	135,820,000	The Yangtze River Delta Region, a pioneering region in modernization and economic liberalization, highest population density, and most affluent region in China, abound with human capital
Southeast Coast	Fujian Guangdong Hainan	330,000	120,190,000	The Pearl River Delta Region, the most open region to foreign investment, adjacent to Hongkong, Macau, and Taiwan
The Middle Reach of the Yellow River	Shaanxi Shanxi Henan Inner Mongolia	1,600,000	188,630,000	Abound with natural resources such as coal and natural gas, stagnant economic growth
The Middle Reach of the Yangtze River	Hubei Hunan Jiangxi Anhui	680,000	230,850,000	Suitable for agricultural development, stagnant economic growth
Southwest China	Yunan Guizhou Sichuan Chongqing Guangxi	1,340,000	246,110,000	Remote from urbanized regions, low infertility of the land, great populations suffers from poverty
Northwest China	Gansu Qinghai Ningxia	3,980,000	58,000,000	Least developed regions in China, low population density, low fertility of the land

	Tibet Xinjiang

China's most high-profile eco-developments, with the strongest political and economic supports, are located mainly along the East Coast and in some cases in Central China. I selected the cases based on listed below:

Criteria of Selection	**Descriptions of the Criteria**
Geographic location	Represent a major urbanizing region
Project initiation	Between 2000 and 2010
Current status	Ongoing, with a major portion completed Possibly undergoing a period of adjustments
Principles of planning and design	Self-proclaimed to be an eco- or low-carbon development Include comprehensive urban programs Highlight ecological design Attempt to mitigate environmental impact
Objectives of development	Planned as a new area to accommodate future urban growth Planned as a motor for the future of the city/region
Development actors	State-initiated development
Planning and design agencies	In collaboration with international designers and planners
Public and private partnership	New approaches to incentivize the private sector
Political promotion and branding	High-profile, internationally well-known A demonstration and/or a rule-setter A pioneer of eco-environmental principles
Saturation of scholarly and media interests	Frequently mentioned in online news and scholarly publications
Recommendation from experts	Recommended by experienced practitioners and scholars during preliminary interviews

The following table, although not meant to be exhaustive, includes the most important cases based on the abovementioned criteria. These projects have been China's frontiers of establishing an ecological culture in key development regions undergoing socioeconomic transitions.

Region	**Project Name**	**Start**	**Main Characteristics**
Northeast Coast/ Jing-Jin-Ji Region	Caofeidian Eco-City, Tangshan, Hebei	2008	Developed through the collaboration between the Chinese and the Swedish governments Planned as a techno-city Incorporate advanced green technologies in the urban systems Informed by principles of sustainable cities in Europe Based on a framework with 141 eco-city indicators
Northeast Coast/ Jing-Jin-Ji Region	Nanhu Eco-City, Tangshan, Hebei	2008	Ecological restoration of former coal mining sites Include the "central park" near the old urban center Include an area of land subsidence Informed by principles of ecological urbanism in the U.S. International award-winning design
Northeast Coast/ Jing-Jin-Ji Region	Sino-Singapore Tianjin Eco-City	2007	Regarded as the most successful eco-city in China A joint venture between the national governments of China and Singapore Informed by principles of sustainable cities in Singapore Based on 26 key performance Indicators A role model for subsequent eco-developments
East Coast/ Yangtze River Delta Region	Dongtan Eco-City/ Chongming Eco-Island, Shanghai	2005	First eco-city proposed in China Envisioned to be a zero-carbon community The original plan was never implemented but became a role model for future eco-cities Shanghai municipal government continued the development and implemented a revised plan of Chongming Eco-Island
Southeast Coast/ Pearl River Delta Region	Shenzhen International Low-Carbon City	2008	Located in the Shenzhen Special Economic Zone Planned by China's National Development Research Center and Shenzhen municipal government as a potential international model of eco and low carbon cities Envisioned as a "living laboratory" to attract young and talented engineers, experts, and professionals Designed in collaboration with Dutch planners
Southeast Coast/	Shenzhen Qianhai Water City / Qianhai	2010	Located in the Shenzhen Special Economic Zone

Pearl River Delta Region	Shenzhen-Hong Kong Modern Service Industry Cooperation Zone		Planned by China's National Development Research Center and Shenzhen municipal government Built on reclaimed land James Corner Field Operations won the design competition The design scheme features "five fingers" which are both the new ecology and new cultural grounds Pilot zones are constructed as demonstrations
Southeast Coast/ Pearl River Delta Region	Shenzhen Guangming District	2007	Planned as a new area for high-tech industries Utilize cleaner energy sources China's pilot area for Sponge City development Incorporate green infrastructure and strategies of ecological restoration
Central China/ The Middle Reach of the Yellow River	Longhu Eco-District, Zhengdong New Area, Zhengzhou, Henan	2001	Incorporate principles of metabolic and symbiotic urbanism Create ecosystems as the green infrastructure of the city Promote high-tech industries and cleaner energy sources International award-winning design

The Focused Cases

China's "golden decade" of real estate development saw a surge of urban construction.[2] At the start of this period, building housing was the quickest, most lucrative investment for both local governments and developers. Cities were growing in an uncoordinated manner. Typical urban developments featured a functionalist approach that maximized profitable building areas. Market competition quickly heightened, leading to diversifying branding strategies for private development. Patchwork construction was evident in most cities, leading to unevenly developed cities and regions across China. While cities were learning by doing, local states faced intensifying competition for resources and attractiveness. Their leaders actively sought growth strategies that transcended a utilitarian focus to incorporate considerations of building and environmental aesthetics. This shift promoted urban greening in local practices, although "greening" was largely limited to adding ornamental elements to buildings or constructing piecemeal green spaces in enclosed parcels.

During the same period, China's nationwide eco-city movement emerged with the intention to search for comprehensive and sustainable growth strategies. In parallel with the nation's high-profile eco-city initiatives, local eco-developments were on the increase. Some projects were initiated by cities that were eager to experiment with new directions of urban transformation for their regions. Their builders claimed to have developed locally integrated ecological strategies based on internationally recognized planning and design strategies. These eco-developments were less known at the start but have gradually gained a reputation with their continual development. Today, they are

[2] According to experienced Chinese developers, the "golden decade" of China's real estate boom is roughly from 2002 to 2012.

discussed as "successful" precedents both domestically and internationally. This chapter introduces two award-winning cases—Zhengdong New Area (Zhengdong) in the City of Zhengzhou in Henan Province and Nanhu Eco-city (Nanhu) in the City of Tangshan in Hebei Province. Zhengdong and Nanhu have been widely praised by Chinese media, officials, and practitioners for their achievements. Zhengdong is one of the earliest new cities in China to be built, mostly in greenfields, based on principles of ecological design and metabolic planning. It has received consistent and strong political support and is regarded as one of the most economically successful new cities in China. Nanhu is located in Tangshan, one of China's earliest industrial cities, and was rebuilt after the 1976 earthquake. Nanhu's development emphasizes the revitalization of Tangshan's old urban center through ecological restoration in brownfields. Both cases were unique at their time of initiation but their approaches have sprouted across China. Each of them represents a type of eco-development in China, especially in cities transitioning towards new economies and new identities. Zhengdong represents urban expansion based on ecological modernization in an emerging urban center, while Nanhu represents urban redevelopment through ecological restoration in a post-industrial urban core. The proclaimed "successes" of the two projects are presented in three aspects: ecological design, implementation strategies, and claimed achievements. The limitations and potentials of the two cases' experiences add diversity and nuance to dialogues about China's eco-exprimentation in urbanization.

Structure of the Dissertation

The dissertation includes seven chapters. The structure is as follows:

Chapter One introduces the premise of the dissertation, study background, and methodology.

Chapter Two is a literature review of key concepts and theories that promote eco-environmental rationality in design, planning, and development. The chapter discusses the concept of sustainable development and its increasing importance in an era of globalization, then engages the discourse about ecological modernization and regenerative development in post-industrial societies. Debates about these concepts and practices are linked with the historical evolution of different cultures of nature, ecological philosophies, and changing views of the human-environment relationship. The chapter also introduces major debates about environmentalism and draws on critiques in social and political ecology to present the call for systemic change according to ecologism. Building on Western debates about ecological rationality, this chapter introduces the meaning of ecology in China's science and policy domain and sets a historical and theoretical foundation for subsequent chapters.

Chapter Three examines four of China's earliest, high-profile eco-cities which symbolize China's rush to globalize with rising eco-ambition. When sustainable development was first proposed in 1987, the goal was to curb growth and reduce carbon emissions. However, in developing countries, growth remains of paramount importance. Continuing urbanization and reducing environmental impact seems to be a real contradiction. The eco-city model has been proposed to address this paradox. As of today, the world's largest, most ambitious eco-cities have been built in China. Despite the branding of their ecological innovation, eco-developments are driven as much by economic and political objectives as by environmental ones. This underlines the need to study eco-cities and similar projects within the political and economic contexts in which they are developed.

Synthesizing findings from literature review, site visits, and in-depth interviews with local planners and officials, this chapter presents major critiques from international scholars, as well as reflections from China's eco-city builders. The investigation of the early eco-cities reveals key reasons behind their failures. It serves as the foundation for the following chapters about "success" cases.

Chapters Four and Five present two award-winning eco-developments—Zhengdong New District in the City of Zhengzhou in Henan Province and Nanhu Eco-city in the City of Tangshan in Hebei Province. Zhengdong and Nanhu have been widely praised by Chinese media, officials, and practitioners for their achievements. Zhengdong is one of the earliest new cities in China to be built, mostly in greenfields, based on principles of ecological design and metabolic planning. It has received consistent and strong political support and is regarded as one of the most economically successful new cities in China. Nanhu is located in Tangshan, one of China's earliest industrial cities, and was rebuilt after the 1976 earthquake. Nanhu's development emphasizes the revitalization of Tangshan's old urban center through ecological restoration in brownfields. Both cases were unique at their time of initiation. Each of them represents a type of eco-development in China, especially in cities transitioning towards new economies and new identities. Zhengdong represents urban expansion based on ecological modernization in an emerging urban center, while Nanhu represents urban redevelopment through ecological restoration in a post-industrial urban core. The chapter introduces the two cases' development trajectories and highlights three aspects: ecological design ideas, implementation strategies, and claimed achievements. Although these two projects were initially conceived to fulfill local developmental needs in two cities undergoing post-industrial transitions, they have risen nationally and even internationally with a reputation of success, setting practical paradigms for greening urbanization and promoting sustainable development in transitional cities. Their tangible achievements—especially the continued implementation and the realization of an ecological environment—have helped to reinforce their reputation as paradigms of ecological transitions. Their approaches to urbanization are emulated and reinvented in subsequent developments, engendering continued experimentation of eco-development.

Chapters Six compares the cases examined in the foregoing chapters to reveal the evolution and limitation of China's attempts at greening its urbanization. This chapter suggests that China's eco-developments have inspired local officials and practitioners to change their "business as usual." By adopting various ecological designs and green technologies in these projects, the Chinese state has explored new ways to alter conventional urbanization approaches. While China's typical urbanization greatly focused on territorial expansion and GDP growth, these eco-developments showcase China's emerging attempts at engineering physical, social, and environmental transformations in tandem. These projects alone, especially their partial, piecemeal achievements, are far from being sufficient in mitigating environmental degradation during China's urbanization. Nevertheless, they exemplify China's once most promoted approaches to greening its urbanization. Such approaches continue generating impact as these places continue their development. Depicted by China's slogan "let the bullets fly," more eco-developments have been proposed across China and their formats have begun diversifying.

Finally, Chapter Seven discusses the continuation of China's eco-experimentation which has seeded environmentalism in urban practice and policymaking in the country. While China's experimentation of eco-developments so far has largely been constrained by a phase of growth-oriented urbanization, the continuation and upscaling of attempts at greening urbanization has achieved partial success. This chapter argues that China's limited success in its demonstration projects has been enabling by

generating momentum for broader, more systemic, and more fundamental changes of developmental rationality. Local trial-and-error has prepared China's political and professional communities for emerging environmentalism in the next phase of urbanization. The chapter illuminates the meaning of partial success in China's eco-experimentation, present lessons learned by eco-development builders, and reflect on what being "eco" means to China and what eco-experimentation means to China's future urbanization.

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Chapter Two: The Eco-Environmental Rationality in Planning, Design, and Development

This chapter reviews key concepts and theories that promote eco-environmental rationality in design, planning, and development. The following sections first introduce the concept of sustainable development and its increasing importance to China's urban sector in an era of globalization, then connects the concept of sustainable development with the discourse about ecological modernization. The latter can be considered a more narrowly defined concept for promoting sustainability and has generated institutional changes in processes of greening urban policy and practice across the globe, including China. The chapter then moves on to examine sustainable development in post-industrial societies, especially in practices with a regenerative approach. Debates about these concepts and practices are further linked with the historical evolution of different cultures of nature, ecological philosophies, and changing views of the human-environment relationship. The chapter then introduces major debates about environmentalism and draws on critiques in social and political ecology to present the call for systemic change according to ecologism. Building on Western debates about ecological rationality, this chapter introduces the meaning of ecology in China's science and policy domain. The literature included in this chapter sets a foundation for subsequent discussions about China's eco-developments and their impacts in practice and policymaking.

Sustainability-Inspired Concepts of Development

The concept of sustainable development has been central to contemporary sociopolitical debates about environmental issues. While studies in natural and social sciences have examined the sustenance base of modern societies and their institutional developments that have led to environmental problems, theories and principles from such studies have inspired paradigms for development and policy in industrializing societies. With the rise of industrialization and globalization in the world, there has been a growing consensus that sustainable development is a valid concept for overcoming the ecological and environmental crisis that human societies are facing. Since the United Nations introduced sustainable development in the late 1980s, it has become one of the most well-known and most influential concepts of rethinking development, receiving policy recognition globally (Barton, 2013; Rydin, 2012; Wheeler & Beatley, 2014). Accordingly, the notion of "triple bottom line," which stresses the codependence of environmental, economic, and social dimensions of urban development, has become a core principle for pro-environmental practice and policymaking.

However, sustainable development remains a vague concept that allows many interpretations. Building on the concept of sustainable development, a series of concepts for improving urbanization have entered urban policy discourse, establishing paradigms of sustainable development. These concepts—including sustainable cities, green cities, eco-cities, low-carbon cities, resilient cities, digital cities, smart cities, intelligent cities, information cities, knowledge cities, and livable cities—share the goals of upgrading urban infrastructure and services while improving environmental, social, and economic conditions of a city in tandem (de Jong et al., 2015). In practice, these concepts are sometimes used in combination or interchangeably by policymakers, planners, and developers.

Increasing development initiatives that seek to enhance a city's attractiveness and competitiveness have adopted these concepts during an era of rising globalization. However, it is unclear whether these concepts embody distinct theories and conceptual perspectives. The ways in which each concept is operationalized and applied in policy and practice remain chaotic (Roggema, 2016). Among these concepts, while the "sustainable city" remains the most frequently used term in policy and academic discourse, concepts such as "eco-cities," "green cities," and "smart cities" have become increasingly prevalent and even used in combination (such as eco-smart cities) in urban modernization policy (Cugurullo, 2018; de Jong et al., 2015). For example, the French city Grenoble embarked on an ÉcoQuartiers initiative that focused on sustainable development through technological innovation and socioeconomic development (Gaudart, 2018; Rudolph, 2020). Melbourne in Australia combined initiatives of the "eco-city" and the "knowledge city" in its largest City Council Plan (2013-17) (Dvir & Pasher, 2004; Ergazakis & Metaxiotis, 2011; Melbourne City Council, 2013; Yigitcanlar et al., 2019). The Chinese and Singaporean governments collaborated to build the "knowledge city" of Guangzhou by adopting "eco-city" indicators (Crane et al., 2012; De Jong et al., 2013). These examples showcase the fuzziness in the adoption of pro-sustainability concepts and the operationalization of these concepts has been contingent on specific developmental and policy contexts (de Jong et al., 2015). Despite the confusing discourses, the diverse pro-sustainability concepts suggest repeated and continued explorations on the articulation, operationalization, and implementation of sustainable development.

With rising globalization, China has become increasingly informed about international discussions about sustainable development and pro-sustainability attempts at improving urbanization. Debates and practices of sustainable development were spotlighted in China at the 2010 World Expo in Shanghai. The Expo focused on the theme "Better City, Better Life," calling for the urgent need to improve urban planning, management, and livability. By presenting projects that had been successfully implemented and had improved quality of life, the Expo served as a platform to catalyze learning, idea exchange, and collaboration and to encourage innovative urban practices. Encompassing the culmination of ideas and debates at the Expo, the United Nations, Bureau International Des Expositions, and Shanghai municipal government co-created the *Shanghai Manual: A Guide for Sustainable Urban Development in the 21st Century (2011)*. The *Manual* adopted the concept of "harmonious cities" developed at the Shanghai Expo, defining it as aspirations to establish harmony between diverse people, between people and nature, between development and environment, and between cultural legacies and future innovations. The *Manual* also presented global debates, principles, and best practices in six themes: 1) urban governance, 2) economic transformation and urban-rural relationships, 3) information and communication technologies and urban development, 4) cultural heritage, creative cities, and urban regeneration, 5) science and technology innovation and urban futures, and 6) environmental protection and urban responsibilities.

The *Manual* listed Shanghai's declaration to build "Better City Better Life." One strategy was to establish "an Ecological Civilization Oriented toward the Future" in China's development. It stressed the concept of low-carbon eco-cities as follows:

> Cities should respect nature, consider the urban ecological environment as an asset, integrate environmental issues into urban planning and administration, and accelerate

> the transition to sustainable development. They should promote the use of renewable energy sources and build low-carbon eco-cities. They should strongly advocate for the conservation of resources and promote environment-friendly manufacturing. Cities and their citizens should join together to create sustainable lifestyles and an ecological civilization in which people and the environment co-exist in harmony (United Nations, 2011, p. 14).

In the *Manual*, the stated "respect" for nature was further linked with the use of renewable energy resources, building low-carbon eco-cities, pursuing inclusive and balanced growth, and preserving an optimal relationship between social equity and economic efficiency. Manifesting Shanghai's commitment to building the "City of Harmony," the *Manual* serves as a resource on sustainable development by providing guidance to municipal authorities, planners, designers, and other decision-makers of city making, who were educated about their crucial roles in shaping the quality of the city and urban life (United Nations, 2011). While the 2010 Expo has greatly transformed Shanghai's infrastructure and enhanced its status on the global stage, it has also set a paradigm of advancing "glurbanization" agendas in Chinese cities (Li, 2019).

The Theory of Ecological Modernization and the Global Spread of an Ecological Rationality

Ecological modernization is another concept underlying the greening of urban policy and practice across the globe. It can be considered a more specific interpretation of the key ideas prevailing in the more general notion of sustainable development (Spaargaren & Mol, 1992). Since the late 1960s, Western industrialized societies have started the process of institutionalizing the environment in national politics and policies. This process has been examined as ecological modernization, which refers to "a restructuring of modern institutions to follow environmental interests, perspectives and rationalities" (Mol, 2006, p. 30). Some scholars argue that the central idea behind ecological modernization is the growing compatibility between environmental protection and economic growth (Hajer, 1996), or the assumption that technology is the key to modern environmental reform (Christoff, 1996; Huber, 1982; Humphrey et al., 2001). Mol (2006, p. 33) challenges these propositions and argues that the premise of ecological modernization theory is "the centripetal movement of ecological interests, ideas, and considerations within the social practices and institutional developments of modern societies." Therefore, ecological modernization promotes the reconciliation and mutual enhancement of the economy and ecology through ecology-inspired and environment-induced processes of transformation and reform of core practices and central institutions (Hajer, 1996; Mol, 2003, 2006; Mol et al., 2009). Such a process began in Europe in the 1980s and has been discussed in a series of European scholarly works that examine the evolution of industrialization and modernization. For example, Huber (1982) views ecological switch-over as a new phase in the maturation of the industrialization process. Jänicke (1993) argues that the modernization of the political processes has been facilitated by the growing importance of environmental interests and ideas. Others argue that ecological modernization is evident in transitions in the infrastructures and practices of consumption (Spaargaren & Vliet 2000) and in industrial innovations (Murphy & Gouldson, 2000). According to the theory of ecological modernization, the productive use of natural resources and ecosystems—such as improvement in

energy and resource efficiency as well as product and process innovations—can be a source of future growth and development in a similar way as through labor and capital productivity (de Jong et al., 2015). Strategies for ecological modernization often seek to reduce emissions and resource consumption and change the quality or structure of industrial production. In Western industrialized societies, environmental logic and perspectives have become crucial for understanding the development of modern cultural, political, and economic institutions (Mol, 2006). Ideas of ecological modernization have also been used by policy-makers and social scientists as useful tools in solving long-standing environmental disputes and conflicts (Spaargaren & Mol, 1992).

While the concept of ecological modernization was introduced by European scholars in the 1980s, in most Western societies, a green ideology had emerged in the 1970s or earlier (Mol, 2006). The green ideology grew into a newly independent political ideology—which was often perceived as radical, progressive, and future-oriented—in addition to old ideologies of socialism, liberalism, and conservatism (Giddens, 1994; Paehlke, 1989). The green ideology was disseminated by environmental non-governmental organizations (NGOs), environmental publications, and other "green" belief systems. By the 1980s, an ecological perspective had started to challenge the monopoly of economic rationality as the all-determining organizing principle in economics. Accordingly, economic processes of production and consumption were increasingly designed, organized, and evaluated based on both economic and environmental perspectives. This had led to institutional changes in the private sector: For instance, environmental management systems and environmental departments emerged within firms; economic valuation of environmental goods was introduced via eco-taxes; pro-environmental insurance emerged; natural resource saving and recycling became important to the competitiveness of utility enterprises; and environmental considerations were articulated in economic supply and demand chains (Mol, 2006). Meanwhile, the domains of policies and politics also saw the emergence of an ecological perspective and ecological rationality as an independent force in the 1970s and early 1980s. This trend was evinced by the establishment of governmental organizations, legal institutions, and monitoring and reporting programs for dealing with environmental issues. Later, green parties emerged in the political systems of many OECD countries[1] (N. Carter, 2007). Mol (2006) emphasized that all the environment-induced transformations were *semi-permanent institutional* changes and that these transformations and their efficiencies were not linear or irreversible. Despite the varying and changing degrees of importance of environmental issues in various domains caused by unstable "issue-attention cycle" of politics (Downs, 1972), the environment has been firmly embedded in the core institutions and social practices of modern societies in the West in the form of an "episodic transformation" that indicated a specific directionality towards pro-environmental reform (Giddens, 1986).

In Europe, the pro-environmental transformations of social practices, institutions, and ideologies have been enabled by three key factors (Mol, 2006). First, political modernization, especially the

[1] OECD stands for Organization for Economic Co-operation and Development. It is an intergovernmental economic organization with 37 member countries. It was founded in 1961 to stimulate economic progress and world trade. OECD countries are committed to advancing democracy and a market economy. The OECD provides a platform for countries to compare policy experiences, seek answers to common problems, identify good practices, and coordinate domestic and international policies of its members. OECD members are typically high-income economies with a very high Human Development Index (HDI) and are regarded as developed countries. The OECD is an official United Nations observer (Wikipedia, 2021).

modern "environmental state," has played a key role in propelling environmental institutionalization through decentralized, flexible, and consensual styles of governance, as opposed to centralized, top-down, hierarchical, and command-and-control regulation (Mol & Buttel, 2002). In such processes, non-state actors, such as businesses, NGOs, and privately governed communities, as well as international institutions have increasingly contributed to environmental protection and reform. This is connected to the second point: market agents, such as manufacturers, consumers, banks, insurance companies, the utility sector, and business associations, have increasingly become enablers of environmental improvements. They have advanced environmental goals through economic restructuring and innovation in market, monetary logic. Third, the institutionalization of environmental improvements has crystalized new ideologies and cultural frames among civil societies. As environmental considerations have increasingly become central to decision-making processes in the public and private sectors, environmental norms, values, and discourses have been spread beyond state actors, professionals, and environmental NGOs, reaching the general public (Mol, 2000; Sonnenfeld, 2002).

Although ecological modernization was typically considered a theory for Western societies before the mid-1990s, this has changed as the geographical scope of the theory's validity has grown from its origin. In 1992, the United Nations convened the Conference on Environment and Development (UNCED). This UNCED is regarded as a breakthrough in pushing for the integration of environmental protection and sustainable development into national and international policy agendas across the globe. This breakthrough has been evident in two ways: First, the 1992 UNCED has brought attention to national, international, and global environmental problems in the policy realm, resulting in institutional innovations such as the United Nations Framework Convention on Climate Change and the Biodiversity Convention. Second, the 1992 UNCED has spurred the growing institutionalization of environmental protection and sustainable development in developing countries (Mol, 2006). Since the late 1980s, a number of developing states in Southeast and East Asia, including Taiwan, South Korea, Singapore, Malaysia, Thailand, China, and Vietnam, have started their industrialization and concomitant modernization, which has been followed by accelerating processes of globalization. With growing global interdependence in political, cultural, and economic domains, new initiatives of environmental governance and reform have become increasingly global. These include environmental governance reforms and environmental management systems initiated as transnational governmental joint ventures and operated by transnational corporations in developed and developing countries. While Western OECD countries have arguably dominated globalization processes, they have also been expected to lead pro-environmental transformations in the global policy arenas. Therefore, they have exported not only economic and political institutions and mechanisms but also environmental reform models, practices, and dynamics (Mol, 2006). Accordingly, major assumptions of ecological modernization have started to be seen as applicable to environmental strategies, practices, and measures in developing countries, especially the newly industrializing economies in Asia (Frijns et al., 2000; Sonnenfeld, 2000). However, scholars continue to interrogate the West-to-East transfer of ecological modernization-inspired environmental strategies and models of environmental governance. In particular, questions have been raised regarding whether such transfer of strategies, policies, and practices can lead to their successful implementation in developing countries which have grown on the basis of political regimes, policy principles, development strategies, and state-market-civil society

relations that are inherently different from, and sometimes contrasting, those in the West. Therefore, rather than leading to "environmental homogenization" across the globe, the Eastern appropriation of environmental reform models inspired by Western ideas of ecological modernization, or sustainable development more broadly, has led to both the resemblance of core features and the variances of modes or styles of pro-environmental reform—all embedded in specific local conditions and the particular country's position in the world's power system (Mol, 2003; Sonnenfeld, 2000).

Processes, modes, and styles of ecological modernization, or sustainable development more broadly, can differ from country to country and from region to region. Although eco-environmental rationality has transferred from the West to the East, and from the developed world to newly industrializing developing countries, the appropriation of foreign perspectives, the constructs of ecological and environmental ideas, and the processes of operationalizing and institutionalizing such notions are contingent on sociopolitical dynamics, mechanisms, and actors at work in local and national contexts. In contemporary China, despite the criticism of China's deteriorating environmental quality and the Chinese state's oversight of environmental issues during its era of rapid urbanization, China's contemporary environmental reforms have been developed and accelerated during an era of globalization. Mol (2006) focused on the seeds of environmental institutionalization in transitional China and revealed the trends in environmental "additions" and "withdrawals" with rising urbanization.

China's environmental institutionalization began in the 1970s. After the 1972 United Nations Conference on Human Environment in Stockholm, China started pollution control by establishing a National Environmental Protection Office in 1974 and subsidiary offices at the provincial level. This institution was further supported by the promulgation of the National Environmental Protection Law in 1979 and accelerated during the 1990s. Since the late 1970s, China has systematically expanded its national environmental regulatory system: the National People's Congress has adopted dozens of new environmental laws, the State Council has issued over 100 executive regulations, and the State Environmental Protection Agency (SEPA) has enacted a series of sector regulations and environmental standards (Mol, 2006). The key principles of China's environmental policy have been to prevent first and then control. Polluters are supposedly responsible for pollution control and strengthening environmental management. The national environmental policy has been implemented through top-down processes—from national to provincial, municipal, and county levels. The enactment of various environmental laws and regulations was paralleled by the general increase of bureaucratic status, quality, and capacity of environmental authorities—namely, the expansion of the "environmental state" in China (Jahiel, 1998).

However, China's environmental improvements remain difficult to assess due to the widespread information distortion in environmental statistics, the lack of consistency in data presentations, and the absence of longitudinal environmental data. Scientific studies and foreign media have reported mixed results of China's environmental action. On one hand, numerous critics have condemned China for failing to control pollution. Media reports suggest that some of the world's most polluted cities are in China and the dumping of toxic human and industrial waste has led to severe water pollution in China's fluvial systems. On the other hand, some studies have reported partially positive

signs of pollution mitigation. For example, sulfur dioxide concentrations, CFC production, and carbon dioxide emissions have reportedly declined since the 1990s; the environmental industry has expanded, although on a limited scale, in China to support its economic growth; a growing number of firms have been certified with environmental standards; a growing number of heavily polluting factories have been closed (Chandler et al., 2002; Mol, 2003; The World Bank, 2001). Despite the reported partial improvements in China's air pollution control, China remains heavily polluted overall; its emissions remain far above international standards; and resource efficiencies in production and consumption remain low in general (The World Bank, 2007). China's high pollution levels—along with vast ecological degradation and rising climate risks—suggest that the country still largely lacks effective pollution mitigation measures, as well as climate change adaptation strategies.

China's initial environmental governance approach bore characteristics that reflected the legacy of its centralized command economy. Its early measures of environmental protection focused on strong intervention of the central state, restricted access to environmental information, excluded citizens from involvement, limited market participation, and lacked a response to international agreements and institutions. The Chinese state also overemphasized large-scale developments of hard technologies while neglecting the coordination among state authorities and the empowerment of environmental authorities (DeBardeleben, 2019; Lotspeich & Chen, 1997; Ziegler, 1982). Therefore, China's initial environmental governance was inefficient and ineffective in ways similar to the "state failures" that occurred in European countries in the 1980s before they adopted ecological modernization approaches (Arts, 2006; Bolognesi & Nahrath, 2020; Delmas & Young, 2009; Tan & Fang, 2016). The eco-environmental transitions in China's modernization bear a certain degree of discontinuity. The emergence and development of China's environmental governance has been shaped and reshaped by continuous economic, political, and social changes, especially the expansion of market-oriented growth, the decentralization and bureaucratic reorganization in political and financing systems, and the growing openness to and integration in the world. Consequently, China's process of environmental institutionalization has been an ongoing, dynamic, and unique process. In this process, China has been modernizing its political system by restructuring traditional hierarchies and divisions of power while appreciating market rationality. This has allowed for greater decentralization and flexibility in environmental governance. Increasingly, local governments have gained freedom in developing pro-environmental policies, developments, financing models, and institutional arrangements. This has resulted in growing diversity in how local governments deal with local and regional environmental challenges and in great variances of the effectiveness of such interventions (Mol, 2006). Nevertheless, decentralization, local freedom, and growing diversity are insufficient to ensure the success of environmental governance, especially when local authorities prioritize economic growth over environmental protection (Kostka & Mol, 2015). Environmental laws and regulations generated at the national level are usually vague and subject to local interpretation in enforcement and, hence, subject to the administrative influences of local authorities (Ma & Ortolano, 2000).

While China's environmental reforms have suffered setbacks due to the priority of market-driven growth, international influences have risen in its influence on the institutionalization of environmental interests in China's market, policy, and development practice. For example, Chinese or joint venture firms that operate in a global market are subject to international environmental

standards, which have pushed domestic markets to adopt new, pro-environmental standards and practices. Foreign environmental industries and consultancies have increasingly influenced China's growing environmental industry, which has pressed for the greening of production and consumption processes (N. Carter & Mol, 2013). However, some scholars argue that China's internal development needs have a bigger impact on China's attitude towards environmental protection and pollution control as opposed to international economic and political pressure (Rock, 2002). Nevertheless, studies have reported significant influences from foreign financial assistance and technological transfer on China's environmental policies and programs (N. Carter & Mol, 2013; Mol & Buuren, 2003; Mol & Carter, 2006; Vermeer, 1998). With growing openness to and integration into the global economy, China's own research and development institutions, such as universities, development and policy research institutions, and governmental think tanks, have been increasingly focusing on examining environmental externalities of economic growth and articulating strategies for pro-environmental policy and practice (Mol, 2006). With foreign players and China's general public having limited access to environmental information or constrained right to intervene, domestic forces, especially state- or market-led institutionalization of environmental interests, have become crucial to China's pro-environmental reform.

Overall, scholars have acknowledged China's emerging processes of pro-environmental reforms and associated political-economic restructuring that have largely taken place in the context of the country's modernization. China's unique trend of ecological modernization can be reflected by the fact that the state and the market have increasingly paid attention to the environmental externalities of economic development and urbanization and incorporated those considerations into institutional innovations. Yet China's pro-environmental reform remains under development and transforming, embedded in transitions in its economy, domestic politics, and international relations. The greening of China's economy, politics, and society and concomitant institutionalization of environmental rationality remains an open-ended, ongoing process. With the country's current integration into the world and its global influences as the world's largest emerging economy, the Chinese characteristics, dynamics, and limitations of environmental reform can significantly impact the success or failure of the world's environmental endeavors. Among many limitations of China's environmental reform, environmental monitoring and environmental data authenticity must be improved to provide a foundation for enhancing the effectiveness and reliability of China's environmental governance (Gang, 2009).

Building an Ecological Environment as a Regenerative Approach

In post-industrial contexts, sustainable development sometimes adopts a "regenerative" paradigm for greening the built environment. Accordingly, ecology is created or reconstructed in a city to stimulate socioeconomic development while preserving environmental resources and restoring wounded ecosystems (Cole, 2012; Mang & Reed, 2012; Plessis, 2012; Robinson & Cole, 2015). Such a regenerative approach to building an ecological environment often reflects ideas of ecological urbanism and incorporates practices of ecological design and environmental engineering. Planning and design effort has been increasingly directed at the regeneration of the inner cities since the 1950s. The 1990s represented a period of consolidation when the overwhelming theme was the

search for sustainability. During that decade, sustainable development became a mantra while cities increasingly competed with other cities to reconstruct their economies by replacing dying industries with new ones and rebuilding the post-industrial, wounded landscapes. The intercity economic competition and the search for sustainability combined have led to a renewed focus on urban regeneration since the 1990s. For example, forging an urban renaissance became a key British policy document at the end of the 1990s which aimed to restore cities' health and produce new, compact, efficient urban forms (Hall, 2002, p. 10).

The contemporary ecological theories, concepts, and principles have typically originated in Western societies (Rapoport, 2014; Spirn, 2012). The notion of ecological urbanism views design and development practice as a means of adaptation. It defines ecology as the study of the relationships between living organisms and their environment and the processes that shape both (Spirn, 1985, 2012). It also encourages discourses across various environmental disciplines, such as climatology, hydrology, geography, psychology, history, and art. Ideas of ecological urbanism set a framework for addressing environmental and social challenges that threaten human wellbeing and social justice, including climate risks (such as global warming and rising sea level), natural resources depletion (such as declining oil reserves and energy overconsumption), and entangled social issues regarding human needs for health, safety, welfare, culture, and meaning (Mostafavi & Doherty, 2010; Spirn, 1985, 2000). Ecological urbanism promotes the integration of ecological design and environmental planning into urban development as a path towards building sustainable cities and addressing environmental and social issues in tandem.

Spirn (2012) has highlighted some key figures in history and their theories to exemplify notions that link human and societal wellbeing with nature. Over two thousand years ago in Western societies, physicians described the impact of natural systems such as air, water, and geographic conditions on the health of individuals and communities, and architects proposed principles of arranging buildings and urban infrastructure in response to climate and seasonal conditions. For example, Leon Battista Alberti (1404-1472), an environmentally conscious architect during the early Renaissance Era who wrote the first modern treatise on the theory and practice of architecture, advocated an adaptive approach to spatial considerations, according to which the location and design of cities would be agreeable to environmental conditions and satisfy human health and psychological needs such as safety and pleasure (Alberti, 1988). Environmentalist George Perkins Marsh (1965) also stressed the importance of working with nature, arguing that "human improvidence" had left lands of impoverished productiveness, shattered surface, and climatic excess on earth which should be reclaimed and reconstructed. These environmentalist principles have become central to contemporary practices of ecological design and planning. American landscape architect Frederick Law Olmsted has pioneered ecological interventions in the built environment by bringing ecology back to post-industrial cities in the forms of urban parks, parkways, and neighborhoods that have integrated infrastructure with natural systems. Early practices of ecological urbanism have been emulated and reinvented by contemporary urban designers, landscape architects, and environmental planners with the goal to enhance interconnected conditions of public health, urban livelihoods, and environmental wellbeing.

Since the late nineteenth century, in response to urban problems in industrial cities, ecological ideas have influenced some key thinkers of city design and planning in Western societies. For example, Ebenezer Howard published his seminal work *Garden Cities of To-Morrow* (1989) which proposed a utopian plan for countryside living and later became the inspiration for garden city constructions and the new town movement in Britain. Geographer and planner Patrick Geddes advocated a regional and historical approach to town planning and city design, arguing that each city and its surrounding countryside should be viewed as an organic whole evolving from its natural and cultural histories (Geddes, 1915). As Western societies evolved into the post-industrial era during the second half of the twentieth century, ecological ideas of the city were further incorporated into theories of city design and planning. Architectural historian Lewis Mumford adopted his mentor Geddes's organic understanding of the city and its region and called for a new urban form that would bring ecological and climate benefits as well as historical, cultural, social, and psychological values (Mumford, 1968). Mumford's socio-ecological understanding of the city influenced theorists in urban design, landscape architecture, and regional planning, exemplified by Kevin Lynch and Ian McHarg. Spirn (2012) compared the two thinkers' perspectives and revealed nuanced differences: While Lynch regarded the city as a human habitat and favored the employment of natural features in enhancing identity, legibility, and coherence in city form (Lynch, 1984)**,** McHarg regarded cities as a part of broader ecosystems and suggested that all human activities and values should respect natural laws (McHarg, 1995). McHarg pioneered the approach of mapping geographic information to understand the physical evolution of a place and proposed a pre-design investigation of an "ecological inventory" that included interrelated natural systems such as climate, geology, hydrology, limnology, soil, vegetation, and wildlife (McHarg, 1967). Such an approach was further developed by Anne Spirn in *The Granite Garden: Urban Nature And Human Design* (1985). Viewing human beings and cities as part of nature, urbanist Jane Jacobs also advocated an ecological understanding of the city and the integration of natural and social considerations in city design and planning (Jacobs, 1961). Throughout history, various ecological ideas have emerged and been increasingly incorporated into urban ideas in the search for solutions to intertwined social and environmental challenges.

Two schools of ideas represent the contemporary discourse about ecological approaches to city design and planning—"ecological urbanism" and "landscape urbanism." Ecological urbanism has become an umbrella term that incorporates a wide range of theories and practices that have focused on multiple interrelated aspects, such as ecological design, environmental art, landscape planning, sustainable design and planning, green architecture, green urbanism, and industrial ecology (Mostafavi & Doherty, 2010). Important concepts of ecological urbanism include: cities are part of the natural world; cities are habitats; cities are ecosystems; urban ecosystems are dynamic and interconnected; and every city has an enduring context (Spirn, 2012). Responding to the understanding of cities as part of nature, ecological urbanism also highlights some fundamental design principles: For example, we need to understand natural processes; plan and design are tools for humans to adapt our built environment to the natural world; human intervention should be contextualized; and our plans should respond to natural conditions and follow natural laws (Spirn,

2012). Landscape urbanism has been promoted by landscape architects and urban designers as a "remediating practice" or "a salve for the wounds of the industrial age" at the intermediate scale between architecture and the city (Girot, 2016; Waldheim, 2006). The landscape urbanism proponents reject the opposition of nature and city implied by traditional environmentalists, such as Ian McHarg, and argue that the habitable spaces of the city are indispensable parts of the landscapes and that nature should be incorporated into the urban system and become the urban infrastructure. The landscape urbanism propositions have derived from the rejection of past models of city making: for example, the modern city was too ordered, overly controlled, and socially divided, and the modernist approach was too rigid and form-driven; the postmodern approach was limited to the revival of stylistic architectural elements; and the New Urbanistic approach created areas that are too compact, overly designed, leaving little space for the natural systems. Responding to the critiques of past design and planning approaches, landscape urbanism proponents argue that the best way to organize cities is through the design of the city's landscape, rather than the design of its buildings. To that end, a new relationship between city and nature can be established if landscapes and the natural systems become the organizational framework of the city, incorporating the dimensions of time, anthropology, and structures (Corner, 2014; Girot, 2016). In particular, the derelict urban areas or the abandoned infrastructure in the post-industrial city have been considered as the most promising opportunity ground to realize the visions of landscape urbanism. Places shaped according to concepts of landscape urbanism are imagined as a complex, multilayered, multifunctional system that is also open-ended, dynamic, life-sustaining, and enduring (Girot, 2016; Waldheim, 2006, 2016).

Based on different interpretations of city-nature relationships, two representative approaches toward ecological planning and design should be highlighted in today's practice in city making. One type of ecological urbanism projects is achieved through a grassroots, incremental, and restorative approach in community planning. For example, the West Philadelphia Landscape Project (WPLP) is an over-three-decade-long community development project, based in a low-income neighborhood in West Philadelphia. Its core strategy is the integration of environmental restoration, community development, and educational reform. It has attempted to simultaneously address issues of poverty, race, deteriorated neighborhoods, polluted water, and troubled schools (WPLP.net, n.d.). Its development has been led by planning experts, educators, and activists, and it engages community schools, students, parents, as well as other community members of all ages. Through collective, incremental efforts, the participants have worked with the existing conditions in the declined neighborhood. Their multifaceted achievements include restoring watersheds, turning vacant lots into productive community gardens, improving school conditions, promoting place-based education and environmental literacy, and practicing participatory planning processes. The project's accomplishment is believed to be manifold. Through the collaboration, the community has managed to improve environmental quality, strengthen community identity, enhance education quality and public health, and provide employment opportunities, although as limited neighborhood scales. The community's grassroots proposals have also impacted the formal planning decisions, and were adopted by the city's official green infrastructure plan—"Green City, Clean Waters." While WPLP demonstrates that community-driven regeneration can engender multifold success in physical and

sociopolitical transformations, scholars have raised questions about the scalability of community-centered sustainability initiatives. Several aspects of such an approach have been discussed, including its limited scope of impact, uncertain funding sources, dependency on experts, the degree of politicization of the initiative, issues of representativeness in participation, lack of systematic coordination, constraints of time, as well as the limited impact on formal interventions (Adamson & Bromiley, 2013; Bruce & Clarson, 2017; Fischer et al., 2017; Henfrey & Penha-Lopes, 2018; Herbert-Cheshire & Higgins, 2004; O'Hare, 2010; Parkhill et al., 2015; Simon et al., 2020).

Another type of ecological urbanism projects, practiced by advocates of landscape urbanism, can be considered as the catalyst in declining urban areas, exemplified by projects such as urban parks and waterfront promenades. These projects often revitalize derelict infrastructure or post-industrial sites that have been engulfed by urbanized areas or are located at the urban peripheries. Some famous examples include the High Line in New York City, the Fresh Kills in New Jersey, and the Central Waterfront in Toronto. The underlying assumption embodied in this type of development model is that technological innovation allows the economy and ecology to flourish at the same time. This approach also enables the natural processes to be engineered and incorporated into urban systems, allowing the natural components to clean the environment while providing agreeable natural settings for public spaces. According to its proponents, such ecological design creates places that are dynamic and performative, being not only environmentally sensitive but also culturally accessible to all and physically appealing. Ultimately, these places would simultaneously contribute to the economic growth and social wellbeing of the urban dwellers. This type of ecological urbanism projects has marked a conceptual shift from traditional landscape projects focusing on plants and aesthetics to a concern about ecology and the environment with a systematic and infrastructural approach. The above-mentioned projects, as well as many other similar attempts, have gained international reputation thanks to their successes in transforming undesirable post-industrial sites into some of the most visited places in the region or even in the world, restoring the economy, ecosystems, and urban vibrancy at the same time. Nevertheless, these projects rely heavily on sufficient political, financial, and technical support, and are time-consuming to be realized. A more challenging issue overshadowed by their popularity is that the design quality these projects bring to the cities has also paradoxically led to gentrification, displacement, and exacerbated social segregation.

The Human-Environment Relationship

The human history has seen evolving ontology of nature and changing perspectives about the human-environment relationship. Scholars have considered institutional traits of contemporary societies—whether capitalism or industrialism—the major factor behind the environmental crisis. Many theories and practices are based on the assumption that institutional reform could solve environmental problems. Yet others, especially scholars in the field of political ecology, have stressed the necessity to address root causes of the environmental crisis. Many have expressed concern that the institutional compositions of modern societies are unable to solve, or even just

reduce, the environmental crisis. These debates have reflected different understandings of "nature" in relation to human society.

The contemporary environmental movement in the West has been regarded as a "demodernization" movement with its emphasis on premodern values (Tellegen & Wolsink, 1998). The relationship between the environment and the city and between man and nature has shifted greatly with the emergence of modern society. Modernity has been constructed in a way that discontinues models of historical development and rejects traditional values. Scholars have pointed out a "discontinuist" view of history that deepens the understanding of the modern environmental crisis by highlighting the essential characteristics of modernity (Giddens, 1986, 1991; Spaargaren & Mol, 1992). For example, Giddens has emphasized the contrasting views of the human-environmental relationship between modern and traditional societies:

> In class-divided societies, production does not greatly transform nature, even where, for example, major schemes of irrigation exist. The city is the main power-container and is clearly differentiated from the countryside but both partake of the "content" of the natural world, which human beings live both "in" and "with," in a connection of symbiosis. The advent of industrial capitalism alters all this. When connected to the pressures of generalized commodification, industrialism provides the means of radically altering the connections between social life and the material world (Giddens, 1986, p. 146).

Murray Bookchin (1980) sees the advent of modern society as the destruction of the cell-tissue society, and the replacement of complex, organic, harmonious eco-sociosystems, which "yield local differences to the natural world," with simplified, inorganic systems that both alienate man from nature and alienate man from man. Bookchin believes that, under conditions of commodification in modern society, the relationship between man and nature is impossible to reconcile in such non-organic ways. To Bookchin, the environmental crisis is fundamental and all-embracing in modern or capitalist-industrial society. Hence, Bookchin insists that the modern environmental movement since the 1970s can only restore the man and nature relationship by promoting pre-modern systems, such as the Greek city-state, to dismantle or restructure modern society.

In Western societies, the rise of modern science and engineering has allowed the human mastery of nature, which had resulted in an idea of separation between man and nature as well as the "bifurcation" of views on nature (Leiss, 1994). In cultural and philosophical sciences, nature carries a duality of meaning: it is both *intuited nature*—the "experienced nature of everyday life" and *scientific nature*—the "abstract-universal, mathematized nature of the physical sciences" (Leiss, 1994, p. 136). Scientific nature is nature harnessed to the ongoing rationalization and expansion of production (Schnaiberg, 1980). The development of natural sciences has led to a partial understanding of how the sustenance base functions. Ecology, as a scientific discipline of the sustenance base, provides understandings of processes of production, from the input of energy and raw materials to the output of waste in societies. Based on an ecological view of modern society, economists have been trying to incorporate the environment as a production factor into neoclassical economic models since the rise of the environmental movement in the 1970s.

In general, scholars have paid increasing attention to the flaws of modernity-based views on the environment, despite the difficulties of correcting the fundamental fault of modern societies (Giddens, 1991). Two schools of interrogation have emerged—one focuses on the sustenance base while the other focuses on the institutional aspects of modern society. The former school of interrogation, as the focus of environmental sciences, questions whether and to what extent humans can possess and develop scientific-technical knowledge in order to rationally control human interaction with sustenance. Scientists have sought to generate predictive models and ecotechnical knowledge to determine whether human societies have burdened or overexploited the sustenance base and how humans can adjust social reproduction to meet the demands of ecosystem reproduction. When answering these questions, scientific and political debates are often intermingled. Yet such inquiries are challenged by the uncertainty and difficulty to assess the impact of human activity on the environment due to reasons such as the innate complexity of ecosystems involved, the displacement of effects in time and space, and the rapidly increasing scale of human-environment interaction across the globe.

The other school of interrogation concerns possible institutional reform—both at a systematic, societal level and at the everyday, individual level—that is necessary to correct the design fault of modernity in the human interaction with the sustenance base. In the fields of environmental social sciences, scholarly debates have evolved about which institutional traits of modern society are responsible for the environmental crisis (Spaargaren & Mol, 1992). Giddens (1991) has defined four institutional dimensions of modernity. These include:

1) Capitalism: Capital accumulation in the context of competitive labor and product markets;
2) Industrialism: Transformation of nature: development of the "created environment;"
3) Military power: Control of the means of violence in the context of the industrialization of war;
4) Surveillance: Control of information and social supervision.

Among the four dimensions, capitalism and industrialism have been highlighted as driving forces of socioenvironmental change. Giddens defines capitalism and industrialism as follows:

> Capitalism is a system of commodity production, centered upon the relation between private ownership of capital and propertyless wage labor, this relation forming the main axis of a class system. Capitalist enterprise depends upon production for competitive markets, prices being signals for investors, producers, and consumers alike. The chief characteristic of industrialism is the use of inanimate sources of material power in the production of goods, coupled to the central role of machinery in the production process. Industrialism presupposes the regularized social organization of production in order to coordinate human activity, machines, and the inputs and outputs of raw materials and goods (Giddens, 1991, pp. 55–56).

Scholars have held the institutional alignments within modern, industrial, and capitalist societies responsible for the chronic impetus towards the expansion of production and transformation of economy and technology in modern society. Theorists of industrial society highlight the central role

of technology and machinery as well as man-machine relations within modern society as the defining characteristics of different stages of industrial development. Building on Marxist critiques of capitalist production and bourgeois analysis of industrial society, Spaargaren and Mol (1992) argue that theories on the interaction between environment and modernity differ in three aspects:

> 1) whether the modern society has followed evolutionary or discontinuist models of change from the historical development during the premodern era;
> 2) whether the critiques of modern society emphasizes capitalist or industrial characteristics;
> 3) whether the evaluation of development and the theorization of the industrial society has occurred in a postindustrial era.

Examining the concept of sustainable development in the context of modern societies, Spaargaren & Mol (1992) point out that the concept is built on the notion of integrating ecological quality with economic growth which is framed in the context of industrialization in modern society. Accordingly, the premise of this concept is that economic growth and technological development are seen as compatible with and even as a condition for sustaining the sustenance base, rather than as the main cause of environmental destruction. Therefore, scholars have argued that ecological modernization—a concept that links the environment with modernity and that builds sustainable development on the ecological restructuring of industrial processes of production and consumption—is more specific in the context of contemporary industrialized or industrializing societies (Simonis, 1989; Spaargaren & Mol, 1992). The concept of ecological modernization is built on two assumptions: First, the greening of the economy—through the development, inauguration, and diffusion of new technologies that are more intelligent than older ones—can benefit the environment. Microelectronics, gene technology, and new materials are seen as promising technologies for reducing resource inputs, resource use, and emissions of economic development, and for monitoring the environmental impact of processes of production and consumption (Gibbs, 2006; Simonis, 1989). The ecological switchover becomes a local, necessary, and inevitable next stage in the development so that the industrial system can correct its design fault of neglecting ecology or the environment (Spaargaren & Mol, 1992). Second, the concept of ecological modernization also suggests strengthening the benefit of economizing ecology by placing an economic value on nature and environmental resources (Dasgupta, 2008; Karsten, 1987; Kenis & Lievens, 2016; Polasky et al., 2019). Spaargaren & Mol (1992) argue that while the theory of ecological modernization clarifies the relationship between modern society and its environment, this theory tends to downplay the importance of state institutions while being overoptimistic about the dynamics of the market. It also neglects the experienced nature of everyday life and assumes an evolutionary and technologically deterministic view of social development in modern society.

Nature, the City, and Urban Change

Conceptions of nature and cultural responses have led to the "greening" of science, technology, religion, philosophy, law, and politics (Huth & Strong, 1990; Jr. Ekirch, 1963; Nash, 1989). Nature

has traditionally been the inspiration for artists to imitate, improve upon, or interpret. Renderings of nature often tend to spiritualize, romanticize, or intellectualize it. The natural world has become artificially remade with the development of human societies. Nature has increasingly become a manmade construct that humans create and recreate. From the rise of natural sciences to the intensification of environmental risks, nature has been reconstituted and increasingly become an artificial experience integrated with artificial systems and embedded in social and political systems. Nature has also become a way to differentiate development and divide people: some populations live in more developed areas with an artificially enhance environment while others still rely on the "natural" nature in underdeveloped areas to sustain their livelihoods. Humans have developed a complex relationship with nature: On one hand, humans have exploited the nation's natural resources with devastating speed clearing forests, damming rivers, killing wildlife, fouling the air and water with pollutants. On the other hand, humans have taken pride in artificially creating extraordinary beatify of our societies (Rome, 2003).

Yet with the widely perceived climate change and growing fear of the Anthropocene, human societies have become more critical of the human dominance over and exploitation of nature. For example, in the late nineteenth century, three kinds of environmental problems became matters of public debate in the United States. One problem was the prospect that the nation would run out of vital natural resources. To ensure that future generations would have adequate supplies of essential raw materials, many people joined "the conservation movement." The conservationists committed to the scientific management of resources, which was driven by political and scientific elites (Judd, 2000). The second problem was the fate of "wilderness." A number of organizations began to argue that undeveloped lands of great natural beauty ought to be preserved (Nash, 2001; Pritchard, 1999; Schmitt, 1969; Sellars, 1997). The third problem was that pollution had increasingly become a threat to public health, especially in the fast-growing cities. Issues of pollution and concerns about public health led to far-reaching efforts on improving the urban environment (Melosi, 1980). After World War II, environmental values gained increasing appeal. Ecological sciences and ecological ideas greatly contributed to the evolution of environmentalism (Craige, 2002; Lear, 2009). The popularization of ecological ideas also educated citizens about the risks of transforming and manipulating nature and greatly influenced environmental politics (Flader, 1994; Worster, 1994). By the 1960s, the modern environmental movement had become a powerful force to conserve natural resources, preserve wilderness, and control pollution while expanding the power of municipal government and local communities (Schultz, 1989). Stephen Fox (1986) argues that the environmental movement largely shifted from grassroots efforts to save wild places and wild creatures to improving the degraded environments of factories and working-class neighborhoods and to campaigning for environmental justice. Unlike conservationists who sought to make the world of production efficient and sustainable, environmentalism was regarded as a consumer-oriented effort to improve the quality of life (Hays & Hays, 1989). Nevertheless, twentieth-century Western societies saw shifting attitudes toward elements of nature, the development of an eco-environmental ethics, and the rise of an environmentalist sensibility (Mighetto, 1991; Schrepfer, 2003; Siry, 1984; Vileisis, 1999). The new ecological consciousness and sensibility has become a new enlightenment, leading to renewal in philosophy and environmental ethics in the West. An ecological account of human nature deals with humanity as part of nature and calls for an organic human-environment relationship (Naess, 1973; Passmore, 1974). Such ecological consciousness has led to

Ecotopian visions of a free and ecological society. Derived from Western philosophies and cultures, an ecological society would be a self-organizing, organic community like nature itself. It would also dissolve hierarchy and oppression while fostering a pluralist, cooperative society that is committed to participatory, democracy, and ecological values (Barnhill, 2011; Callenbach, 1990; Hubbell, 2020).

In history, the changing meanings of nature have always intersected with wider debates about urban change in social, economic, and environmental domains and with political consideration of the force of capital. Different meanings and cultures of nature have led to progressive dimensions of urban policies. In modern societies, ecological perspectives have been combined with more radical conceptions of social change. Modernist visions of urban space are sometimes ambiguously marked by a blurring of the boundary between technical rationalization and social control (Gandy, 2002). Nature has been reworked in a myriad of ways to reflect new advances in science, engineering, and other fields. It has also been represented back to urban societies in an increasingly sophisticated array of cultural forms ranging from art and literature to the latest innovations in landscape design (Gandy, 2002). Lewis Mumford (1961, p. 568) argues that "the chief function of the city is to convert power into form, energy into culture, dead matter into the living symbols of art, biological reproduction into social creativity."

There are three conceptions of urban nature that have generated broader implications for city making. Inspired by medical knowledge and other empirical sciences involving sanitary discourses, the notion of the circulatory, organic, and metabolic city emerged to promote the free movement of water, air, and citizens through the body of the city (Gandy, 2004b; Heynen et al., 2006; Swyngedouw, 2006). Such organic metaphors were used to describe the circulatory health of rapidly growing industrial cities in the nineteenth century, contrasting the political and economic instability and the social polarization that cities were undergoing then. In the twentieth century, technological advances increased the influence of organic understandings of the city on the production of urban space and on the flow of water, energy, and raw materials. A complete metabolic system of the modern city became the goal of urban organization enabled by modern technological advancement (Céspedes Restrepo & Morales-Pinzón, 2018; Chini & Stillwell, 2019; Wolman, 1965). Cities were regarded as the space of flows the morphological perimeters of which were an arbitrary division within a wider system of flows (Bambó & García, 2018; P. Carter & Jackson, 2004; Kennedy et al., 2007). However, the metabolic understandings of the city focused on the physical realm and overly relied on technological improvement, downplaying the broader social, economic, and political factors that shaped urban form and social relations. Second, the concept of cyborg urbanization emphasizes the physical vulnerability of the human body as part of a hierarchy of larger-scale social and metabolic systems and reveals the interaction between social and biophysical processes that produce urban space and sustain everyday life (Gandy, 2004a; Lokman, 2017; McFarlane, 2011). According to the cyborg notion, the city is both an abstract arena for capital and a lived space for human interaction and cultural meaning. Third, inspired by the environmental literature, the conceptions of ecological urbanism assume the binary between the natural and the artificial. Since the 1980s, the notion of an ecological city has gained growing interest as an alternative to the environmentally irresponsible and socially segregating approaches to shaping the contemporary city. The concept of an ecological city is founded on four interrelated assumptions: a) nature is the foundation that sets rules for the organization of human society; b) the regional economy could be

an organic, largely self-sustained system; c) the urban pastoral setting rooted in nineteenth-century romanticism remains aesthetically pleasing to contemporary urban dwellers; d) the ecological world view is critical of modernist thought and design. As McHarg (1971) suggests, a city can emulate a stable and complex ecosystem in dynamic equilibrium. Accordingly, principles of city design and planning can be found in nature, especially using ecological science as a command. Others apply ecological science to the understanding of complex urban systems including the biophysical realm and the economic structure of the city (Adams, 2014; Gandy, 2015; Hagan, 2014; Hodson & Marvin, 2010; Steiner, 2011). However, the aesthetic and scientific paradigms of an ecological city, despite their antimodern premise, often overlook the continuities in processes of capitalist urbanization (Gandy, 2002; Thompson, 2012). Instead, an ecological city is conceived as a self-organizing living organism in which the eco-social organization is cooperative and non-hierarchical (Allen, 1997; Connolly, 2013; Eken, 2019; Poletto & Pasquero, 2013). Accordingly, urban ecology and nature—both rest on the authority of science—become interchangeable in design thinking to inspire ideological and landscape changes and to promote ecological stability and social cohesion (Cook & Swyngedouw, 2012). Gandy (2002) argues that ecological conceptions of the city must be more critical of the social production of nature, especially the role of capital and social power in shaping urban space. Without engaging sociopolitical critiques of modern society, the fusion of ecology and society is far from being a radical or new idea when compared with eighteenth-century discourse about nature. Nevertheless, the interaction between different cultures of nature and progressive thoughts of the environment, society, and politics have been central to debates in scholarly fields such as political and social ecology. Such interactions continue reworking the natural and urban environments while reshaping social relations and power dynamics in contemporary societies. Ecology and nature have become the tautological symbols of modernity bringing aesthetics, economic use, and cultural meaning to new changes in neighborhoods, infrastructure, and broader urban landscape.

In modern societies, raw materials of nature have been reworked to produce a "metropolitan nature" in processes that are emblematic of wider social and political struggles (Gandy, 2002). Contrasting premodern forms of nature, a "metropolitan nature" can describe multiple forms of urban nature, ranging from nature for admiration—such as the preservation of wilderness for the consumption of natural beauty and the aesthetic discourses of European landscape design—to nature for utility—such as new water technologies within the home and the construction of infrastructure that provides drinking water and ensures sanitation in the city. The beauty and utility of nature have been constructed in an integrated way to create more civilized urban life. The creation of urban nature, especially the form- and meaning-making of urban space through transforming nature into a city-nature synthesis, enable processes that enrich social and cultural experiences. In Europe and North America during the nineteenth century, the politics and cultures of major metropolises not only dominated processes of urbanization but also played decisive roles in changing perceptions of nature-society relations. Gandy (2002) examines how the transformation of the experience and perception of nature in New York City intersected with a series of social, political, and economic developments during the nineteenth and early twentieth centuries and argues that "the production of urban nature is a microcosm of wider tensions in urban society" (Gandy, 2002, p. 2). New York City faced a rapid urban boom, deteriorating housing and infrastructure, and concomitant social and economic collapse during the first half of the nineteenth century. The

construction of the city's water supply system instituted new patterns of municipal intervention and innovative mechanisms for the raising of capital, leading to a new kind of mediation between nature and the city. Such emerging patterns of practice and institutional changes also enabled later developments such as the creation of Central Park and the construction of landscaped roads. Gandy (2002) suggests that all these projects of urban nature construction engendered a realignment between municipal government, capital, and nature and, hence, set in place a remarkably resilient framework for the construction of urban infrastructure, which has greatly shaped the city in the twentieth century. These developments were where the public and private dimensions of urban space intersected, where technical and political opinions concurred, and where significant changes in the urban environment occurred. Nature as an ideological construct not only shaped perceptions of the city but also intensified new forms of social stratification within the city. Urban environmental change not only reflects technological change and economic growth but also reveals contrasting and conflicting sets of political, economic, and sociocultural interests.

Distinguishing between modernity and capitalist urbanization, Gandy (2002) examines alternative modernities that vie for representation in the urban landscape and the different conceptions of meaning and identity that have been etched into the fabric of the city. Capital—either monetary or environmental—has played a crucial role in shaping urban space, urban history, and landscape iconography. In particular, nature is often transformed into new commodities such as urban parks in the interaction between real estate speculation and landscape aesthetics. Gandy argues that the production of modern cities has altered the relationship between nature and society in a series of material and symbolic dimensions. To Gandy, the progressive forms of urban society are produced only through radically reworking the relationship between nature and culture, since the modification of nature is part of the pretext for a more civilized kind of urbanism through which the benefits of metropolitan nature can be spread more widely. Therefore, Gandy stresses that the urbanization of nature is a historical and political process and suggests that the reworking of modern nature has become a collective project that applies the human imagination to the transformation of urban space and affirms the interdependencies that sustain a flourishing civic realm. The production of urban nature also involves the transformation of capital and simultaneously intersects with the changing role of the state, emerging metropolitan cultures of nature, and wider shifts in the social and political complexion of city life. Accordingly, Gandy (2002) argues that a meaningful conception of urban nature should be sensitive to the social and historical contexts that produce the built environment and should imbue places with cultural meaning.

The Call for Systemic Change

Scholars in the field of political ecology have questioned the fundamentals of modern industrialized society, arguing that capitalism and the state have been the root causes of intertwined economic, political, ecological, environmental, social, and spiritual crises. They call for a social revolution that would eliminate domination, hierarchy, and exploitation. They argue that environmental challenges such as climate change can only be addressed by building radical social movements that would totally re-envision society and the human-nature relationship in a democratic and redistributional way (Roussopoulos, 2018). In the United States, many supporters of a Green New Deal have argued

that a wartime organization of social and economic capital is needed to transform the destructive, exploitative economic and political machine into an egalitarian, ecological, and profoundly democratic society (For example: Aronoff et al., 2019; Barbier, 2010; Klein, 2020; Pettifor, 2020; Rowe, 2020; Schwartzman, 2011). Roussopoulos (2018) stresses that the differentiation between environmentalists and ecologists is key to understanding the limitation of the past environmental movement and the perils of green consumption and green capitalism. According to political ecologists, environmentalists only manage destruction by tweaking policy and technology to attempt to lessen pollution, but they leave a rotten system untouched. Environmentalism has emerged as an approach that only deals with environmental and social crises as they arise. Therefore, an environmentalist approach does not deal with underlying systemic causes and is reactive. Ecologists consider environmentalism to be conservative for it does not concern a systemic transformation of the social and economic structures that have produced the environmental crisis. As a result, environmentalism tends to be biased toward the concerns of the elite, proposing reforms that will make life more pleasant for the already privileged, but neglecting the problem of social and economic inequality (Roussopoulos, 2018).

In contrast, ecologists reject technocratic solutions and mammoth projects; instead, they demand to cut the crisis-causing system at its roots. Accordingly, a political-ecological approach is preventive and creative. Ecologists condemn the eternal quest for "economic growth" as the root cause of both the environmental crisis and disastrous inequality. They argue that humans must transform our relationship with each other and with nature and articulate a new system in a new kind of society with fruitful symbiosis between human and nature. This would allow humans to look beyond piecemeal reforms and create a more realistic roadmap for genuine pro-environmental change at scale. To do so, ecologists advocate for a new politics that would radicalize democracy and enable massive civil resistance to current economic and political systems (Bookchin, 1986; Roussopoulos, 2018). To these social ecologists, top-down, undemocratic capitalism based on profit and authoritarianism could be challenged by a bottom-up, democratic, and decentralized system based on respect, ecology, and community need. They regard the new politics as democratic innovation, which would function as a counterpower to the state and which would rival and eventually replace it. Political ecologists argue that cities as concentrations of economic, legal, and institutional power and as the closest level of government to the people should be the center of social resistance and be the enablers of a democratized economy. As the main sites of economic and political power and civilization, cities should form a network of democratic, ecological city governments and reorganize regional economies by decentralizing power from corporations, politicians, and bureaucracies to neighborhood citizen collectives at the human scale. Political ecologists in the West believe that a radically decentralized economy and more sensible human-scale politics could foster community democracy at the roots of society, which would allow the people to redesign civilization based on ecological intelligence and genuine societal needs. Political ecologists' views on the environmental crisis present an Ecotopian nature (Barnhill, 2011; Hubbell, 2020; Pressley, 2015; Schneider-Mayerson & Bellamy, 2019). Ecologists' understanding of the contemporary eco-environmental problems recognizes their deep-seated social and political roots in human societies. They stress the fundamental, inseparable connections between eco-environmental and sociopolitical questions. Accordingly, the exploitation of and domination over nature is a reflection of the exploitation and hierarchical domination in human societies (Bookchin, 1992).

Acknowledging the fundamental differences between environmentalism and ecologism, Roussopoulos (2018) critiqued the environmentalist nature of the notion of sustainable development, arguing that the concept is based on the premise that the environmental and social

crisis can be addressed by incorporating environmental considerations into economic development plans. Furthermore, sustainable development goals have been vaguely constructed and are difficult to translate into action. Therefore, Roussopoulos, like other political ecologists, considers the broad and abstract principles of sustainable development pious wishes that are insufficient for more far-reaching political and economic changes in the dominant institutions of modern society, or for a genuine reversal of global patterns of development. Instead, ecologists call for a roadmap beyond mere environmentalism—one that can enable urgent systemic change, transcend a profit-centric economic system based on ruthless competition, and replace capitalism and the nation-state with a new society that values humanity and nature over materialism and its products. They believe the roadmap should recognize community organization as strategic, applied political terrains to amplify the people's impact and build a durable and well-organized radical base for systemic change (Roussopoulos, 2018).

Meaning of Ecology in China's Science and Policy Domain

Ecology has been rising in importance at the intersection of science, technology, and public policy in modern China. Although in Western societies ecological perspectives have sometimes been associated with premodern systems and values, ecology has become a policy term that encompasses green and sustainable development goals (Rodenbiker, 2021). While China's political rhetoric on sustainable development and ecological modernization has caught international attention, the meaning of ecology and how it shapes China's eco-environmental policy remains obscure. Examining moments of global exchange and knowledge production by Chinese Marxists, earth systems scientists, and economists that produced eco-developmental logic, Rodenbiker (2021) argues that ecology has become integral to environmental governance, state formation, and uneven relations of power in China. At the Paris Climate Accord in 2015, President Xi Jinping claimed that China is "vigorously making ecological endeavors" to foster "ecological civilization," which is "a new pattern of modernization featuring harmony between man and nature" (Xi, 2015). "Ecological civilization building" (*shengtai wenming jianshe*) is a political campaign initially proposed by China's central leadership in 2007 to transform the modernization-environment relationship and innovate the whole processes of economic, political, cultural, and social developments (Hu, 2012; X. Zhang & Wang, 2013). The then-president Hu Jintao called for modeling growth and consumption, innovating energy and resource use, and protecting the environment. Since then, ecological civilization building has been written into China's central state policy, government documents, and political rhetoric (Geall & Ely, 2018). This political agenda at the top has led to the adoption and popularization of green discourse, green policies, and green technologies in China's urbanization, infrastructure, energy sector, industries, agriculture modernization, social progress, and even spiritual development. In support of China's ecological civilization building, urbanization remains the significant and sustainable force on China's political agenda that is expected to drive the country's future economic and social development (Pan, 2016).

The narrative of China's ecological civilization resonates with Western discourse about ecological modernization that regards the ecological switchover of industrial civilization as a solution to the environmental crisis (Pan, 2016; Wan, 2013; Weng et al., 2015; L. Zhang et al., 2007; X. Zhang & Wang, 2013). China's resolution to construct an ecological civilization exemplifies how scientific

knowledge, such as ecological science, has played a significant role in shaping developmental logic and contributed to uneven relations of power (Rodenbiker, 2021). China's environmental scientists have been key intellectual contributors to national developmental policies and programs who construct the notion of development as processes of improving the society towards a more ecological, civilized future. Such processes are carried out through urbanizing both rural land and rural population while engineering population and environmental control (Chan & Zhang, 1999; Pow, 2018; Yeh, 2009).

Rodenbiker (2021) traces the history of the term "ecology" in the literature from prominent Chinese scientists and thinkers during the nineteenth and twentieth centuries, most of whom have been influenced by Western education and Western ideology. Ecology (*shengtai*) in China has become a term that encompasses scientific meanings in the disciplines of biology, botany, and engineering as well as spiritual meaning to express morality, aesthetics, and environmental controllability (Rodenbiker, 2021). On one hand, the scientific meaning of ecology connotes natural processes of the environment that can occur independently without human activities. On the other hand, ecology has become a term at the intersection of natural and social sciences that connotes human-nature relations. The coining of the Chinese term ecology has roots in various historical conjunctures during China's processes of modernization and, hence, is context-specific. Knowledge formations centered on this term have been relational and conditioned by the context of its emergence. Ecology connotes historical practices of idea and knowledge exchange, collective experimentation, interpretation, and claims making (Haraway, 1988; Rodenbiker, 2021).

Forms of nature have always been the product of social and historical context (Williams, 1980). In the West, ecology emerged as an explicit critique of modernity and modernistic approaches to environmental management (Odum, 1959). Ecological sciences have been mobilized in support of urban development (Hutchinson, 1978; Kingsland, 1985). Modern knowledge of ecology, like other modern scientific knowledge, is often considered to be universally applicable and has transferred from the Global North to Global South or from the West to the East (Hathaway, 2013; Lewis, 2004). Through global knowledge exchanges and local practices of meaning-making, ecological sciences have emerged in China and been incorporated into urban policy. Ecology now provides the epistemological groundwork for modernistic narratives in China, especially those about ecological civilization and sustainable development. In the global circulation of scientific knowledge, ecological ideas, and environmental movements, ideas have been appropriated in new geographic territories and reinvented with new localized meanings. Scholars have regarded such processes of remaking knowledge and meaning as opportunities for scientific innovations and new forms of practices (Hathaway, 2013). Others highlight that in processes of global knowledge formation, the conceptual constructs of ecological knowledge are inseparable from power relations and shift over time (Lewis, 2004; Lowe, 2006). Therefore, the meanings of the terms ecology, ecological knowledge, and relations of power are shifting and interacting unevenly over time and across contexts.

In China, Rodenbiker (2021) argues that ecology has emerged with a pluralistic nature during global-local exchanges, connoting the multiplicity of actions, actors, places, and claims within localized contexts shaped by uneven global relations of power. In modern China, the term ecology has not only taken on meanings of sustainability sciences but also become a form of situated logics of state-

society power dynamics (Sze, 2018). In China's processes of modernization and urbanization, rural population and rural resources have been framed as backward and inefficient while the state and its technocrats can improve such conditions through technological and ecological modernization. During the era of accelerated globalization, building an ecological civilization has become the Chinese Communist Party's central vision for the nation's future development in all economic, social, and environmental domains. This signals that the Chinese state power is now exercised through initiatives of sustainable development and ecological modernization. While Western discourse about the environment and modernity has emerged with a techno-optimistic nature, China's approach to greening its modernization has featured a strong, highly interventionist state with centralized regulatory power (Muldavin, 2008). The proponents of ecological modernization in Europe believe that a strong civil society, new industrial advancement, and responsible corporate involvement could lead to technological innovations and green transitions that mitigate environmental degradation during industrialization and deindustrialization (Buttel, 2000; Hajer, 1997). In contrast, the Chinese Academy of Sciences (CAS) has labeled China's attempt at building an ecological civilization as the "second modernity" (L. Zhang et al., 2007) which some Western scholars regard as a state-led political project with Keynesian characteristics (Buttel, 2000). The CAS reports that the Chinese society has developed from primitive civilization to industrial civilization and now transition into a knowledge civilization which highlights eco-rationality as the supreme developmental principle while striving for technical innovation and eco-environmental improvement (L. Zhang et al., 2007). Ecology has become a label of China's ecological modernization project that articulates developmental logic and bolsters state power and legitimacy (Rodenbiker, 2021). In China's political domain, the importance of ecological knowledge and ideas has reached its historical apex. Rodenbiker (2021) points out that Chinese natural and social scientists have constructed ecological civilization logics that justify hegemonic narratives of sustainable development and ecological modernization. Such state-centered construct and appropriation of ecology is analogous to how ethnologists in the United States theorized the nature of indigenous savagery as a scientific reality to justify violent civilizing missions of Western expansion. As a result, what is regarded as the "civilized" has become outside of and in control of nature, which could perpetuate civilization-nature and urban-rural dichotomies as well as associated injustice.

China's ecological discourse has been inspired by the rise of an ecological consciousness in industrialized capitalist societies in the West and a shift in global environmental awareness since the 1960s. Since the late 1970s, Chinese scholars and technocrats, especially ecologists and environmental policymakers, have begun paying attention to concepts of sustainability and sustainable development. For example, an article titled "The Way to Cultivate Individual Ecological Civilization Under Conditions of Mature Socialism" published in 1985 in *Guangming Daily* was one of the first Chinese publications using the phrase "ecological civilization" (S. Zhang, 1985). The news article reported the conference on scientific Marxism at Moscow University which discussed ecological civilization as a way to combine Marxist-Leninist and ecological sciences which would remake socialism and restore the human-nature relationship within industrialized modernity. Ma Shijun served as a member of the United Nations World Commission on the Environment and was one of the principal authors of the Brundtland Report *Our Common Future* (1987), defining sustainable development. Examining writings on ecological Marxism and the establishment of green parties in Western Europe, Wang Jin, a professor at Renmin University studying Marxist- Leninist

thought suggested that China should learn from political and scholarly movements in the West, revolutionize its technical production and moral ideals, and remake its socialist system into ecological socialism (J. Wang, 1986). Building on Western debates about the limitations of resources on earth, Wang proposed to radically reshape production and consumption within industrial capitalism to create equilibrium between resource availability and human demand and between economic growth and environmental protection. Wang regarded green intellectuals as the emergent force of industrialized capitalist nations and advocated for strict population and resource control in China. The notion of creating economic-ecological balance through state control has become central to China's state vision for an ecological civilization. As China began to open up its economy to global capitalism, the state has been retheorizing its socialist rationality of science and modernity and associated measures for socioenvironmental control in concomitant with reform processes of marketization (Z. Wang, 2012). Rodenbiker (2021) argues that the underlying logic of China's ecological discourses have framed urbanization as moral progress, defined an interventionist role for the state, and refashioned the peasantry's role from the revolutionary vanguard to a backward social force impeding modernization.

The Eco-City as the East-West Confluence on Design and Planning Principles

The relationship between humans and the environment has long been the core of many philosophical debates both in Eastern and Western societies. The rise of modern science in the West since the sixteenth century has greatly influenced worldviews of nature and human's relationship to the modern city. As Chapter Two has shown, scientific understandings of nature have continued evolving and have shaped institutions in human societies. Explorations on scientific understandings of, and institutional interventions in, human-nature relationships have continued evolving into the twenty-first century. Today, neoliberal networks of goods, ideas, and services in global markets have led to homogenizing effects on the built environment and market cultures while generating more aligned sociopolitical values that increasingly favor pro-environmental actions. Ecological design and planning has played a crucial role in contributing to such global processes of homogenization and alignment. China's urbanization, as a crucial factor impacting the twenty-first century, has been greatly influenced by ecological design and planning ideas originated in the West, as well as by associated development models and underlying worldviews. While China has become a practical paradigm for other developing countries due to its unprecedented pace and scale of growth, the nation has been simultaneously appropriating foreign ideas and reinventing its own traditions during its city making movements.

In particular, China's fever for eco-cities, although largely fueled by Western ideals of a modern eco-city, has historical roots in its own long-lived ideologies of the human-nature relationship. The latter is at the core of ancient East Asian worldviews. Establishing human spirituality and physical environments in relation to nature has always been essential to the region's tradition and culture in history. In Eastern ideologies, humans and nature cohabit to create harmony; the understanding of nature was internalized by humans to understand their own being and society. The view of

intertwined human-nature relationships is still ingrained in Chinese people today. Therefore, the enthusiasm for creating an ecological environment for living is not new in China. In traditional Chinese settlements, urban structures were carefully positioned in relation to surrounding geographic conditions and larger natural systems, such as the sun, stars, water, soil, vegetation, topography, and microclimate. Yet, China's traditional ecological philosophies had a limited impact on modern China's urbanization approach, although one could argue that the tradition of "living with nature" might have laid a partial foundation for the appropriation of Western notions of an ecological modernity. During China's movement to innovate and globalize its growth, Chinese officials and practitioners have been actively appropriating notions of sustainable development and ecological modernization, leading to growing environmental considerations in development policies.

Despite the drastic transformations in post-1978 Chinese cities, John Friedmann (2005) argues that Chinese civilization is continuous from antiquity to the present, underpinned by stable Chinese traditions. Academician Wu Liangyong, one of China's most influential architects and urban planners, notes that China's traditional design principles are influenced by the ancient philosophy of *fengshui*, which informs the relationships between man-made objects and the natural setting (Wu, 2010). *Fengshui* is defined as a result of the adaptive behavior of Chinese people through their long experience of the natural law (Lip, 1995; Wheatley, 1971). Based on the ideas of *fengshui*, ecology to Chinese people is a concept that merges science and spirituality. Such an understanding underlies practical strategies for planning and assessment in China's contemporary eco-developments. Chen and Thwaites (2013) suggest that traditional design ideas have become a "typological thinking" deeply integrated into the Chinese people's spontaneous consciousness, into their collective social values and beliefs, as well as into their popular lifestyles. They argue that this cultural continuity has contributed to maintaining social stability in the drastically changing Chinese society.

China's new developments increasingly involve foreign designers via the "transnational production" of architecture (Ren, 2011) in order to manifest the image of globalization through architectural spectacles (Liang, 2014). These architectural manifestations of globalization have contributed to the rise of what Roy and Ong (2011a) call a "worlding city"—a place that is a testing ground for economic growth, rational planning, ecological sustainability, and cultural reinvention in pursuit of world recognition in today's global inter-city rivalry. Roy and Ong (2011a, p.2) state that "worlding" cities exhibit unstable, contested, and incomplete urban characteristics while continuously reinventing globalized urban norms. In China's "worlding cities," where each urban development must be "distinct and stand out from the rest," cities have become "a globally familiar cacophony of discrete interventions" with a homogenized urban experience (Chow, 2015, pp.1, 65). Meanwhile, with the hope of establishing a competitive image of "Worldclassness", Chinese cities physically imitate "successful" models of global cities, such as New York City, Dubai, or Singapore (Roy and Ong, 2011a, p. 18). This rush of modernization is criticized for erasing urban history and building cities without character, what some have called a "Generic City" (Koolhaas and Mau, 2001, pp. 495-516). In response to China's cultural erasure and environmental degradation, and under the influences of the rise of eco-environmental rationality in global design culture and international

politics, ecology has been brought back to the rapidly urbanizing Chinese cities—both ideologically and physically—as a promising component that would enhance the built environment and enrich social life in tandem. With growing transnational collaborations in urban development, both the concept of ecology and the physical ecologies have become the domain with confluences of various Eastern and Western dialectics.

Building the Ecological City in Contemporary China

China's urbanization, which began in 1978 when the country opened up its economy, has been widely criticized for sacrificing life vibrancy, social justice, environmental wellbeing, and public health for economic gain. As China increasingly becomes integrated into the global economy, it has been searching for a more sustainable approach to urbanization that would adopt more advanced technologies while fostering a greener economy that is not based on manufacturing. Chapter One and Two have introduced that ideas and practices in industrialized, modern Western societies, especially those regarded as paradigms since the late nineteenth century, have been key references for the decision-makers of China's urbanization. While eco-environmental worldviews from the West have largely shaped China's modern views of urban ecology, ecological design and planning strategies have been adopted in China's green urbanization movement, especially in eco-city projects. China's eco-city projects—whether officially labeled by the formal programs of the Ecological City/Zone or proclaimed by local officials and practitioners—have been products of global influences that incorporate Western ideologies and practical strategies.

The influence from international initiatives of sustainable development on China's urban development can be traced back to 1971 when the United Nations Educational, Scientific and Cultural Organization (UNESCO) launched the Man and the Biosphere Program (MAB). UNESCO states:

> The MAB program is an intergovernmental scientific program that aims to establish a scientific basis for the improvement of relationships between people and their environments. It combines the natural and social sciences, economics and education to improve human livelihoods and the equitable sharing of benefits, and to safeguard natural and managed ecosystems, thus promoting innovative approaches to economic development that are socially and culturally appropriate, and environmentally sustainable (UNESCO, 2019).

MAB is the first transnational program to promote the integration of ecological and technological approaches in order to enhance economic productivity, urban growth, and human imagination (Liu and Sheng, 2017). China participated in the MAB initiative in 1971 and has been a member country since then. In 1978, China officially included research on eco-environmental problems in its long-term, national plans for science and technology development and established a national MAB Research Committee (Liu and Sheng, 2017). In August 1982, China hosted its first Urban Development Strategies Conference with the Committee's emphasis being to "value urban problems and develop urban science." It also established the research on urban ecosystems in Beijing and

Tianjin, which was designated in the nation's Sixth Five-Year Plan as a key project of technological innovation. In December 1984, China's first National Symposium on Urban Ecology was held in Shanghai, which is considered a milestone of China's evolving ecological approaches to urban planning and development. In the same year, China's Urban Ecology Committee in its Ecological Sciences Academy was founded, further promoting the international exchange of China's research on ecology.[2] In 1986, the City of Yichun in Jiangxi Province first set development goals to build an "eco-city" and carried out experimental projects in 1988. Yichun incorporated knowledge of eco-environmental science as well as principles of sustainable development in its planning and construction. This marks China's first exploration in practice that aimed to build an eco-city (Liu and Sheng, 2017). Academic research on ecology emerged to improve urban development. Scientific and technological approaches to understanding the city have been integrated into China's development strategies since then.

Under the influences of both globalization and local changes in Chinese cities since the early 2000s, an eco-city building movement emerged in China as a step for the country to move away from the image of the "factory of the world." The Chinese state has conceived a series of high-profile eco-cities which incorporated plans of social engineering. These newly constructed spaces and societies embody various ecological conceptions of the city. They carry the mission to create a new middle class with increasingly globalized consumption and behavioral patterns. The next chapter introduces four earliest, most high-profile model eco-cities. These projects reflect China's earliest attempts at innovating its urbanization through comprehensive planning of physical, social, and environmental changes. Analysis in the following chapters shows that the design, planning, and construction of eco-developments have created sites of physical, social, and environmental engineering that facilitate global socio-cultural assimilation at the local level in Chinese cities undergoing industrial or post-industrial transitions along with economic and infrastructural modernization.

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Chapter Three. Chinese Ecological New Cities as the World's "Laboratories"

Introduction to the Chapter

The experimentation with ecological and environmental strategies for development practice and policy-making has become a popular approach to sustainable development and a global phenomenon. When sustainable development was first proposed in 1987, the goal was to curb growth and reduce carbon emissions. However, in developing countries, growth remains of paramount importance. Continuing urbanization and reducing environmental impact seems to be a real contradiction. The eco-city model, proposed in North America, has been appropriated in developing countries to address the paradox between growth and environmental sustainability. Many researchers, designers, and NGOs across the world have constructed standards for building and assessing eco-cities. Demonstration projects labeled as eco-cities have been carried out in both developed and developing countries. Yet their formats vary greatly. With the expanding and diversifying usage of the term "the eco-city," its definitions have become increasingly obscure and chaotic. As of 2021, the world's largest, most ambitious eco-cities have been built in China. These projects were initially designed by the world's leading design and engineering firms but have been implemented under the constraints of national and local political economy.

Continued urbanization was the emphasis of China's political agenda during its tenth and eleventh five-year periods (2001-2010) when the country underwent a decade of drastic real estate boom in concomitant with rising globalization. Chinese cities not only experienced tremendous spatial and socioeconomic transformations but also carried out the boldest experiments in urbanization to create new cities with the potential to gain global competitiveness. Such bold urbanization projects often featured building an entire eco-city anew, which became China's once most promoted city-making strategy during its era of peak urbanization. It was also a period during which China eagerly adopted city-making models from developed countries to accelerate modernization and globalization. In response to the central government's call for international prominence in development, many local governments formed collaborations with foreign states and global design firms to innovate urbanization processes. While urbanization in China had largely prioritized economic growth through conventional industrialization and modernistic infrastructural upgrading, eco-cities—both through policy designation of existing jurisdictions at the municipal and district levels and through the construction of new urban areas—were promoted as China's frontiers of quality urbanization that would lead China's growth and modernization towards a path of deindustrialization and infrastructural greening. In particular, since the early 2000s, China's central government has supported the construction of several ecological new cities in its major coastal cities, since China's east coast has been a region at the forefront of urban transformations. This chapter first introduces the origins of the eco-city concept and the historical and piecemeal promotion of the ecological city/zone programs within China. The Chapter then provides a glimpse into China's once enthusiasm for building ecological new cities through the lens of four of China's earliest, once most

promoted eco-city projects, including Dongtan Eco-City in Shanghai, Caofeidian Eco-City in Tangshan, Hubei, Sino-Singapore Tianjin Eco-City in Tianjin, and Sino-Dutch Shenzhen International Low-Carbon City in Shenzhen. These projects—although vary in conception and implementation—not only exemplify China's earliest approaches to eco-city building but also serve as inspirations for subsequent eco-developments both within China and in other developing countries. Drawing on international critiques of China's eco-city construction fever, this chapter discusses the limitations of these earliest, high-profile ecological new cities.

Through the common features of the four cases of China's ecological new cities, this chapter illuminates the emergence of Chinese eco-environmental rationality during an era of peak urbanization and rising globalization. The four model eco-cities were all conceived as new cities built on a *tabula rasa* area according to principles of a green economy and ecological design. The development sites were typically former reclaimed land, greenfield, and rural villages at the hinterlands of the coastal cities. In preparation for the eco-city developments, original ecologies had been cleared to make a clean slate for construction. Land reclamation, despite the resultant ecological devastation, has been a common strategy in these coastal cities to build land from the ocean and expand urban territories. The underlying assumption of these ecological new cities was that these developments would serve as new engines for local and even regional growth while reducing the environmental impact of old urban areas. In reality, the implementation of China's iconic ecological new cities has been full of contradictions. The contrast between the optimistic visions and the failures in implementation invites skepticism about these ecological visions of a future city: Are eco-cities mere greenwash?[1] Are there any genuine intentions to promote environmental sustainability in these early initiatives? Guided by these questions, this chapter introduces the design and planning strategies as well as development outcomes of the selected model eco-cities to shed light on the contradictions underlying China's early initiatives of green urbanization. Synthesizing findings from literature review, site visits, and in-depth interviews with local planners and officials, this chapter presents major critiques from international scholars, as well as reflections from China's eco-city builders to reveal key reasons behind their failures and limitations. Despite the branding of their ecological innovation, the design, planning, and development of these model eco-cities were driven as much by economic and political objectives as by environmental ones. In fact, the social, cultural, and political underpinnings of an eco-development can fundamentally shape its ecological approaches and limit the effectiveness and authenticity of green transitions. Dialogues in this chapter serve as the foundation for the following chapters about the domestically proclaimed "success" cases. Together, discussions about the "failures" and "successes" in eco-development point to both meaningful progress to enable, and barriers to, green transitions in China's continued urbanization.

[1] In this chapter, greenwash refers to the disinformation disseminated by eco-city builders, including the government, the private sector, and other practitioners, so as to present an environmentally responsible public image of their policy and practice as well as the resultant projects.

Rising Eco-Ambition during China's Rush to Globalize

Since China's economic reform began in 1978, a "socialist market economy" has drastically transformed the country's urban landscapes. China's urbanization accelerated after the 1994 tax reform, when municipal governments began to rely on land-based financing to generate the majority of local revenues. Cities have become increasingly entrepreneurial, playing an instrumental role in facilitating urbanization. Along with a series of housing reforms, the nation's physical realm has been overwritten by millions of piecemeal and privatized constructions—including new housing, new businesses, and new factories—served by new infrastructure created through state-led modernization (Song and Ding, 2007). In 2001, China's accession to the World Trade Organization (WTO) marked the country's deeper integration into global markets. The first decade of the twenty-first century witnessed China's soaring real estate market, an unprecedented construction boom, and increasing foreign investment. Its urbanization inevitably became heavily influenced by the global neoliberal industries of design, planning, and construction.

Rapid urbanization has drastically improved the poor living conditions of a significant portion of the population, rapidly providing sufficient housing and amenities and alleviating poverty at a massive scale. However, China's hasty growth, fueled by the GDP-based political promotion system, has been widely criticized. Critics argue that local officials' focus on GDP increase and efficiency in development has resulted in projects that are socially insensitive, environmentally irresponsible, and physically unappealing (Chakroff et al., 2016). Chinese cities have been condemned as being superficially built without history and lacking in character (Koolhaas and Mau, 2001), and as being entirely instrumentalist or pragmatically geared for development (Wu, 2007). In order to stand out from the rest, some developments favored "weird" architecture that was aesthetically contentious (Holland, 2019; Li, 2016). The overall urban fabric of Chinese cities has become disconnected patchworks of monotonous buildings on superblocks (Chow, 2015).

In addition, the speed of market liberalization and urban construction has greatly transcended that of legislative and regulatory reforms, leaving the post-reform urbanization largely uncoordinated. With the lack of effective and systematic planning, fierce inter-city competition constrained by an overarching land quota system has resulted in uneven development across the country. The uneven development can be reflected by the contrast between the overcrowding in coastal regions and the overbuilding of infrastructure, housing, and industrial facilities in inland provinces. While coastal cities have risen to become regional and even international hubs for growth and innovation, cities in the rest of China have largely failed to keep up with such rapid paces of industrialization, economic growth, and infrastructural modernization. As the unevenness of development continued widening during China's era of peak urbanization, architectural design and planning became an important branding tool for new developments.

With the rise of globalization, Chinese officials and practitioners became increasingly informed about foreign ideas and practices. China's architectural design industry became increasingly

influenced, and even dominated, by multinational firms and brand-name designers. Gradually, ecological design and planning became important branding strategies in the inter-city and inter-region competition. Ecological and modern designs were rapidly produced by local-global design and planning collaborations. Developments were often typically advertised with ecological features visualized in photorealistic renderings and dubbed by optimistic rhetoric. In this way, cities compete to create "worldclassness" through strategies such as "modeling," "inter-referencing," and shaping "new solidarities" (Roy and Ong, 2011).

China's unprecedented economic growth has occurred with high environmental and social costs, which increasingly threatens sociopolitical stability. As China's central government has promoted a series of model cities since the 1980s to guide local practices toward more sustainable urbanization (see Table 1 in Chapter One), the evolution of these model cities reveals that environmental degradation, public health, social harmony, and quality of life have become increasingly emphasized on China's top political agenda. The more recent models, especially those promoted after China had reached peak urbanization around 2010, also emphasize the importance of eco-environmental principles in design, planning, and governance. Over the last decade, both the economic slowdown and international environmental initiatives have pressured the Chinese party to change its propensity for growth—shifting away from a growth-oriented mindset while adopting a degrowth, pro-restoration, and pro-regeneration approach to development. China's recent political discourse seems to have become more aligned with that of global environmental initiatives.

While China's ongoing pro-environmental changes remain uncertain, the campaign-like experimentation with building eco-cities predates the recent shifts. To facilitate more coordinated growth and enhance the image of the city, master planning became increasingly encouraged in state-led urbanization projects. Several model eco-cities were proposed in some of the country's fastest-growing coastal regions to continue attracting domestic and foreign investments. They were products of China's rush to globalize and were conceived as regional centers with a global reach, or were envisioned as the urban cores of future global cities. Such objectives were commonly stated in the comprehensive long-term plans of the hosting municipalities of the eco-cities. Facilitated by local state's entrepreneurialism and a land-based growth regime, many new cities labeled as "eco" and "low-carbon" broke ground in coastal cities. They exemplify a key strategy for China to modernize and gain global importance. Their planning incorporated green technologies at various scales and operationalized eco-environmental principles into sustainability-based frameworks. Under foreign designers' influences, these master-planned mega eco-projects shared the characteristics of optimistic rhetoric, images of progress, rapid design and prototypes, super-sized blocks, and homogeneous architectural form. Intended to stand out from conventional developments, these eco-cities were the best manifestation of China's ambition to globalize during its era of peak urbanization.

China has carried out the largest, most comprehensive eco-schemes in the world. These ambitious projects suggest that a *tabula rasa* solution for a massive new city in the form of a comprehensive blueprint is more likely to be implemented in a country with sufficient space and political and

economic power, such as China. The country has an authoritarian regime and tremendous national pride; its government owns vast areas of developable land; and it is both eager and able to invest in changes for a better future (Sze, 2015; Williams, 2017). The ecological new cities were conceived as the sites of massive experimentation with, and holistic adoption of, green technologies. In this way, the Chinese government sought to use demonstration eco-cities to show to the world that the nation has the economic and political power to build brand new cities from scratch while adopting the world's most innovative technologies in construction and management.

The conceptions of China's earliest, most high-profile eco-cities have integrated both state-centered reimaginations of a new urban society in China and Western ideas and practices of an ecological city. These projects have been developed through complex processes that often involve multinational governmental joint ventures or international collaboration of experts. Nevertheless, the rhetoric of these projects remains hyped and ambiguous, including chaotic discourse. As mentioned in Chapter Two, the term "ecological city" (*shengtai chengshi*) emerged in China long before the establishment of any nationwide programs or the globalization of the design and planning industry. China's first eco-city—Yichun, Jiangxi—was announced as early as 1986, without a clear definition, to demonstrate a path to sustainable development in the Chinese context of urban growth. Since then, the eco-city has been used in China to refer to incomplete and contingent "objects" defined based on objectives, power relations, different institutional organizations, and economic and social practices. Such variegated use of the term has led to the difficulty to lockdown the definition of an eco-city or to consolidate eco-cities into specific categories.

Despite the diverging ways of defining the concept, the institutionalization of the programs of the Ecological Demonstration Zone and later the Ecological City mark the early interventions from the country's environmental agencies in urbanization. These programs are considered a major revolution during China's modernization and urbanization in promoting regional sustainable development (Bertaud et al., 2009; Zhao, 2011). In 2010, the central government announced that 300 new cities would be built by 2025 and that about 20 of those new cities would be eco-cities. By late 2015, it announced that China already had at least 284 eco-cities dealing with a variety of ecological and environmental problems. Such drastic statistical increase of eco-cities seems to have occurred with apparent vagueness in the definition of eco-cities as well as their assessment criteria for performance. As eco-city programs and projects continue to grow and diversity, China's earliest high-profile model eco-cities have become precedents providing lessons for subsequent experiments.

Transnational Influences on China's Ecological Design, Planning, and Policy

As mentioned earlier, several ecological new cities emerged as pioneers of and models for urbanization during China's era of fastest growth, roughly from 2000 to 2012. The design and planning of these ecological new cities have all involved global intelligence corporations (GIC) (Olds, 1997; Ward, 2005), who introduced Western paradigms of the Garden City, new towns, the eco-city, eco-districts, and eco-communities to China's policy-makers, scholars, and planners. As a result, China's urbanization has undergone ideological and methodological Westernization during

the era of rising globalization. After Richard Register first coined the term "eco-city" in 1987, he further developed this concept, stating that eco-cities should "be designed from scratch to be compact, be designed for living beings, fit the bioregion and heal the biosphere, reduce energy consumption, promote social equity, community and health, prioritize pedestrians and bicycles, and contribute to the economy" (Register, 2002). The concept of the eco-city carries an optimistic vision of the future city in which economic growth, social wellbeing, and environmental sustainability are compatible with, and even complement, each other. The design and planning of this paradigm incorporates principles of human settlements in Ebenezer Howard's Garden City; the latter integrates natural elements in urban living through strategic allocation of greenbelts, residences, industries, and agricultural land (Rapoport, 2014). China's ecological new cities have commonly adopted these design and planning principles.

As of 2021, China's top scholars and policy researchers have continued learning from abroad about ecological approaches to city making. Among Chinese studies on eco-cities sponsored by China's National Science Foundation, a series of principles and best practices have been highlighted as useful lessons for China. For example, Chinese dialogues and studies on foreign eco-cities have emphasized approaches such as curbing growth and setting physical boundaries of the city, transit-oriented development, compact and mixed-use development with small blocks, green architecture, clean energy transition, placemaking in public spaces, low-carbon transportation, incentivizing the private sector, and public participation (Yang et al., 2018). Meanwhile, Chinese scholars and practitioners have studied several foreign eco-cities and eco-communities as paradigms and successful practices (see Table 1).

Table 1. Characteristics of Foreign Eco-Cities and Eco-Communities Highlighted by Chinese Studies (summarized by Yang et al., 2018)

City/ Community	**Year**	**Area (km^2)**	**Population**	**Key Ecological Approaches/Achievements**
Portland, ON, U.S.A.	1979	376.5	2 million	1) Setting legal growth boundaries and promoting smart growth; 2) utilizing GIS to support transportation and urban planning; 3) following principles of transit-oriented development and developing walkable streets and compact, mixed-used neighborhoods; 4) integrating green infrastructure; 5) refining the city's Climate Action Plan and setting emission standards.
Freiburg, Germany	1986	153	200,000	1) Developing environmental economics and a solar research hub; 2) achieving major reductions in energy use by energy saving, energy efficiency and renewable energy use including solar energy; 3) promoting low-carbon transportation, such as buses, walking, and biking; 4) reserving open

				spaces; 5) refining legal, regulatory, and policy guidance and enacting ecological indicators; 6) emphasizing waste classification and management.
Curitiba, Brazil	1970	132	1.6 million	1) Promoting transit-oriented development; 2) building an efficient, convenient, and affordable public transit system; 3) developing equitable and inclusive social programs and helping vulnerable populations; 4) sustaining protection for forests and ecosystems.
Copenhagen, Denmark	1990s	97	672,000	1) Effectively integrating rapid transit systems with biking and pedestrian systems; 2) preserving historical and cultural heritage and ecosystems; 3) replacing gray infrastructure with green infrastructure; 4) refining flood prevention strategies and the city's Climate Adaptation Plan.
Berkeley, CA, U.S.A.	1990s	46	100,000	1) Educating officials and the public about climate risks; 2) expanding the coverage of solar power and aiming to replace half of the existing energy sources with solar power by 2030; 3) integrating climate adaptation into urban planning, diversifying water supply, and developing green infrastructure to enhance neighborhood services; 4) promoting social equity and racial justice; 5) enhancing cooperation among various stakeholders and empowering communities; 6) strengthening inter-community collaboration to enhance regional resilience.
Masdar City, U.A.E.	2008	6.4	50,000	1) Adopting advanced technologies to construct energy-saving architecture and utilizing renewable energy; 2) building a compact, high-density city; 3) designing architecture to adapt to local climate; 4) promoting the efficient use and recycling of water resources.
Hammarby Sjöstad, Stockholm, Sweden	1996	2	35,000	1) Featuring ecological waterfront landscapes; 2) building compact neighborhoods with small blocks and dense streets to enhance walkability; 3) designing architecture to be adaptive to the environment; 4) establishing a self-sustaining ecosystem within the district; 5) regularly monitoring and evaluating daily energy and resource consumption.

BedZED eco-village, U.K.	1997	0.0165	270	1) Adopting climate-adaptive, energy-efficient architectural design to save energy; 2) promoting carbon-neutral housing that integrate work and living spaces; 3) installing a "living machine" system of recycling waste water; 4) recycling materials such as wood and self-planted forests to generate power.
Halifax EcoCity Project, Adelaide, Australia	1991	0.024	350-400 households	1) Promoting community-driven, public participation, and self-governance with the support from international organizations such as the United Nations; 2) specifying community-centered planning principles and practical strategies; 3) utilizing local techniques and technologies for construction.

According to reflections from Chinese scholars and practitioners, they are well-aware of the various eco-concepts and practices of city making promoted by the central government. Many view the "ecological city" as a concept that aims at sustainable development and encompasses multiple dimensions of being "ecological"—including being "green," "low-carbon," and "resilient." Similarly, they regard various eco-concepts and practical paradigms—such as the Garden City, the Forest City, the Green City, the Eco-City, the Low-Carbon City, and the Sponge City—as subcategories of "ecological city development." They still consider the highest-profile ecological new cities initiated by China's national government as paradigms. The Dongtan Eco-City, the Caofeidian Eco-City, and the Tianjin Eco-City are among those most discussed by officials and practitioners. Many Chinese planners argue that the experimentation of these projects has inspired subsequent explorations on the guidelines and regulations for the design, planning, and construction of ecological and green development.

In 2013, China's Ministry of Housing and Urban-Rural Development (MOHURD) announced the *Development Plan for Green Architecture and Green Ecological Urban Districts during the Twelfth Five Years*, which claimed to establish 100 demonstration projects of "green ecological urban district," including planned new areas, economic and technological development zones, high-tech industrial development zones, and ecological demonstration industrial parks. In 2014, the MOHURD designated 19 National Green Ecological Demonstration Districts. In 2017, the MOHURD released the *Evaluation Standards for Green Ecological Urban Districts* (GBT-51255-2017) for the evaluation of planning and management phases. The *Standards* specify eight categories of indicators, including 1) land use, 2) ecological environment, 3) green architecture, 4) resources and carbon emissions, 5) green transportation, 6) smart governance, 7) industry and the economy, and 8) culture and society. The MOHURD enacted the *Standards* in April 2018 and aimed to regulate all ecological developments using a scoring system. The *Standards* specify the thresholds for each indicator and the correlated scores. However, MOHURD has yet to explain how to ensure the consistency and

accuracy of such measurements or who should be the authority to ensure fairness in such evaluations. As of 2021, many demonstration districts remain incomplete developments with an ecological label. China has yet to collect authoritative data and generate official reports to comprehensively introduce and assess the existing ecological cities, zones, and communities.

Although systematic, credible evaluation remains absent, some pioneering projects within China, in addition to foreign paradigms, have become popular precedents for China's ongoing eco-developments. Existing studies in China have highlighted several Chinese projects of eco-cities and eco-communities as pioneers and paradigms (see Table 2.)

Table 2. Well-Known Domestic Eco-Cities and Eco-Communities
(summarized by Yang et al., 2018)

Project Name	**Year**	**Area (km^2)**	**Population**	**Key Ecological Approaches/Achievements**
Guangming New District, Shenzhen	2007	156.1	504,200	1) Setting a long-term plan with ecological redlining and environmental planning; 2) designing a compact district according to the layout and capacity of the transportation system; 3) promoting mixed land use to support urban vibrancy; 4) promoting green economic transitions and fostering entrepreneurship and innovation in the high-tech sector; 5) promoting decarbonization by incorporating green infrastructure.
Caofeidian International Eco-City, Tangshan	2008	74.3	800,000	1) Specifying an eco-city indicator system with 141 initial indicators; 2) constructing a multi-layered network of water ecosystems; 3) favoring transit-oriented development by organizing the urban layout based on public transit routes and mixing land use to enhance land use efficiency; 4) building water ecologies and waterfront landscapes to enhance the image of the city.
Sino-Singapore Tianjin Eco-City	2007	31.23	350,000	1) Emphasizing ecological restoration and constructing multi-layered ecosystem networks; 2) incorporating green architecture and renewable energy; 3) building community-based physical and social infrastructure systems; 4) the initial development has achieved partial success, forging culture and creative industry, internet, and finance as the

				three major industries driving future development.
Yanqihu Ecological Development Demonstration District, Beijing	2010	20.93	n/a	1) Building a center for high-end international conferences and business travels; 2) promoting water and aquatic ecosystem management; 3) adopting technologies for renewable energy, energy saving, and green architecture; 4) the project has involved high investment and its approach is difficult to replicate elsewhere.
Dongtan Eco-City, Chongming Island, Shanghai	2004	12.5	50,000	1) Establishing an all-encompassing, comprehensive eco-city development model; 2) integrating urban ecology into local socio-cultural protection and enhancement; 3) modernizing local agricultural production; 4) the project has been suspended due to land-use conflicts with farmlands and ecological protection zones.
Zhongtian Future Ark, Guiyang	2012	9.53	170,000	1) Fostering recreational zones, eco-tourism, and services for business travels; 2) incentivizing private investment in building green architecture; 3) designing waterfront landscapes, constructing wetlands, and treating water resources according to local geographic and ecological features; 4) utilizing renewable and energy-saving technologies.
Yuelai Eco-City, Chongqing	2012	3.44	57,000	1) Adopting walkable design for streets and blocks and connecting public transit systems with biking and walking systems; 2) designing natural landscapes and public spaces according to natural conditions; 3) designing pedestrian paths and open spaces to enhance pedestrian accessibility; 4) adopting climate-adaptive, low-cost, and green technologies for architectural design and construction.
Zaishuiyiyang Community, Qinghuangdao, Hebei Province	2006	0.56	11,000 households	1) Adopting climate-adaptive, passive systems in architectural design and construction, including energy-saving technologies, solar-based appliances, and geothermal heating systems; 2) adopting rainwater collection and treatment technologies, including rooftop runoff collection system, groundwater

				collection and treatment facilities, and constructed ecological water retention and cleanup systems.
Longxiangshiji Community, Nanyang, Henan Province	2011	0.33	7,680 households	1) Improving microclimate by the strategic design of buildings, community layout, and landscapes; 2) adopting economic design and low-cost construction techniques for greenery, levees, and constructed ecologies; 3) adopting climate-adaptive design to mitigate flooding risks; 4) integrating waste classification and reuse systems; 5) experimenting with residents-led community management and self-governance; 6) fostering the collaboration between ecological and environmental scientists and architectural design and planning practitioners.

Chinese Eco-City Builders' Justification for Western Inspirations

All the international and domestic projects listed above suggest that China has been searching for best practices of eco-development by learning from the West. Experienced practitioners and officials who participated in the conception and development of China's model eco-cities—what I call China's eco-city builders—provided some important insights into China's search for inspiration. They believed that Western practices of ecological planning and design served as paradigms for China's eco-cities. Their reasoning was threefold. First, the Chinese state considered itself an underdeveloped country that needed to catch up with the First World. It was eager to innovate its urbanization so that it could construct cities with the image of a global city. Hence, China sought solutions by involving the world's leading design and planning firms. These global firms often promoted the eco-city model as an innovative and progressive way to build the city for the future. They adopted ecological principles and green technologies to grant new developments exceptional qualities in a competitive planning and design industry (Rapoport, 2015). Hence, building eco-cities master-planned by international firms was once regarded as an effective strategy for innovating local practices that would leave a mark on the global stage (Caprotti, 2014; Chang and Sheppard, 2013; Rapoport, 2014).

Second, China's eco-city builders believed that the nation was not only eager to adopt foreign ideas but also capable of pooling resources and concentrating investments to enable massive modernization. Accordingly, building new cities from scratch could provide privileged areas with limited constraints on the experimentation of forward-looking visions. While retrofitting or reconstructing old urban areas would inevitably have to confront preexisting social, political, and

environmental problems, building anew escapes some existing institutional constraints and allows for easier, faster, and more comprehensive experimentation with bold, unconventional ideas. Building new cities based on globally recognized innovative ideas was also an effective strategy for local governments to achieve GDP growth while establishing a modernized, prosperous image of the city. From the global designers' perspective, given China's state power and available resources, they viewed China's new city initiatives as opportunities for testing new ideas comprehensively on considerable scales. In addition, the short-term GDP growth and the modernized image of the city helped to increase local officials' chance of political promotion. With such combined interests in experimenting with ecological new cities from both within and beyond China, the country still hosts some of the world's most comprehensive eco-city projects. These projects shared some common strategy—to generate a blueprint for a massive new city, the processes and outcomes of which would be controlled by a comprehensive, scientific framework. China's eco-city builders were proud of such a centralized, *tabula rasa* approach, because they believed that few countries could develop like China, where a powerful government could provide vast developable land and sufficient capital. To enable the comprehensive development of a new city, the Chinese government would exercise a high degree of control over population and resources and concentrate resources effectively and in a timely fashion to implement a bundle of place-based policies, including massive developable land, new housing stocks, utilities and transportation networks, preferential business policies, subsidized industrial land, government-controlled jobs, as well as social infrastructure that include healthcare, education, recreation, civic and cultural centers, and other public amenities (Jo and Zheng, 2020).

Third, China's eco-city builders stressed that the affinity for ecological ideas in the Chinese urban culture laid a partial foundation for appropriating Western ideologies of urban ecology. In Eastern ideologies, humans and nature cohabit to create harmony. The understanding of nature was internalized by humans to understand their own being and the society (Wu, 2010). In traditional Chinese settlements, buildings, roads, and agricultural fields were carefully positioned according to surrounding geographic conditions and larger natural systems, such as the sun, stars, water, soil, vegetation, topography, and microclimate. The layout of human settlements followed the principles of *fengshui*. While the ancient pseudoscience of *fengshui* still has lingering influences on contemporary practices, the longing for a harmonious life in relation to the environment is deeply ingrained in Chinese people. In modern China, Chinese people retain a propensity for ecological living environments. China's traditional ideal of "living in harmony with nature" resembles the core assumption underlying the eco-city model—to allow for the codependence and co-flourishing of the city and nature.

Although China's eco-city builders highlighted the East-West convergence of ecological ideas and practices, they seemed unaware of the distinctions between their conception and the original Western conceptions of the eco-city. These Chinese officials and practitioners embraced the transformation of nature as a means to create a more effective place for human health, economic growth, and social development. Their approach unintentionally paralleled the ideologies underlying ecological modernization—a concept introduced in Chapter Two. In contrast, Western conceptions

of the eco-city have been built on the beliefs that the environment must come first and that restrictions must be imposed on the development of human societies.

The different values underlying the development of China's ecological new cities and that of contemporary Western societies have been further legitimized in China's policy agendas towards an "Ecological Civilization". Although the worldwide eco-city movement originating in the West had a clear objective to save the Earth by restricting humans' unsustainable behavior, when this intellectual movement reached China—where the desire for economic development has been a prevailing social norm for over three decades—the eco-city ideal was appropriated to take new forms. China dubbed its programs as "Ecological Cities with Chinese characteristics" (Rapoport, 2015; Williams, 2017). In President Xi Jinping's speech at China's National People's Congress in February 2015, the construction of eco-cities with Chinese characteristics was emphasized as a crucial component of China's systematic approach to future reforms, called the "four comprehensives" (Williams, 2017). The speech advocated plans to build comprehensive eco-cities, which would delve into a wide range of urban environmental objectives in response to a comprehensive spreadsheet of ecological concerns. For each eco-city, priority could be given to one aspect, which would be explored more deeply. This would grant local authorities flexibility in interpreting the definition of "Ecological Cities with Chinese Characteristics" so that China's own path does not have to comply with all physical and moral restrictions of the Western model. Accordingly, the policy rationale underlying China's eco-city initiatives still validates the notion that the transformation of nature in order to create a better, more effective location for human growth, economic development, and social expansion is welcomed. This further reflects the similarity between China's approach to "ecological civilization" and the ideas of "ecological modernization." In contemporary Western conceptions of the eco-city, the environment comes first and restrictions must be imposed on development; whereas in China, societal prosperity must be the primal target of ecological planning and design. This points to tensions between the Eastern and Western understanding of man's relationship to nature in a contemporary, modernized society. Williams (2017) argues that growth is a "cognitively dissonant concept" in Western societies, but not yet in China.

Nevertheless, China's eco-city programs and practices indicate the increasing environmental awareness among China's policy-makers, which has begun reshaping the country's course of urbanization. Such pro-environmental transitions have been facilitated by both new policies and new practices: as mentioned earlier, the Ecological Zone/City program exemplifies a revolutionary policy that aimed at reforming urban planning and management, whereas building ecological new cities exemplifies an intended paradigm shift in how the Chinese state constructs the built environment and reshapes socioeconomic geographies at the local level. The following sections first introduce how China's Ecological Zone/City program has sought to reform its urbanization by generating a guiding framework through a technocrats-led, top-down planning process. The subsequent sections then discuss China's practices of building ecological new cities—what I call the earliest "model eco-cities"—to illuminate fundamental contradictions between development and the environment within growth-oriented economic, political, and social systems.

China's Attempts at Setting Standards for the Eco-City

Just as the definition of the eco-city has become increasingly obscure and diverse, the assessment criteria of an eco-city have also diversified and become chaotic. Globally, numerous frameworks and principles have been proposed to define, plan, and assess an eco-city, such as the United Nations' International Ecocity Framework and Standards (IEFS) (UN, 2017), the Ecocity Builders and associates' Ecocity Framework and Standards (Ecocity Builders, 2011), and others discussed in scientific and scholarly studies (to name a few, Bibri, 2020; Liu et al., 2016; Saad et al., 2017; SCJ, 2021; Tsolakis and Anthopoulos, 2015). Although these initiatives and studies have sought to clarify the concept and enable the development of more eco-cities to promote sustainable development, the operationalization of the proposed frameworks and principles must be carried out and examined within specific economic, social, cultural, political, and institutional contexts.

In China, the attempts at establishing a comprehensive framework for guiding the implementation and evaluation of an eco-city began as early as the conception of China's earliest model eco-cities. The Ministry of Environmental Protection has officially promoted the Ecological Zone/City as a model for sustainable development since the early 2000s, marking the nation's resolution to promote coordinated urbanization that integrates economic growth, social development, and environmental protection. This model targets the comprehensive enhancement of the quality of the living environment through ecological principles in urban planning and construction. The Chinese government envisions the ecological city as an economic-social-natural ecosystem that would achieve rational exploitation of natural resources and improvement of the environment while ensuring socioeconomic development and meeting the growing material and cultural needs (Zhao, 2011). According to this rationality, and building on principles of sustainability, the assessment of China's ecological cities was originally based on three major categories of indicators: economic growth indicators, ecological and environmental protection indicators, and social progress indicators (CSUS, 2000; Hald, 2009; Zhou et al., 2012).

According to the Chinese Society for Urban Studies (CSUS), building eco-cities is an imperative path toward realizing sustainable urban development. The CSUS has conducted extensive research on eco-city indicator systems and generated the report on *Eco-City Assessment and Best Practices (2010-2011)* (Chang, 2017). Owing to the variegated practices of eco-cities, the researchers selected 13 paradigmatic cities or new districts in China as representative cases, which include Tianjin, Tangshan, Shanghai, and Shenzhen. The CSUS researchers also reviewed a wide range of international indicator systems, including the Habitat Agenda Indicators and the Global Urban Indicators Database by the UN-HABITAT, the Indicators of Sustainable Development by the United Nations, the City Indicators by the World Bank, the European Green City Index by the Economist Intelligence Unit, the Healthy City by the World Health Organization, the Environmental Indicators by the Office of Community and Economic Development, the Agenda 21 by the United Nations, the City Indicator by the Asian Development Bank, and the Sustainable Energy Indicator by the International Atomic Energy Agency. The CSUS researchers also conducted

online surveys to collect public opinions regarding what indicators are viewed as important. Synthesizing the international standards, the domestic development models, and the public survey results, the CSUS researchers expanded upon China's past assessment system of eco-cities and established a framework with five major categories of indicators (Figure 1). These include efficiency in resource consumption, environmental protection, sustainable economy, social harmony, and innovation. The CSUS's research on eco-city indicators has set the foundation for, and been incorporated into, the aforementioned 2017 standards for Green Ecological Districts.

In the CSUS's original research, each of the five indicators is further evaluated based on a series of detailed indices that are quantitatively measured. For instance, the efficiency in resource consumption indicator is measured according to the utilization rate of reclaimed water, reuse rate of industrial wastewater, proportion of renewable energy, energy consumption in public buildings, area of per capita urban development land, and proportion of urban development land in the city. The environmental protection indicator is measured by indices for air pollutant concentrations, water quality, waste treatment, noise, and green space ratio. The sustainable economy indicator is measured by indices for GDP, industrial structure, income, and employment. The social harmony indicator is measured by indices for housing provision, healthcare for the elderly, cultural and sports facilities, education investment, income disparity, transportation provision and commuting time, numbers of criminal cases, and areas of shelter for natural disasters. Lastly, the innovation indicator is measured through indices of certified green buildings, transit-oriented development, environmental adaptation, heritage conservation, bio-diversity, disaster prevention, organic food production, low-carbon lifestyle, internet accessibility, and public participation.

While China's technocrats have carried out research to propose an indicator system as the policy guideline for the planning and evaluation of an ecological city, the central government has supported a series of mega urbanization projects to establish model eco-cities to demonstrate its new green urbanization approaches to the rest of the country or even the world. The earliest, most-known model eco-cities include the Dongtan Eco-City, the Tianjin Eco-City, the Caofeidian Eco-City, and the Shenzhen Low-Carbon City. They each have explored a detailed indicator system with the knowledge support from foreign scientists, designers, and engineers who were based in North America, Europe, and East Asia. Such an indicator-based approach to conceiving an eco-city is technocratic, deterministic, reductionist, and rigid in nature. Indeed, China's eco-city builders reflected on their practice and argued that the indicator-based planning of an eco-city curbed creativity in design and was proven unrealistic in implementation. After all, it is impossible to control the multi-stakeholder, dynamic development processes with a predetermined, one-size-fits-all framework based on pure scientific and engineering rationality. Without considering social and political factors, such as local economic conditions, cultures, power relations, and stakeholders' mindsets, imposing science on a complex city-making project is merely another way of being idealistic. Despite the ineffectiveness expressed by China's eco-city builders, Chinese technocrats and policy-makers have continued exploring indicator-based frameworks and standards to govern

eco-developments at scales ranging from a building to a community or to a whole city. Setting a conceptual framework remains a compelling approach to guiding the conception, planning, and evaluation of green urbanization in China. Such explorations have diversified to include both expansion and renewal projects. Policy-makers and planners are also tailoring green frameworks and standards to different land uses, such as recreational waterfronts, green residential communities, green industrial zones, and mixed-use eco-districts.

China's Ecological New Cities

China's policy-makers have not only sought to conceptually construct the eco-city, they have also been eager to apply this concept to engender physical and socioeconomic impact at the local level. While several ecological new cities remain the most comprehensive precursor of China's green urbanization movement, the enthusiasm for building an ecological new city is unflagging despite the nation's economic downturn. This enthusiasm is the continuation of China's green development policy during its era of peak urbanization. China's eleventh and twelfth Five-Year Plans (2006-2015) designated eco-cities as the key mechanism to transform economic production and urban development to build an environmentally, economically and socially harmonious society (Williams, 2017). Despite its wide adoption in practice, the term "eco-city" is still largely undefined in China. Its formats vary greatly from case to case. By 2009, about 100 or so eco-city initiatives were allegedly underway (Figure 2; CSUS, 2011). As of 2011, a total of 259 cities (above county level, representing 90% of cities in this category) announced their objectives to develop "eco-cities" or "low-carbon cities" in the near future (Rapoport, 2014). By late 2015, China claimed to have established at least 284 eco-cities dealing with a host of ecological problems (Shepard, 2017). Such a drastic statistical increase of eco-cities has occurred with apparent definitional vagueness. Many so-called eco-cities are still missing in action. Comprehensive data on the progress of China's ambitious campaign of building eco-cities remains unavailable or non-existent. The earliest model eco-cities remain under iterative processes of re-planning and expansion while new green projects continue to spawn. A systematic understanding of China's green urbanization movement is also obscured by the popularity of the "eco," "low-carbon," "green" rhetoric in urban development. New projects, whether labeled "eco" or otherwise, would claim to have adopted certain combinations of eco-environmental strategies at certain scales in order to innovate and brand their development. Ecological design and master-planning remains highly promoted in China with the promotion of an "Ecological Civilization" and thanks to its top-down planning systems.

In fact, a recent new city initiative suggests that building eco-cities remains a national strategy for urban policy reform. On April 1, 2017, President Xi Jinping designated three counties in Hebei Province as the "Xiongan New Area." Xiongan is China's supreme new development or a "millennial strategy" demonstrating state-of-the-art "eco" and "smart" technologies in city making and the nation's transition towards ecological civilization. Xi is building his "dream city" to showcase a "millennial strategy" for China to transition toward an ecological civilization (Li and Xie, 1AD;

Liangyu, 2017). Although Xiongan's planning has been underway secretively, the central government has mobilized tremendous resources and agencies from both within and beyond China in search of the most innovative designs and technologies. Xiongan's administration committee announced an international design competition for master planning. Major planning and design institutes have generated environmental plans and green building designs. The central government plans to relocate major enterprises and universities to Xiongan to boost its economic development. Many technology companies have flocked to Xiongan to experiment with new digital tools for public services and urban management. Various research programs and demonstration projects have been established on site to explore eco and smart approaches to developing the new area. With the highest political support, Xiongan has become the nation's most important testing ground for urban innovation that would demonstrate "the construction of ecological civilization." Some participants in Xiongan's initial development reflect that the lofty aspirations from all of the various actors have led to a bias towards action even when this action is not fully reasonable yet. While China's newest development now exhibits even higher eco-ambition, Xiongan's approaches are highly similar to those found in China's earliest ecological new cities.

Four Earliest Model Eco-Cities

Despite the hyped eco-ambition of the nation, building high-profile eco-cities remains an important phase of China's green urbanization movement. China's earliest ecological new cities were conceived in the early 2000s. They broke ground during the eleventh five-year period (2006-2010) and are still awaiting further development today. These ecological new cities were supposed to rise from nothing. They were comprehensively planned megaprojects that would showcase some of the world's most forward-looking strategies for sustainable planning and design as well as the world's most advanced green technologies that would reduce the environmental impact of human societies. The planning and design of these eco-cities incorporated constructed ecosystems, urban parks, and measures for environmental protection and energy saving. Their schematic designs involved the world's leading intelligence corporations as well as scholars in planning, science, and engineering. Most ecological new cities were strategically located at the hinterlands of major cities in coastal China to meet the demands of growing population influx and industrial development. The ecological features of the new cities would attract productive populations and facilitate industrial upgrading. More importantly, these new cities are planned as demonstration projects that would enhance regional economic performance and showcase model sustainable development to the world.

The implementation of these pioneering eco-cities had initially received strong state support at the central, provincial, and local levels and was led by leading Chinese planning institutes. Their builders remarked that these ecological new cities were envisioned as the world's "laboratories" for future-oriented ideas and innovative technologies. They carried tremendous optimism about reforming urbanization for environmental sustainability. In contrast, their actual implementation has been fraught with challenges. Due to local financial difficulties and discontinued political support, some originally planned demonstration eco-cities were suspended, although their original proposals were

re-adopted and adjusted by new generations of local administrators and planners. In such processes, ideas underlying the original planning and design are lost in iterations and hence yet to be realized. Most of the built parts of these eco-cities look like a generic Chinese city with empty neighborhoods and commercial districts awaiting future occupancy. The journalist Bianca Bosker views Chinese eco-cities as "the same sprawling McMansions under a different name" (Bosker et al., 2013).

Some scholars argue that the rise of "eco" has become a signature style of urban China (Governa et al., 2019). The Finnish environmentalist Eero Paloheimo calls eco-cities "standard-setters" (Paloheimo, 2009). Although the eco-city model was imbued with tremendous optimism, their design, planning, and construction has drawn skepticism. Sze (2015) suggests that China's eco-cities are full of contradictions. These pioneering eco-cities either remain plans on paper or are suspended. Most of the built parts of eco-cities look like a generic Chinese city awaiting future occupancy. The incompletion and the quality of the built environment in these eco-cities have drawn wide criticism. Their "ecological designs" are yet to be realized; hence disbelieving commentators view eco-cities as merely a branding strategy. They have been widely criticized for their bold plans, greenwashed branding, land speculation, incomplete implementation, generic urban form, and environmental damage (Chang and Sheppard, 2013; Joss and Mol, 2013; Rapoport, 2014; Shiuh-Shen, 2013; Williams, 2017).

Despite the widespread criticism, officials and practitioners within China and in other countries have studies these ecological new cities as paradigms of green urbanization. Similar eco-city projects continue being spawned and diversified, especially in developing countries. Contentions about demonstration eco-cities are focused on either the utopian visions in their rhetoric or dismal outcomes in practice. This dichotomy in opinions remains unresolved. Nevertheless, China's ecological new cities have allowed for both the reimagination and the experimentation of city making based on new technologies and normative worldviews of sustainability. Their implementation is nested in socioeconomic, political, and cultural challenges in local practices while being intertwined with a globalizing economy.

The following sections discuss four model eco-cities that are among the earliest, most famous ecological new cities in China: Dongtan Eco-City, Caofeidian Eco-City, Sino-Singapore Tianjin Eco-City, and Sino-Dutch Shenzhen International Low-Carbon City. They exemplify China's most promoted green strategies for urbanization. An overview of the four projects' major actors, eco-environmental planning, and development outcomes suggests similar strategies and common drawbacks in China's earliest model eco-cities. Lessons from the four cases provide background knowledge about what Chinese officials and practitioners perceived as "best practices" of green urbanization. The evaluation of these demonstration projects serves as a reference point for assessing the success and failure of subsequent eco-developments.

All the selected cases are new cities planned and built completely from scratch on reclaimed and/or rural land on China's eastern coastline (Figure 3). In the Yangtze River Delta region, Dongtan Eco-City was planned in 2005 by Shanghai municipal government and designed by ARUP. It is China's

earliest plan for an "eco" new city (Chang and Sheppard, 2013; Sze, 2015). In the Bohai Rim Region, the municipal government of Tangshan, Hebei, proposed Caofeidian Eco-City as part of the Caofeidian New Area. Its planning began in 2009 as a joint venture between the Chinese and Swedish governments. It was designed by Sweco to accommodate 1.5 million additional population from the entire Caofeidian New Area (Joss and Mol, 2013). In the same region and in the same year, the Sino-Singapore Tianjin Eco-City broke ground thanks to the collaboration between the Chinese and Singaporean governments. It aimed to accommodate at least 350,000 people in the long run (Caprotti, 2014). In the Pearl River Delta region, Shenzhen launched the Sino-Dutch International Low-Carbon City in 2012 to establish a model for future low-carbon planning and governance. This project stemmed from the region's development reform plan to establish a "regional industrial ecological new city" (Cheshmehzangi et al., 2018). All of these ecological new cities were promoted with maximum publicity as models for future city planning and design as well as for modern industrial and social development. There was tremendous optimism about their economic success and attractiveness for new residents, skilled workers, modern services, and new and clean industries.

How was innovation conceived in the planning and design of these ecological new cities?

As the earliest comprehensive plan for an ecological new city, the Dongtan Eco-City was envisioned as "a global template for sustainability in urban planning" and "a prototype for the future of all cities" (Figure 4 & 5; Arup, 2005; DBN, 2005). Located at the outskirts of Shanghai along the coast, the Dongtan Eco-City was originally remote from the urban center of Shanghai—with no transportation infrastructure connection—and mainly relied on localized, small-scale agricultural activities. The new plan aimed to create a city with a 60 percent smaller ecological footprint, 66 percent reduction in energy demand, 40 percent energy use from bioenergy, 100 percent renewable energy use for buildings, on-site transportation, 83 percent reduction of landfill waste, and almost no carbon emissions. The Dongtan Eco-City was also envisioned as a compact city with low-rise homes and high-tech companies dispersed in vast networks of wetlands and parks. The plan also adopted advanced green technology by proposing to install organic "plant factories," use solar-powered LED lights, only operate zero-carbon-emission vehicles, and employ organic waste management methods (Chang and Sheppard, 2013). The Dongtan Eco-City would only occupy forty percent of Chongming Island, leaving the remainder as agricultural production spaces and natural habitat for migratory birds.

Planned a few years later, Caofeidian Eco-City's design (Figure 6) consisted of a comprehensive set of programs, including: a high-rise city center, a mixed-use district incorporating a city service quarter, a multifunctional resource management center (including water/waste/material recycling and district energy systems), and a flexible area for future development (AE, 2015; Cooke and Eriksson, 2011; ESCI, 2016; SWECO AB, 2008). Its ecological approach to city design was best represented by the surrounding greenbelt, designated as a wetland park, which would also act as a natural barrier separating the freshwater habitat from the saline water near the seashore. The promoted green lifestyle was supported by an inclusive, equitable public transport system that was designed to put 90 percent of residences and offices within 500 meters of public transport services. Renewable sources, including wind, solar, and geothermal energy generated onsite, would provide

ninety-five percent of energy use. All the masterplan, individual district plans, and local site plans were based on an elaborate, specially developed system of 141 eco-city indicators (with a similar framework as the one mentioned above). In support of the ecological focus in the plan's innovation, Caofeidian Eco-City was also envisioned as a "techno-city" that would realize its low-impact, environmentally sensitive objectives through adopting state-of-the-art, scientifically developed technologies (Joss and Mol, 2013). Infrastructural construction and real estate development were supposed to parallel each other across the entire city so that the first 800,000 residents could be well-served by public transit and settle down by 2020. The overall investment and construction costs were expected to be around US$15 billion (98 billion yuan), which would be heavily subsidized by the local government of Tangshan City especially at the start, with a small portion coming from a few public-private companies.

Developed around the same time as the Caofeidian Eco-City, the Sino-Singapore Tianjin Eco-City (Figure 7) adopted its precursor Dongtan Eco-City's ideological framework and became a showcase of China's international engagement and ambitions in developing ecological cities. Its plan was designed to be practical, replicable, and scalable. It was also intended as a demonstration of effective strategies for tackling environmental protection, resource and energy conservation, and sustainable development more broadly. The innovation in its design strategies was again represented by ecological approaches. For example, the green spaces would be interspersed throughout the city; the city would draw a significant part of its water supply from desalinated water and reduce freshwater consumption; its public transportation would rely heavily on networks of trams and buses in order to reduce carbon emissions; and waste production would be reduced through reuse and recycling. The Tianjin Eco-City was designed based on 26 Key Performance Indicators (KPIs). Many of these indicators have an eco-environmental focus, such as ambient air quality, tap water quality, carbon emission per unit GDP, the proportion of green buildings, green transportation, usage of renewable energy, non-traditional resources for water, and sources of renewable energy. The KPIs used in Tianjin Eco-City have become a model for subsequent ecologically driven development projects. As the project continues evolving, local planners have endeavored to refine the KPIs so that the targets are more practical and hence more likely to be realized.

One of the most recent high-profile new cities is the Sino-Dutch International Low-Carbon City in Shenzhen (Figure 8). Since Shenzhen was designated as China's first Special Economic Zone, the city has been the leader in China's experimentation of innovative, sustainable urbanization strategies. Shenzhen is China's first demonstration city of low-carbon development (Baeumler et al., 2012). It currently undergoing a post-industrial transition, and its built environment has been regenerated through urban renewal projects. The International Low-Carbon City was conceived as a new form of an ecological new city that would transform a manufacturing-based, carbon-intensive local economy into an advanced economy that would build on cleaner industrial development. The development is expected to comply with a comprehensive set of quantitative goals, which include nine categories of indicators for measuring carbon emissions: carbon output, industry types, green buildings, transportation, energy structure, green spaces, resource use and recycling, environmental quality improvements, and management and monitoring. Through collaborating with the Dutch government and involving other international experts, the planning and design of the International Low-Carbon City has proposed to construct futuristic green buildings, preserve ecosystems, and

transform the cultural identity of the area. The site of the International Low-Carbon City is the original Pingdi Sub-District in the Longgang District, a low-income, underdeveloped, and partially urbanized rural area in the northeastern part of Shenzhen. Pingdi's population consisted of 170,000 low-income farm workers and its built environment was heavily polluted. The new development aimed to transform the backward image of the area into a "livable, dense, mixed-use, futuristic, and ecologically-centered" city that will draw global attention (Li, 2021; Zhan, 2018). Population in the new city was expected to reach 420,000 by 2020. The development was also projected to create around 50,000 high-paying jobs by 2020. The project also aims at creating new forms of mixed-use and low-carbon businesses and services which would foster a startup ecosystem for creative industries. In addition, approximately 70% of the project's land area is reserved for constructed green spaces and natural ecologies in order to use nature-based solutions to improve heat dissipation, natural ventilation, air quality control, and flood and waterlogging control.

The four projects are located in different regions—each with unique political and economic importance in China. Each project has constructed a detailed indicator system similar to the aforementioned general framework. Their eco-environmental design and planning principles commonly include enhancing energy use efficiency, integrating waste management systems, preserving ecosystems, mitigating pollution, creating green public spaces, promoting low-carbon lifestyles, establishing transit-oriented developments, mixing land use, incorporating high-tech industries, and adopting green building technologies. The commonalities in their key strategies seem to suggest that there is a model for an eco-city. However, these projects have all been suspended shortly after they started and have undergone years of recalibration of their strategies for planning, design, and implementation. Today, most of them are still in the initial phases of development, and their sites largely await development. The eco-city model's effectiveness in greening urbanization has yet to become tangible in these earliest demonstration projects.

These model eco-developments showcase that China's ecological new cities were conceived based on the assumption that comprehensive master planning could be a common strategy for coordinating urban development and environmental governance at a regional scale. China's authoritarian regime, including a planning system with a socialist legacy, favored the "comprehensiveness" in planning and design and promoted master-planned blueprints, mega projects, building anew, and top-down implementation. In the meantime, their ecological and environmental measures emphasized environmental engineering, scientific calculation, and the utilization of green products and technologies. In the plans of these model eco-cities, green spaces were heavily designed and artificially engineered for ornamental and recreational purposes, which were intended to incorporate constructed ecosystems and networked green infrastructure. In addition, each project adopted a framework of indicators that set standards for the economic, social, ecological, and environmental impact of the development. The frameworks function as a tool for controlling development outcomes. The main goal was to increase green spaces and ecosystem coverage while reducing pollution and carbon emissions. The state determined land use, spatial organization, and the quantitative thresholds of one to two hundred indicators. Together, the blueprint of the physical and environmental design plus the scientific, indicator-based framework for planning and process control were expected to regulate growth, curb environmental impact, ensure

development coordination, and balance economic, social, and environmental impacts during the implementation of an eco-city. The physical design, environmental planning, scientific evaluation, and new technologies combined had supposedly integrated the most advanced knowledge, experience, and expertise from both local and international experts. Accordingly, China's development authorities expected that such rational planning would guide industries and developers in implementation so that the whole project would meet economic, social, and environmental targets.

Contradictions of China's Earliest Model Eco-Cities

The aforementioned four cases reveal a series of contradictions in multiple aspects of China's earliest eco-cities. Despite the political importance of these eco-cities, the prolonged, unsuccessful implementation of the grandiose visions of China's ecological new cities has created a sharp contrast between fantasy and reality. In many cases, humanistic spatial design integrating ecological approaches to flood prevention, pollution mitigation, and environmental restoration were reduced to massive, concrete infrastructure and building blocks for reduced cost and fast implementation. Public spaces for social life were minimized to maximize profitable areas for real estate development. Critiques from international media and scholarly communities have highlighted a series of failures of China's eco-city experimentation. These include their technical solutions, the capitalization of the environment, the contradiction between economic growth and the environment, the idea of a universal model, and the uncritical appropriation of foreign approaches. The following sections speak to the common features and shortcomings of China's earliest ecological new cities.

Who were the constituents?

These high-profile projects are state-led demonstrations that experiment with new ideas for reforming economic growth, planning practice, and urban policy. They have been incorporated into municipal and regional development strategies, especially the Five-Year Plans, and received strong political support from local, national, and even supranational governments. The national government designated these areas as special, and privileged, development zones which received favorable, and often more liberal, policies to encourage international trade and foreign direct investment. These areas are administered by special commissions who are allowed to work beyond the constraints of conventional planning and governance. As a result, these projects were once drivers of globalization, receiving multinational support. For instance, Caofeidian Eco-City was developed through the collaboration between the Chinese and the Swedish governments; Tianjin Eco-City was a joint venture between the national governments of China and Singapore. The Low-Carbon City has involved extensive collaborations with the Dutch government. They were envisioned not only as local growth engines but also as hubs that would strengthen regional, national, and transnational economic connectivity and competitiveness. In such transnational collaborations, China provided sufficient land and political power to efficiently implement change. Foreign governments, corporations, and practitioners were attracted to the potential for these

projects to create new global markets for green technologies and new nurturing grounds for green industries.

The strong governmental support was reinforced by powerful state-owned enterprises (SOEs) in China's major industries. In fact, SOEs played a crucial role in kick-starting these projects. Some formed partnerships with local governments and established private enterprises to construct and manage the pilot phases of the project. Others relocated their headquarters to the new areas which became anchor industries in the new development.

It is worth noting that all the projects involved famous global design and engineering firms in generating their schematic master plans. However, global firms could only participate in the conceptual stage of the projects. Domestic planners argued that although foreign designers offered innovative design ideas they had little understandings of technical specificities in China's physical planning and architectural practices. As a result, despite the involvement of foreign governments and experts, all the projects remain under strict control of the Chinese state. However, the stagnant growth of these projects has led to an inadvertent outcome: the rise of pluralistic planning processes that involve various non-state or semi-public stakeholders, especially developers, key institutions, urban residents, and rural collectives. Over the last two decades, the lengthy and iterative development processes have inevitably been shaped by ongoing transformations in policy agendas as well as local socioeconomic conditions. Although opinions from the public and long-standing rural collectives were initially neglected in these projects, China's eco-city builders suggest that in the new phases of planning and design the development authorities not only encourage public engagement but also seek to redistribute benefits generated by the development in more equitable ways among various governmental, market, and individual or collective stakeholders.

How have the projects been implemented?

When discussing the four projects' implementation, Chinese officials and planners typically emphasize how much construction has been carried out and whether the developments are profitable. The Dongtan Eco-City and the Caofeidian Eco-City were indefinitely suspended in 2008 and 2012, respectively (Figure 9). Their implementation was greatly affected by corruption involved in both cases, signaled by the arrests of each project's political leaders. Without sustained political support, both cases fell through quickly after their start. As a result, the two projects were once considered as total failures that might never be completed. However, in recent years, new leaders have continued exploring eco-environmental planning in the two new cities. New development strategies mainly focused on real estate and industrial development that would promote economic growth. The originally proposed eco-environmental strategies and the frameworks of indicators have largely been discarded for their lack of practicality.

In contrast, both the Tianjin Eco-City (Figure 10) and the Shenzhen International Low-Carbon City have undergone continuous development and attracted increasing global attention, although their growth has been slower than what was originally expected. The Tianjin Eco-City has attracted nearly 60,000 residents as of 2015. With growing numbers of new residents and new businesses, a series of top real estate developers have been building new homes and offices in the pilot areas of the new

city. Renewable energy systems are being embedded in its infrastructural system in order to cut down energy consumption and reduce carbon emissions. The International Low-Carbon City has attracted many new businesses and industries. Between 2011 and 2014, 40 high-tech companies with a total output of RMB 9.6 billion have relocated to the new area. The development is allegedly transforming the underdeveloped area by replacing heavily polluting and low output factories with more advanced industries. In Shenzhen, tensions between the government, developers, and rural collectives have been a major challenge of redevelopment projects over the last three decades. Similar challenges have significantly hindered the growth of the International Low-Carbon City, despite that it was conceived as a new city. Over the years, the International Low-Carbon City's development plan has shifted away from China's conventional urbanization strategy—namely, large-scale demolition plus building from scratch—and took a new path by adopting a more retentive and regenerative approach. The proposed solutions are twofold: on one hand, some of the existing buildings are planned to be preserved and refurbished according to the latest environmental standards; on the other hand, new buildings and infrastructure demonstrating cutting-edge, low-carbon technologies have been, and will continue to be, constructed. This shift in development mentality and planning strategy has become the new innovative feature of this project.

Chinese media, officials, and practitioners have praised the achievements of Tianjin Eco-City and the International Low-Carbon City, emphasizing the increases in growth rate, the amount of building and infrastructure constructions, numbers of attracted businesses and residents, housing prices, green spaces, and more advanced industries. These aspects have been frequently mentioned to praise the "success" of the two projects, revealing the importance of measures of GDP growth. Such an economic focus in key decision-makers' development assessment fundamentally contradicts the rationality underlying the projects' ecological design and planning. The sustainability-based framework has been largely ineffective in guiding development and assessment. Without monitoring the development process, it remains unclear how much ecological design and environmental planning in the model eco-cities have contributed to environmental improvement. The development of the model eco-cities suggests that eco-environmental principles of development were yet to be institutionalized during China's era of peak urbanization, despite high-level technocrats' attempts at setting standards. GDP growth remained front and center on local states' political agendas and was the main criterion for evaluating development achievements and officials' performance.

Are the original design ideas realized?

The builders of these eco-cities have admitted that it has been challenging to realize the original ecological and green ideas. They have encountered market, institutional, and regulatory barriers when operationalizing the eco-environmental principles and when applying the indicators to practice. Comparing the ample green spaces in the renderings with the actual built areas in these projects, it is evident that ecological design has fallen short in most parts of the projects. Elements of eco-environmental design—such as constructed wetlands, greenways, solar panels, and wind turbines—can only be observed in the pilot zones in a piecemeal fashion. These features are ornamental rather than performative. Some local planners and officials suggested that it was in fact expensive and time consuming to restore ecologies and construct new green spaces in these

developments. Therefore, based on GDP-centered rationales, it was difficult to incentivize developers to invest in green infrastructure and ecological components of the new city. Even when green spaces were constructed or when green technologies were adopted, the scales of these interventions were too limited to engender effects such as decarbonization or energy saving. With insufficient public funds to finance these megaprojects, the rapid development in these new cities was largely driven by private developers. Without sophisticated institutions mandating private investment in the public realm, the initial development of these areas lacked sufficient infrastructure and public amenities. The local government located these new cities on cheap land near the ocean for potentially profitable waterfronts. While public transit connections were still under construction, these projects have been urban exclaves far from the original city. They are either completely disconnected from, or have limited connections with, existing urban areas. Access to these model-eco-cities, as well as getting around within them, largely relies on private cars. The built environment of these so-called eco-cities appears as generic modern cities with wide roads and gated superblocks. They resemble the majority of the rapidly built urban areas throughout China, only produced at much larger, non-walkable scales. With economic considerations taking priority on local development agendas, ecological features have become a branding strategy serving pro-growth purposes. Similarly, the ecological identity has become a label intended to attract privileged citizens and boost continued consumption of housing and services. Nevertheless, an ecological label has proven to be insufficient for attracting residents to these model eco-cities. Housing, office buildings, shopping malls, and the central business districts in these places remained largely vacant in 2019. Despite some scenic views in a few pilot parcels demonstrating ecological design, these new cities remain vast heat islands waiting for high-rises to spawn. Overall, these projects hardly realized the original eco-environmental principles. Considering the increasing government debt due to the huge spending on new city construction, local authorities have sought to overcome economic difficulties by further focusing on economic development while compromising, or even completely discarding, environmental objectives. Rather than following eco-environmental principles, these "ecological cities for the future" are re-envisioned as "growth machines" that would encourage construction, boost consumption, and fuel economic development at the local level.

Commonalities among China's earliest ecological new cities point to the once prevailing strategies for innovation in the nation's architecture and planning industry. The ideological and technological inspirations from ecological ideas have influenced local and national urban policies and mobilized forward-looking explorations in local practices. Builders of these eco-cities placed tremendous confidence in eco-environmental approaches in their search for an effective and efficient way to stimulate growth while reducing environmental impact. Such optimism was indeed shared among designers, planners, government officials, developers, entrepreneurs, and the residents of the city. However, the environmental, economic, and social goals underlying ecological approaches to city making have hardly reached a balance in practice. China's experimentation of building ecological new cities suggests that the notion of a model eco-city is fundamentally flawed. Below are some key problems underlying this once prevailing approach.

A contextualized, environmentally sensitive intervention, or a fully invented, alternative stimulus for economic growth?

First and foremost, despite the branding of their ecological innovation, eco-city projects are driven as much by economic and political objectives as by environmental ones (Caprotti, 2014; Joss, 2011). China's ecological new cities exemplify such rationality. Although planners and designers have successfully utilized ecological ideas to mobilize new explorations in policy making and practice, in order to realize these ideas, urban development must occur first. This means that huge initial capital investment is crucial for even starting the project. When the premise of the development was to build a whole new city for GDP growth, the main decision-makers—local governments, SOEs, and developers—would still prioritize economic gain. To them, the initial success hinges on effective strategies for creating business agglomeration, facilitating urban expansion, and driving consumption. Without systemic, institutional reform to move towards a degrowth path, ecological ideas would remain a tool for boosting economic growth. After all, China's eco-city projects prove the shortcomings of greenwashing capitalist growth: The capitalization of the environment could ultimately lead to the exploitation and devastation of the environment.

While the ecological focus of these projects is explicit in all promotional materials, the economic focus is dominant in their implementation, resembling conventional development strategies subject to China's political economy of development. The advertisements and publicity materials of these projects contain bold claims, ambitious targets, eye-grabbing physical designs, futuristic renderings, attractive green programs, and innovative technological integration. Their promoted images have conveyed a bright future with an ecologically attractive, flourishing urban environment in which human society would thrive. Despite the focus on ecological design and cutting-edge technologies in their advertisements, the strategies for environmental concerns are carried out at a basic, minimal level. In many cases, the ecological components were diminished to installing a few solar panels and wind turbines dispersed in some spots in the city. Although they claim to be innovative by incorporating planning principles for all environmental, economic, and social aspects of sustainability, most of these promoted projects worked within China's growth-oriented, land financing-based models of urban development.

In Western societies, ecological design and planning firstly emerged as small-scale interventions in the existing built environment to engage both natural and social environments. These interventions were carried out through a bottom-up process led by citizens, activists, and design and planning professionals, all of whom were primarily motivated by concerns about ecological limits, social equity, and physical quality in the neighborhoods. In contrast, China's current ecological developments, resembling many other new city projects in the developing contexts in Asia and the Middle East, are often vast, overly ambitious developments with greenwashed, technocratic characteristics. The optimism embodied in these futuristic, utopian projects was partially bolstered by China's decade-long double-digit growth, which had also stimulated tremendous ambition to maintain economic growth. Both the Chinese state and the private sector have become entrepreneurial so as to profit from urbanization, forming growth coalitions that reinforce the entrenched productionist approach in China's urban policy (London, 2018). Urban development was simplistically evaluated by increases in economic terms, with little social and environmental considerations.

Central to the eco-city's contribution to economic development is its value in distinguishing and branding the new development projects. With rising concerns about climate change across the globe, the core ecological aspiration in these projects has made them hugely appealing to all actors in city making in various cultural, social, and political contexts. Therefore, ecological design and pro-environmental technology have become necessary components of a utopian vision that helps to mobilize these projects and attract businesses and residents. Overshadowed by the current economic objectives, what has been poorly studied is the validity of indicators selection, the methods of the indicators' measurement, and the effectiveness and impact of these projects' ecological approaches after their implementation. The actual eco-environmental performance of the new development was largely neglected once the city was built. In fact, whether the eco-cities met the targets within the frameworks was evaluated by self-reporting from their builders. Neither the eco-cities' development authorities nor the experts in a specific field knew how to evaluate the complex, ongoing outcomes of an eco-city.

Learning from abroad or appropriating modern ecological rationality for growth?

Eco-cities and similar projects have been conceived, and must be examined, within the political and economic contexts in which they are developed. While some eco-districts were constructed as municipality-driven developments in Europe in the late 1990s, eco-city projects in developing countries have received high-level support from the national governments. China is one of the most ambitious countries whose national programs and subsidies promote ecological innovation (Pow and Neo, 2013; Shiuh-Shen, 2013). China has always been eager to learn new lessons from best practices and successful developments elsewhere. For example, China's search for innovative ways to green growth opened the discussion of some sustainable developments by northern European municipalities in the 1990s and early 2000s. They include model eco-districts, such as Hammarby Sjöstad in Stockholm, Sweden, Vauban and Rieselfeld in Freiburg, Germany, and Bo01/Western Harbour in Malmö, Sweden. These prominent projects were viewed as inspirational for their use of design and technology to achieve sustainability goals and promote social advancement. They are often referred to as some of the best practices in early sustainable development and design (Ritchie and Thomas, 2009). These projects helped to popularize the idea of incorporating sustainability principles into the planning and design of new urban areas, although they were limited to neighborhood or district scales. Nevertheless, socio-political differences may limit the applicability of the approaches. Critics of the eco-city ideal argue that this concept is firmly rooted in developed contexts with a Western perspective on urban practices (Lye and Chen, 2010). One cannot assume that other places have the required social structures, such as democracy, strong civil society, and political accountability, to support its appropriation (Myllylä and Kuvaja, 2005). Others argue that this concept can be flexible enough to be adapted to different political systems and societies. For example, in the Chinese context, eco-city projects focus more on implementing basic services, pollution control measures and ecosystem restoration projects (Wong and Yuen, 2011), with limited concerns for exacerbating inequality and patterns of exclusion.

In China, the ideal of the eco-city has been promoted and popularized by a transnational network of ambitious actors. These actors include national governments, politicians, investors, international institutions, and international professionals in fields such as planning, design, and engineering. For example, the most high-profile eco-city projects in China are initiated by joint efforts between the Chinese national government and another state, such as Singapore, Sweden, or the Netherlands. Many eco-cities in China are zones with exclusive policy incentives to attract direct foreign investment and accelerate foreign trade. The World Bank has established the *Eco²Cities* initiative to support cities in developing countries to develop projects with both economic and environmental objectives (Suzuki et al., 2010). The planning and design processes of eco-cities often involve urban design professionals from North America and Europe (Pow and Neo, 2013; Rapoport, 2015). These professionals work for a limited number of globally famous design firms, which are known as global intelligence corporations (GIC) (Ward, 2005) or global master-planners (Rapoport, 2015). Schemes for eco-cities or sustainable development generated by these prestigious GICs present similar ideas and approaches, suggesting an unspoken consent to a universally applicable model for sustainable urban form (Cugurullo, 2013, 2016; Hult, 2015). Together, these actors have consciously and unconsciously promoted the eco-city ideal as a product which is believed to fundamentally reinforce the capitalist system (Pow and Neo, 2013). The production of eco-cities becomes an outcome of complex processes that are influenced by cultures, politics, and economies across geographic scales. It is nested in intertwined power dynamics of the specific locale, the city, the region, the nation, and the globe.

Williams (2017) points out a number of contradictions and oddities in Chinese eco-cities which arouse confusions and controversies. First, eco-cities are usually not built where there are ecological problems or where there are many people already living. They are not built for ordinary people or to address everyday social and environmental concerns. Second, many eco-cities in China are merely existing cities, or conventional cities, with add-ons. As a result, they are not eco-environmental places but instead are any projects, such as parks, industrial zones, and waste incinerators, that have fabricated correct numbers for the sustainable indicators and hence won a license of the eco-city. China's eco-city builders reflected on these projects and admitted that labeling a development project as an "eco-city" was an effective strategy for local governments to win place-based favorable policies and subsidies. Therefore, these eco-cities have been privileged projects resembling other special development zones (Wang, 1994). They are fundamentally different from the ecologically sensitive zones that China has started to identify for environmental conservation based on environmental sciences. Some environmental planners argued that a genuine eco-city development would have identified such ecologically sensitive zones for preservation. Yet the initial conception of China's earliest model eco-cities failed to consider such ecological and environmental factors and hence did not curb growth according to environmental considerations.

Are the earliest master-planned eco-cities doomed to failure?

To synthesize all the critiques about China's earliest model eco-cities: A few elements in these master planned megaprojects are fundamentally flawed, failing to improve on preexisting practices.

First, strategies for building China's ecological new cities suggest that economic concerns consistently take priority over environmental ones (Cugurullo, 2013; de Jong et al., 2016; Shwayri, 2013). In China, most eco-cities are first and foremost concerned with land acquisition, economic growth, and cost minimization (de Jong et al., 2016; Shiuh-Shen, 2013). As a result, eco-cities' success is judged by their economic rather than their environmental performance (Cugurullo, 2016; de Jong et al., 2016). Their ecological approaches to design and development challenge the validity of "green capitalism" (Prudham, 2009; Scales, 2014; Sweeney, 2015). A bone of contention in theoretical dialogues is the inherent contradictions between environmental preservation and the capitalist system. The underlying assumption that economic and environmental goals are compatible demonstrates the belief underlying ideas of ecological modernization or green capitalism—meaning the environment and the economy can complement each other's growth and flourish at the same time. In fact, these eco-cities sought to capitalize on ecological assets in order to promote growth. This suggests that these projects are merely products constrained by the exploitative nature of the prevalent capitalist system. Consequently, the capitalization of the environment will highly likely lead to the decay or destruction of the fundamental values of the ecology. In the meantime, the appropriation of ecology for economic gain is more likely to serve the interests of privileged populations. This perpetuates the illnesses of capitalist societies, worsening social inequalities. Solutions to the co-development of the economy, the society, and the environment must rise beyond the constraints entrenched in current economic and political systems and thereby engender systemic reforms.

The fundamental contradiction underlying eco-cities is captured by the debates about whether green development is ecologically or economically driven. Green innovation is the key selling point of eco-city projects and is supported by capital investment, individual choices, and entrepreneurial innovation (Chang and Sheppard, 2013; Prudham, 2009). Some intellectual traditions are critical about such development, believing there are inherent contradictions between environmental preservation and the capitalist system (Czech and Daly, 2004). Exploiting the capital inherent in the ecology and the environment could lead to their decay or destruction (Chang and Sheppard, 2013). China's model eco-cities can be regarded as new forms of growth-oriented models of urban development, failing to challenge the notion of capitalist development at a fundamental level. Such approaches also suggest that Chinese officials and practitioners have yet to critically reflect on the flaws of modern societies and the design fault of conventional processes of industrialization and urbanization. Failures in eco-city projects are demonstrated by unrealized bold claims, incomplete implementation, the disregard of ecological constraints, and the focus on economic gain.

Second, these eco-cities were designed as models that could be replicated and applied elsewhere. An assumption underlying the search for a model is that ecological development strategies can be universal and decontextualized. This points to the utopian nature of these projects' ecological

idealism. Its problems are twofold: It rejects gradual, incremental improvements to existing cities; meanwhile, it imposes a blueprint that would overwrite the urban environment and disrupt existing social life. This *tabula rasa* approach fails to engage people who are not in power and excludes ideas grounded in local knowledge. Therefore, it fundamentally contradicts the essential urban sustainability goals of achieving social equity and respecting local culture. After all, environmental challenges are deeply embedded in existing economic, social, cultural, and political systems. Ecological development strategies should inevitably vary across different locales and communities and respond to the needs of local populations, especially those long-standing, marginalized rural residents.

Third, the design, planning, and implementation of these projects involves actors in different sectors and at different levels of administration. Both structural barriers in China's political systems and cross-sectoral discrepancies have led to conflicting interests and mismatched interpretations among the actors. On one hand, there are discrepancies between the central government's objectives and local governments' priorities. The implementation of centrally announced urban policies relies heavily on local interpretations. This causes a shifted focus from long-term, public-oriented visions to immediate, narrowly focused needs for implementation and other pragmatic purposes. The entrepreneurialism of local states results in profit-driven developments. On the other hand, developers and enterprises prioritize economic return in their investments and therefore are reluctant to change their business as usual. In addition, foreign actors have had limited influence on how the eco-cities are shaped. Although global design firms incorporated forward-looking ideas in the original master plans, local officials would commission local planning and design institutes to rework the original design. They claimed that foreign ideas were not practical, whereas local practitioners understood the conventions and could better adapt foreign ideas to local needs. After the interpretation and redesign by local politicians and planners, original plans were taken at face value and modified according to local technical guides for physical planning and design. Their ecological designs were reduced to the engineering of the physical form of the built environment, which neglected the genuineness and effectiveness of scientific processes underlying approaches of ecological restoration and environmental mitigation. As a result, innovative, pro-environmental strategies have been lost in translation. The development outcomes only formally conform to original visions to a limited extent.

Fourth, the initial imagination of these eco-cities relied heavily on services provided by global design firms. However, these firms' expertise in ecological design and planning had not been researched in depth or scientifically proven. In many cases, design firms were only given short amount of time to produce a master plan, without conducting extensive site surveys or consulting local experts. Design production was largely shaped by expertise in architecture and landscape architecture, lacking interdisciplinary collaborations that would involve other experts, such as planners, engineers, and environmental scientists. The designers working for these firms also inter-referenced each other's projects as precedents. In this process, a series of trendy strategies were repeated, creating an impression of a universally effective model for eco-cities. However, with the incomplete statuses of these projects, to what extent these strategies contribute to sustainable development cannot be reliably evaluated.

Lastly, all these projects were highly experimental and future-oriented. They experimented with ideas and technologies that were far more advanced than the scope of work that was commonly practiced in China. When the original designs were operationalized, their strategies were revised to meet the outdated regulations, standards, and building codes in the existing institutional systems. Often, innovative characteristics were beyond the scope of what the existing regulations could allow or what local practitioners knew how to realize. Or, due to time constraints, the implementation of innovative ideas occurred before any policy reform could happen. As a result, the actual built fabric in these novel projects lost the original innovative, ecological characteristics. These places appear as banal as most generic developments. The limitations of local operationalization further underline the importance of policy and institutional reforms that could address locale-specific challenges.

International Criticisms of Eco-Cities and Rebuttals

International critics have connected failures in China's high-profile ecological new cities with experiences elsewhere. Eco-city projects are commonly criticized for the lack of progress in transforming prevalent practices. Indeed, despite the buzz and hope brought by such progressive attempts since the 1990s, very few eco-cities were actually implemented or completed across the world (Barton, 1998; Williams, 2017). General critiques of eco-cities fall into six categories:

1) *Eco-modernization and technocracy*: Today's eco-city projects rely heavily on technical solutions (Joss and Mol, 2013). These places resemble generic examples of the built environment in Chinese cities, having nothing distinctive from typical Chinese cities. These places exhibit a generic quality of the built environment. Their ecological designs are yet to be realized.
2) *Growth machine and green capitalism*: Eco-city projects consistently prioritize economic concerns over environmental ones (Cugurullo, 2013; de Jong et al., 2016; Shwayri, 2013). Such development suggests an inherent contradiction, that is, capitalizing on the asset of the ecology and the environment could lead to their decay or destruction.
3) *Self-contradictory and eco-labeling*: Eco-cities are usually not built where there are ecological problems or where there are many people already living (Williams, 2017). They are often any projects with add-ons, such as parks, industrial zones, and waste treatment plants, which have fabricated correct numbers for the sustainable indicators and hence earned the label of eco-cities.
4) *Global "masterplanners" and a universally applicable model*: The planning and design of eco-cities often involves prestigious global design firms. These global master-planners present similar ideas and approaches (Rapoport, 2015). This seems to suggest an unspoken consent to a universally applicable model for sustainable city making.
5) *Impractical appropriation of foreign approaches*: Local authorities are accustomed to trust and rely on foreign experts due to a lack of experience. With limited understanding of local contexts, popular foreign ideas are imposed in different geo-political contexts. For example, China does not have the required social structures, such as democracy, strong civil society, and political accountability, to support this appropriation (Caprotti, 2014).

6) *Different views of development*: Growth is fundamentally questioned in developed countries, but not yet in developing countries such as China (Williams, 2017). In emerging markets, the transformation of nature for urban growth is welcomed. In comparison, eco-concepts that have emerged in the West are based on the premise that the environment comes first and restrictions must be imposed on development.

Despite these controversies, Williams (2017) acknowledges the contributions from early eco-city experiments for rapidly improving the physical and infrastructural landscape of underdeveloped areas in China and Africa. If we put criticism aside, these eco-cities are interesting challenges that China has carried out for social and environmental betterment; they are experimental urban constructs that nudge forward-looking transformation in developmental ideologies (Williams, 2017). They are testbeds for incorporating environmentalism into new industries, new research facilities, and new ways of working that will lay the foundation for future experimentation. Chang (2017) has observed that despite the failure in policy mobilities in the case of Shanghai Dongtan Eco-City, the conception of Dongtan has established a set of urban planning procedures adopted by many practitioners, including those who designed and delivered the Tianjin eco-city. Chang argues that parts of a project that has failed in implementation can remain mobile, influential, and present in other developments.

Many eco-city projects market themselves as models for future urban development or "living laboratories" where technology and society are brought together as co-evolving entities (Bulkeley et al., 2011; Cugurullo, 2013). Rather than being models for universal application, commentators argue that eco-cities are testing grounds with transformative capacities (Williams, 2017). They have substantial influences at local, national and even international levels. They have encouraged increased consciousness of environmental sustainability (Pow and Neo, 2013; Wong and Yuen, 2011). They also are the nurturing grounds for innovation in urban design, management, and governance. They have allowed for new ideas to be experimented and reformulated, inducing a gradual change of opinions. Eco-cities also create the space needed for learning, interaction, and building of social networks that disseminate knowledge (Bulkeley et al., 2014). These tangible, demonstration projects are the best tool to educate the general public and shift social norms. Lessons from experimentation can be employed by others and improved for future projects, contributing to the evolution of good design and policy decisions.

The flexible nature of the concept of the eco-city allows for future iterations of its reconstruction and deconstruction. The eco-city banner serves as a constant reminder of underlying sustainability goals and resistance against the conventional, economically driven developments. The recent combination of the eco and smart city ideal in new eco-projects hints at the technology fetish in the utopia of ecological modernization. These projects remain sites of experimentation and innovation for an alternative, environmentally sustainable urban future. They will continue driving broader socio-technical transitions of cultural norms, values, and persistent socio-technical structures (Rohracher and Späth, 2014).

Commentaries have largely focused on the failures of redressing environmental problems in Chinese developments, regarding "eco" labeling as merely a new means to city branding (Bosker et al., 2013; Shepard, 2015). However, that should not be the conclusion of China's fight against its deteriorating environment. China is still learning and adjusting. Notwithstanding all the problems and contradictions that arise out of eco-city developments, all the domestic disputes and international criticism, and all potential environmental costs and social tensions, China continues to explore alternative approaches. Ren (2013) argues that eco-cities are intended as role models for sustainable urban living. They are built purposely and ambitiously for speculative growth. Although the creation of these places often lacks innovation and creativity, China is trying to build better cities in these places. Given these experimental projects, local authorities have experimented with a combination of new approaches to urban development. For example, they have introduced new land financing strategies, explored new forms of public-private partnership, liberalized planning constraints, tested out new environmental techniques, and incentivized business innovation. Although the impact of new reforms remains limited, these places are risk-taking and transitional.

Evident in the promoted city-making models, China has seen a growing emphasis on the quality of both urban environment and ecosystems since the late 1990s, as well as growing concerns for social issues such as income disparity, uneven development, and political stability. In the last decade, the central Chinese government initiated a changing objective for urban development, which is concomitant with changes in the regulatory environment, urban planning practice, and development financing strategies. At the Nineteenth National Congress, China granted ecological civilization top priority on its political agenda in its search for "good lives for all." This marks the desire for a major reorientation of policies and practices. Ecological civilization is essentially a program to speed up the "cultivation of good social morals" by the inculcation of environmental education in schools, local communities, and government (Williams, 2017). It is also an official political reaction to China's transition towards a post-industrial society. In search of new forms of city making, the central politicians and scholars have officially proposed "Green Urbanization" as a concept that challenges the conventional ways of urbanization through industrialization (CCICED, 2017; Zhang, 2021). This concept calls for a new form of urbanization that facilitates "the fourth industrialization" and is environmentally more responsible by incorporating strategies for environmental remediation and climate change adaptation. In response to the central initiatives, local policymakers have established a series of measures, policies, and regulations to address existing environmental issues, including those for pollution mitigation, treatment of contaminants, a transition toward clean and renewable energy, and emission monitoring. The era of "ecological civilization" has brought about a wave of exploration to rethink how environmental consciousness can reform urbanization approaches.

The Reflection from China's Earliest Eco-City Builders

Green, ecological approaches to urbanization and modernization remains a relatively new frontier for policy and practice in developing countries. The newness brings experiments, misconceptions, variations, and mistakes, making the definition and realization of any eco-development a moving target. Nevertheless, China's earliest model eco-cities provide the world a glimpse of China's changing attitudes toward the environment as the nation re-envisions its course of urbanization. The

ecological new cities' evolution and mutation over the years demonstrate how Chinese practitioners, especially environmental engineers and designers, operationalize China's green ambition and learn from best practices abroad while tackling many fundamental contradictions entrenched in China's urbanization regime.

Although not fully fledged yet in their eco-environmental mindsets, China's eco-city builders have begun reflecting on reasons for failure. Some expressed frustration because the implementation of these projects has been greatly constrained by China's political economy of development and outdated regulations. Others stress that these projects have largely failed due to a highly techno-scientific yet overly prescriptive approach to planning. As one planner put it: "Everyone was learning from abroad blindly. No one knew how to promote environmental sustainability while cities were rapidly urbanizing." China's earliest eco-cities were initiated during its "golden decade" of real estate boom, when municipal leaders were rushing to get cities built. Local officials and planners visited the best cases of eco-districts in Europe and invited designers of those cases to generate proposals. The hasty design production has led to problematic replications. Some blueprints for the foreign cases were simply scaled up and mapped onto China's new cities.

Chinese earliest eco-city builders also consulted foreign experts in science and engineering in order to find an authoritative, comprehensive guide to control project implementation. They would set standards according to scientific studies and include those in an overarching framework. Along with the foreign design, pro-environmental technologies and products were also imported to China and adopted in the new cities. The ecological design and technology combined would facilitate innovation to meet the new standards. In practice, the application of new standards and new technologies lacked cooperation among different agencies within the government. It also faced resistance from the private sector due to the perceived or actual increases in cost. In hindsight, involved practitioners recall that it was impossible to realize the one-size-fits-all frameworks, because the indicators were controlled by various actors and administrations who refused to change their "business as usual" or didn't know how to work together. In addition, without a third party who would have the authority and expertise to conduct the evaluation, the assessment of these developments largely relied on self-reporting and was reduced to simply ticking boxes on a checklist. After all, setting technocratic frameworks and universal standards is a reductionist approach to exercising control. Despite genuine intentions of going green, imposing rigidity on highly dynamic, complicated processes of development is an approach doomed to failure. Science is merely another way of being idealistic. Cultural logics in each locale—such as norms, values, and institutions—and their variation across regions must be considered.

Although China has failed to achieve genuine green transitions in its once most promoted ecological new cities, the reflections from their planners and officials suggest that they have learned from trial and error in these experimental and pioneering eco-cities. These eco-city builders insist that they continue to improve on pro-environmental planning and design in subsequent projects, through which they advocate for ecological principles and push for favorable policy and regulatory reforms.

They believe that successful eco-developments, even if they were implemented at small scales or were only partially successful, would demonstrate what could be possible and set paradigms for future practices. These pioneering practitioners have gained unique experience in building eco-cities. They are known in their professional communities at a national scale, invited as experts to peer reviews and governmental educational programs. Through conferences and collaborations, they have shared ideas with other planners and officials, informing the professional communities about their lessons learned from eco-city experiments. The following chapter introduces two "success" cases whose builders have been partially influenced by the earliest eco-cities.

As China's model eco-cities have demonstrated the drawbacks of a universally imposed model, Chinese officials and practitioners have become increasingly aware of the importance of local lifestyles and cultures, as well as the impractical appropriation of foreign ideas. They are also wary of the replicability of so-called eco-city models, since these projects were proposed during a particular phase of China's growth. Such massive experimentation is highly unlikely to proliferate. Rather, new projects will be more likely to emerge at a smaller scale in existing urban areas. While the past and ongoing attempts have been focusing on incorporating new and experimental technologies with an international appeal (Caprotti and Romanowicz, 2013; Datta, 2012), China now sees growing solutions emerging from indigenous contexts with respect to specific consequences of former experiments. Differences in demographic composition, urbanization patterns, and resource availability have led to variations in how local decision-makers view the challenges and priorities in eco-city projects.

Learning from China's Model Eco-Cities

Despite the limitations evident in the once prevalent model of ecological new cities, China's earliest explorations in greening city making remain influential demonstration sites for sustainable development goals. In particular, these practices have informed policy makers and practitioners about green ideologies. The operationalization of green ideas is a process of trial and error that has been gradually popularizing ecological principles and normalizing green standards in city making. These special zones are the testing rigs for new practices and policies for China's next phase of urbanization. In the process, some design and planning professionals and local officials have played the role of ideological forerunners, informing their peers, politicians, developers, and the general public about existing problems. These forward thinkers have also urged institutional adjustments—although at a limited local scale—that would facilitate the transformation of social norms that challenges the existing political and economic systems. Huge amounts of money, resources and effort have been invested by both the public and private sectors to realize these master planned megaprojects. These master plans are ideologically instrumental and can potentially bring about social change. After all, the ultimate goal of design innovation is to engender social changes, especially when environmental challenges, intertwined with social struggles, are increasingly embedded in urban development.

Among China's earliest eco-city builders, proponents of transnational collaborations on eco-developments believe that the ideological impact of the images of eco-cities, as well as the social values they embody, can transcend the local or even the national scale to bring about collective action across the globe. Despite past failures, the utopian visions underlying ecological approaches have been leading normative transformations in the processes of city making in various parts of the world. In these mega- and utopian projects, even the bold imagination and/or partial success in early phases of implementation can greatly inform later developments and shape their trajectory. Today, the world sees unflagging, and perhaps growing, enthusiasm for eco-cities and similar projects. The ambitions embodied by the eco-city ideal continue to attract investment interest and political support in order to enhance domestic and international competitiveness. Eco-developments in contained, controlled settings continue to be spawned. The existing eco-city projects have been widely discussed as sites for bold experimentation, drawing increasing interest in lessons that have been learned—or should be learned—from these experiments. Simply viewing these projects as total failures could overshadow the value of such progressive experiments. Many eco-cities are still growing, adapting, and learning from their mistakes to explore valid approaches to sustainable city making. More in-depth studies of past eco-city projects, and their conception and evolution, can reveal barriers of reform and opportunities for innovation. Future studies should investigate the transformation and performance of the implemented parts of eco-developments, identify indicators used for evaluation and decision-making, assess the effectiveness of development strategies, and evaluate the economic, social, and environmental impact of the projects. The goal is to learn from failures and suggest promising recommendations for improvement in development strategies and policy making.

Since its earliest eco-cities, China has been further diversifying its eco-environmental strategies for environmental protection, pollution mitigation, climate change adaptation, and green technology integration. On one hand, China continues its explorations in comprehensively planned megaprojects that incorporate variegated combinations of "green," "low-carbon," and "smart" strategies. On the other, there have been shifting governance strategies at both local and central levels. Programs for building comprehensively planned megaprojects are increasingly strengthened by regulatory and legal reforms and by programs with specific targets of eco-environmental management. Thanks to the growing political importance of environmental sustainability in its next phase of urbanization, China is introducing new policies and regulations to constrain urban growth in order to prioritize environmental sustainability. China is also learning from past and ongoing eco-city projects, which are undergoing a period of adjustment. Their development agencies are reflecting on their past experiments and drafting future plans and development principles anew. In order to understand the trajectories of China's eco-developments, it is necessary to examine the evolution of China's earliest eco-city experiments as well as alternative formats of eco-cities in subsequent experiments. Chapter 7 further discusses the recent transitions in relation to China's earliest eco-developments.

China has the luxury of having new construction sites where new ideas are experimented with, prototyped and replicated. Many eco-cities are considered as failures because they are unbuilt, incomplete, or not "green," yet failure is indisputably a part of the pathway to progress. Projects with the banner of eco-urbanization continue to spawn, receive political support and draw investment. Past attempts offer valuable lessons for better ways to develop and manage cities while protecting the environment. Existing projects are not all ended or static; they continue to evolve. China's conception of eco-urbanization does not generate a one-size-fits-all strategy; rather it has brought about varied local interpretation and experimentation. China's eco-environmental projects are conceived not only as testing rigs for environmental techniques but also as real-life experiments that incorporate strategies for industrial advancement and social reproduction. With growing environmental awareness and political incentives, planners and designers continue to experiment with new approaches, correct mistakes, and adjust their strategies in order to build a sustainable city. These context-driven, micro-scale trials and errors provide fundamental insights into the challenges for China to operationalize its green ideals and into the potential to advance environmental sustainability in urban development.

Under the spotlight of the world's environmental challenges, China has reached a turning point in its development. Many commentaries liken China's economic slowdown and its emphasis on ecological civilization to the post-industrial turn and the emergence of environmentalism in Western societies. For example, as countries in Europe and North America were challenged by resource depletion, especially during the second half of the twentieth century, their development shifted from massive expansion to urban rehabilitation, with growing attempts at environmental conservation and historical preservation in parallel with various social movements. Since then, Western design ideologies and development experiments have greatly diversified. A similar shift has been centrally promoted in China today, concomitant with an unprecedented emphasis on ecological urban design, a green economy, and environmentally responsible urbanization. China's top officials and scholars have begun fundamentally reconsidering urban development by incorporating eco-environmental rationality. The central political campaign of building an ecological civilization has fueled the nation's unflagging enthusiasm for sustainable development as a means to gain global prominence in economic and political realm.

Images:

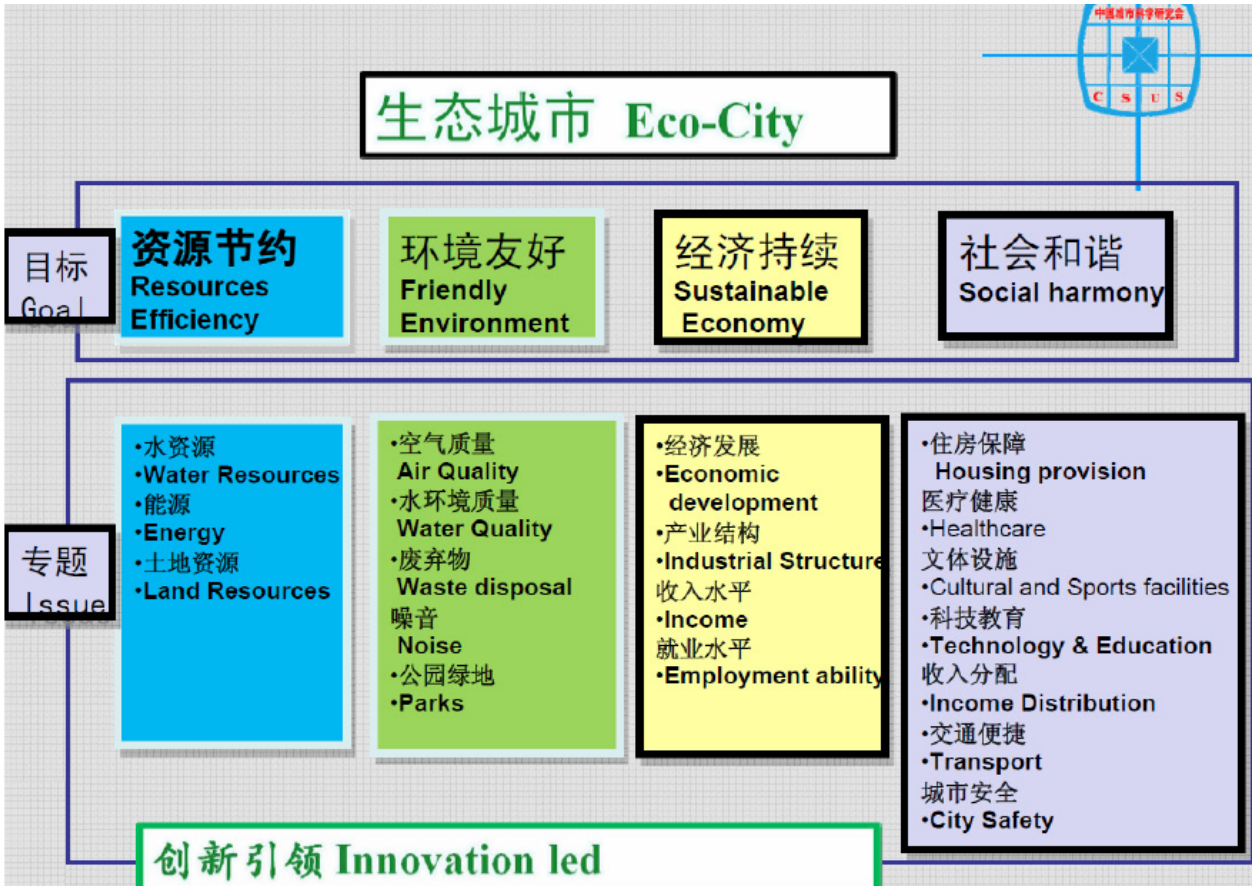

Figure 1. The Assessment Framework for China's Ecological Cities (CSUS, 2011)

Figure 2. The Clusters of Eco-City Projects in China as of 2011 (CSUS, 2011)


Figure 3. Land Reclamation at Caofeidian New Area: satellite images in 2008 and in 2010 (Source: Google Maps)

Figure 4. The Planned Area of the Dongtan Eco-City (Arup, 2005)

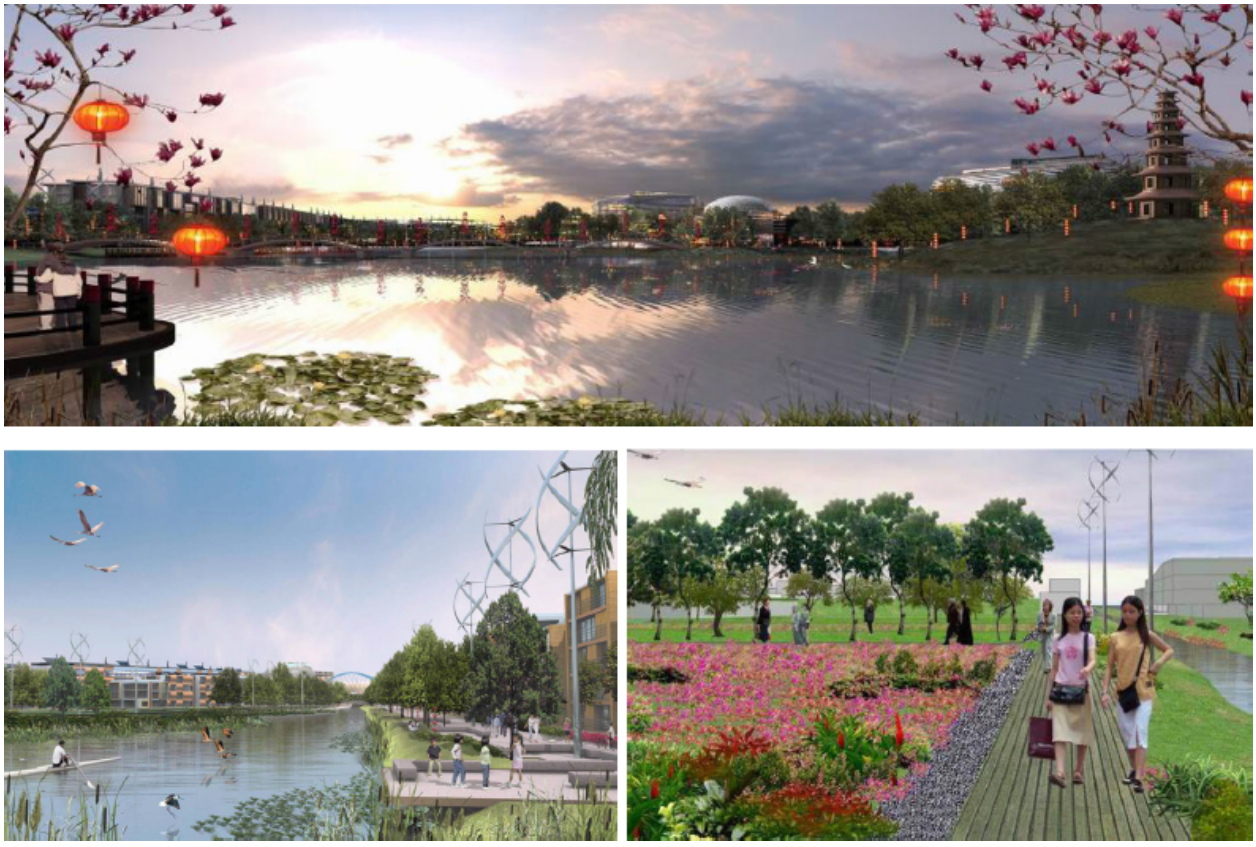
Figure 5. Renderings of Dongtan Eco-City (Arup, 2005)

Figure 6. Plans and Renderings of the Caofeidian Eco-City (Sweco, 2009)

Figure 7. Renderings of Tianjin Eco-City (tianjinecocity.gov.sg)

Figure 8. Renderings of Sino-Dutch Shenzhen International Low-Carbon City
(Images Source: Shenzhen Municipal Government)

Figure 9. Parts of the Caofeidian New Area in 2014 (open source data)

Figure 10. Parts of the Tianjin Eco-City in 2017 (photos by author)

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Chapter Four: Zhengdong New District: Inventing an Ecological Culture through Building a "Metabolic" New City

In history, human societies have equated building new cities with progress and civilization. Modern societies see unprecedented scale and speed of new city developments. Building new cities remains a political priority in developing countries, which have commonly been challenged by a population boom and unplanned growth. China, having established more than 600 new cities since 1949, is regarded as the global epicenter for new city development (Shepard, 2015). While hundreds of new cities are still under development within the country, China has joined new transnational initiatives in other developing countries to support their metropolitan expansion. The United Nations has cautioned that urbanization exacerbates climate change on a global scale and has set sustainable development goals to guide urban development (Kacyira, 2020). Accordingly, lessons for building greener cities have been widely sought after. In China's current administration, both President Xi Jinping and Premier Li Keqiang have emphasized that China's future urbanization must integrate urban and rural development through a compact, energy-saving, and ecological approach (Xinhua News, 2013). These principles are incorporated into China's *New-Type Urbanization Plan* (2014-2020) (CCP, 2014). Promoted by China's political leaders as a paradigm for New-Type Urbanization, Zhengdong New District was initially master-planned by foreign designers as a new city with comprehensive functions of a modern city (Xinhuanet, 2019). It was sited as an eastward extension of the old city of Zhengzhou (Figure 1) and envisioned as a key area for the city's future growth (Figures 2 & 3). Although Zhengdong was once regarded as a ghost city, it is now known as one of China's most economically vibrant and environmentally agreeable new cities (Ye, 2019; Zi, 2012). In 2015, at the fourteenth meeting of the Shanghai Cooperation Organization, Zhengdong was presented to leaders of several developing countries to showcase China's accomplishments in building new cities in a sustainable way.

This chapter describes the planning, design, and construction of Zhengdong New District. Data were collected between 2018 and 2020, especially during extensive ethnographic fieldwork in summer 2019. I triangulated data sources and gathered information through mixed methods. These include literature review in both English and Chinese, local archival research, direct observation on site and in authorities' offices, interviews, questionnaire-based surveys, and participation in local activities and formal meetings. I conducted in-depth, semi-structured interviews with Zhengzhou's former and current officials, administrators and rank-and-file employees of Zhengdong's development authority, local planners, scholars from local universities, developers, investors, as well as managers and engineers at environmental construction and management companies. I also carried out semi-structured interviews with visitors, current residents, workers, and the original rural residents in the area. In addition, I distributed around 100 questionnaires in the public spaces in Zhengdong to survey residents' opinions, asking them to evaluate the development outcome and their quality of life (see Chapter One for more details on methodology). The following sections introduce Zhengdong's development history, its design and planning rationale, its spatial characteristics, and its claimed achievements according to governmental and media reports as well as the assessments of local officials and planners. This chapter concludes with some reflections about the project and sets the foundation for the comparison and analysis in Chapters Six and Seven.

The Conception of Zhengdong New District

Zhengdong New District—located in Henan's capital city, Zhengzhou— is geographically important for its local and regional political agendas. Henan is located in Central China, a region that has a large rural population and that has been losing its population to coastal provinces.[1] Central China is generally viewed as an underdeveloped region that grows at a slack pace and lacks attractive characteristics in its urban and natural environments. By the turn of the twenty-first century, China's central government had recognized the regional imbalance of development across the country and sought to spur growth in central provinces. Henan Province, facing common challenges in Central China, has been eager to build a stronger economy by heightening its urbanization (Yang, 2019). In 2000, Henan was home to about 95 million people, 76.8 percent of whom were rural (NBS, 2001). Its economy relied heavily on agriculture, heavy industries, and low-end manufacturing. Henan's officials believed that Zhengzhou, as the capital city, should lead urban transformation and spur economic growth.

The conception of Zhengdong's plan took place against the backdrop of Henan's growth ambition at the very beginning of China's "golden decade." In the late 1990s, the City of Zhengzhou anticipated eastward urban expansion and proposed to relocate a military airport which was sitting right outside the city's eastern border (Figures 4 & 5). The relocation vacated a plot of developable land owned by the city. Discussions about repurposing the former airport seeded an ambitious plan to build a whole new district. In 2000, with strong support from Henan's then provincial governor Li Keqiang and Zhengzhou's then-mayor Li Ke, Zhengdong New District was officially established to accommodate Henan's future transitions (Governa and Sampieri, 2019). The planned district covered 150 square kilometers of mostly rural land right outside Zhengzhou's original eastern border. This plan seemed grandiose, for the planned new area was 18 square kilometers larger than the city's existing total area. Zhengzhou's officials were indeed challenged by such an ambitious plan of building a holistic city from scratch. At that time, the region lacked sophisticated development institutions. The urbanization in the City of Zhengzhou had occurred largely in a piecemeal, uncoordinated manner. Its existing urban area was considered "crowded," "polluted," "decaying," and "economically backward." The provincial and municipal governments saw the necessity to create an effective urbanization plan in order to avoid disordered expansion while fostering more environmentally friendly industries. More importantly, this plan ought to be "new" and "advanced" in order to transform the backward image of Henan and enhance its regional competitiveness.

Seeking a new approach to urbanization, especially one that would create a modernized, economically competitive city, in 2001, Zhengzhou announced an international design competition and invited six globally renowned design firms to generate a schematic master plan for Zhengdong New District. The six firms included Kisho Kurokawa and Associates from Japan, Cox from Australia, Sasaki Associates from the United States, Arte Jean Marie Charpentier & Associates from France, PED Consultants from Singapore, and the China Urban Planning Institute from Beijing. In order to decide on a winning scheme, local authorities organized design reviews and public voting to solicit experts' and citizens' opinions. Today, Kurokawa's plan is known as the winner thanks to

[1] According to *The Rise of Central China* plan (*zhong bu jue qi ji hua*), announced by the then Premier Wen Jiabao in 2004, the central region includes six provinces: Shanxi, Henan, Anhui, Hubei, Hunan and Jiangxi.

choices made by both local authorities and the public. Local officials claim that the master plan by Kisho Kurokawa and his associates stood out because its design incorporated both modern ideologies from the developed world and cultural elements originating in East Asia. They highlighted that Kurokawa's masterplan was internationally recognized for its design excellence, adding that "few domestic planners had the capacity to generate a long-term vision for an advanced modern city holistically." In 2002, Kurokawa's plan received the "best urban planning" award at the World Architects' Congress in Berlin. However, some local architects questioned the authenticity of the competition selection and public voting processes. One argued anecdotally that Kurokawa's plan was chosen mainly due to Zhengzhou officials' preference and that the public voting was just a gesture for the purpose of formality.

At least one of Zhengdong's officials and planners in charge of implementation was an urban designer who originally worked with Kurokawa on Zhengdong's initial design. Supported by the mayor's policy to "realize the master's original masterplan," original and new officials have been cooperating on the faithful implementation of the plan, especially the physical, infrastructural, and functional layout of the original plan. Kurokawa's former employees would oversee the principles underlying the master designer's vision. Zhengdong's officials and planners claim that Kurokawa's plan integrates five models of an ideal city into Zhengdong's blueprint. These models include "a symbiotic city, a circular city, a metabolic city, an eco-city, and a regional-cultural city." According to the official manifestation of Zhengdong's plan, the symbiotic city emphasizes the symbiosis between the old urban center and the new city and between different clusters of the new city. The circular city is the conceptual model underlying the concentric layouts of the new district's key clusters. The district's planned networks of new ecologies reflect the concept of an eco-city that would bring ecology back to the city and allow the symbiosis between human and nature. In addition, Zhengdong would become the economic, cultural, and political center of Henan province and an economic and cultural icon in the region of Central China.

In Kurokawa's vision, the new district would extend the old city and grow in clusters. Its transportation networks would separate fast (inter-city and inter-cluster) and slow (intra-cluster) traffic. High-speed rail and highway systems would link Zhengzhou with the rest of the country while subway systems and artery roads would connect the old city with all the new clusters. Kurokawa considered these networks of fast traffic as megastructures, which would serve as an enduring, interconnected framework to help the clusters to flourish. Within each cluster, all activities would be connected by slow traffic systems, including pedestrian and bike paths. Accordingly, the scale of each cluster would be constrained in order to encourage pedestrian-oriented activities as opposed to vehicular mobility. Different functions of the city would spatially agglomerate while forming a symbiotic system as a whole. Each cluster would serve a main type of urban activities, such as cultural, educational, commercial, and residential activities, supported by associated businesses, amenities, and services. The combination of mutually reinforcing functions would allow for self-sufficient growth within the cluster. Multiple clusters would strengthen each other's performance and collectively provide for all dimensions of working and living. This way would also allow Zhengdong to remain a component of the City of Zhengzhou, forming a symbiotic relationship between old and new parts. The overall urban dynamism would build on both enduring megastructures and self-sufficient clusters and hence be able to sustain urban growth.

The logic underlying Kurokawa's ideal model of the city was indeed inspired by how biological cells grow in living bodies. The origin of this model can be traced back to the architectural movement during Japan's post-WWII years—namely, Metabolism (*shinchintaisha*) (Lin, 2010). It was introduced

to the world in the 1950s by a group of young, progressive-minded Japanese architects, who named themselves the Metabolists. The Metabolist utopias of modern Japan fused ideas about architectural megastructures with those of organic biological growth (Koolhaas and Obrist, 2011; Lin, 2010). The organization of Metabolist cities featured multiscalar and symbiotic linkages among multiple elements of the city and between each element and the whole. The linkages are supported by connective and enabling superstructures. Kurokawa's teacher Kenzō Tange had greatly influenced the Metabolists and remained a mentor for them. Zhengdong's officials believe that its scheme, especially the strategy of attaching functional, interdependent clusters to megastructure-like, infrastructural networks, resembles the approach in Tange's *Plan for Tokyo Bay* (1960).

Kurokawa argued that the rationale underlying his design and planning was "metabolic," although his approach had been heavily influenced by Modernism. On January 14, 2005, architects from a Chinese magazine *Time + Architecture* interviewed Kurokawa in person.[2] In the interview, Kurokawa suggested that he had been very critical of China's architectural practice, which had fallen to be mere a facilitator for economic growth. He argued that China's planning and design practices exemplified problems in growth-oriented design and planning across the world. Kurokawa recalled that in 1958 when CIAM (*Congrès internationaux d'architecture modern*, or International Congresses of Modern Architecture) was about to disband, he received a letter from Peter Smithson, the content of which was from Le Corbusier. To Kurokawa, the letter conveyed a message that the era of Modernism was over while an era for the exploration of new design and planning ideas and approaches had begun. Kurokawa expressed that he and his peers were shocked by Le Corbusier's message, stating that "the founding father of modernism has announced to the world that modern design and planning is invalid and dead." This historical event had encouraged him to rethink his practice. In his subsequent explorations on new design and planning ideas, Kurokawa advocated a shift from an era about "machines" to a new era about "life." He suggested that he applied biological concepts of "metabolism" and "symbiosis" to city design and planning in order to create cyclic processes of material flows and promote sustainable design. In addition, Kurokawa emphasized the importance of allowing systems of information and ecology to evolve in contemporary societies. To Kurokawa, a symbiotic city must allow economic growth and sociocultural development to be mutually enabling; in this way, people could be "rich" in both "material" and "spiritual" (or "moral") terms. He remarked, "Rather than only focusing on economic gain, China should reimagine itself as a nation and create a new culture that belongs to its own." He believed that China's new culture must be "co-created" by numerous designers and intellectuals who were well-informed about various cultures in the world. Kurokawa argued that he designed the circular layout of Zhengdong's core area based on such "metabolic," "symbiotic" rationales in order to create new lifestyles and a new culture in the city. While the manmade lake and constructed ecologies would serve as the ecological center, the rest of the city would grow around and expand from this center. He envisioned that the new city would be connected by efficient transportation infrastructure, pedestrian path systems, as well as natural systems of water and ecologies.

Zhengdong's officials and planners considered Kurokawa's rationale for planning and design, especially the considerations of processes, connectivity, ecology, and culture, to be very innovative at its time. They argued that Kurokawa's scheme was influenced by the eco-city paradigm that emerged in the 1970s. Kurokawa envisioned a symbiotic relationship between nature and the city. The megastructures of the new district would include not only new transportation and technological

[2] I received the interview scripts as a gift from a local university professor, who was also present at the interview. The interview was never officially published.

infrastructure but also newly constructed ecosystems. Local planners who worked with Kurokawa on design development of the original masterplan suggested that they calculated the dimensions of water bodies and green spaces to ensure that they would perform ecologically rather than being simply ornamental. They reviewed literature on the necessary dimensions of ecosystems for the survival of plants and little animals. They also selected famous park systems and greenways in major cities in Europe and East Asia to gather the measurements of their constructed green spaces and emulate their design. The ample "natural" spaces would be networked to create sanctuaries for wildlife, increase biodiversity, and reduce urban pollution. In addition to potentially providing ecosystem services, the constructed green spaces would also contribute to social and psychological wellbeing. They would serve as buffers between noisy zones (such as highways and busy transportation hubs) and quiet zones (such as residential neighborhoods). They would also provide urban dwellers with spaces for leisure. Zhengdong's builders insisted that constructing urban infrastructure in tandem with ecology would allow for the co-flourishing of diverse ecosystems and socio-cultural activities. Accordingly, they argued Zhengdong's plan began with a vision that sought to defy conventional profit-driven growth and, hence, encouraged the investment in ecological infrastructure despite the enthusiasm in GDP growth and fast speed of real estate construction. Local officials and planners believed that, compared with typical urban development in Central China, Zhengdong's investment in its ecological features had provided a greener, more enjoyable environment, fostered healthier lifestyles, and enhanced citizens' happiness.

As an architect who was highly influenced by Modernist ideals, Kurokawa embraced symbolism embodied in perfect geometries in Zhengdong's master layout and architectural forms. In order to create a more compact urban form, Kurokawa adopted the model of a circular city for the core clusters of Zhengdong New District. Zhengdong's Central Business District (CBD) presents a concentric composition. The center of the CBD is Ruyi Lake, a vast manmade lake shaped in a perfect circle. It is surrounded by civic complexes, such as an exhibition center, theaters, and concert halls. The outer rings include a range of urban functions, including parks, transit lines, major roads, recreational paths, greenbelts, buildings of financial institutions, and commercial-residential complexes. Roads and green areas radiate from the center, connecting the central lake with other elements in the rest of the cluster. Kurokawa believed that the circular city was an efficient model that could bring multiple benefits to the city: A concentric layout, he claimed, could ensure the legibility of the urban pattern, enhance the efficiency of flows, shape an iconic appearance, establish a strong identity for the city, and provide its residents with pride and a sense of belonging. In addition, planners who worked closely with Kurokawa believed that his ideas of a metabolic and ecological city not only connected with Western modern ideologies but also originated from Eastern traditional cultures. In particular, Buddhism greatly influenced Kurokawa's design philosophy. The master plan's layout and architectural form have adopted traditional Chinese symbols, such as *ruyi*, dragon, pagoda, traditional courtyards, and canals. Places and landmarks are named accordingly to symbolize nature and tradition in pre-modern Chinese philosophies and to evoke the image of a cultural city.

Implementing the Grand Zhengdong Plan

Kurokawa envisioned a long-term plan for growing the new district. The provincial and municipal officials found his design rationales to be highly sensible and expressed great respect for this internationally renowned star architect. They were committed to almost fully adopting Kurokawa's plan and were determined to realize the entire scheme as it was proposed. Consistent

implementation of massive urban developments had always been a challenge in practice, especially with China's frequent leadership changes and volatile policy adjustments. Resolving to fully implement Kurokawa's vision, in February 2002, the Standing Committee of Zhengzhou Municipal People's Congress passed a bill granting Zhengdong's master plan regulatory effect. The bill mandates that no one shall drastically modify the master plan or disregard its fundamental strategies in future development of Zhengdong New District. This demands faithful implementation of the original master plan by all authorities, including those who were yet to be appointed. The city also assembled Zhengdong's Administrative Committee (ZAC) to coordinate and carry out the new city's development and subsequent management. In January 2003 the construction of the exhibition center broke ground, marking the start of the construction of the entire Zhengdong New District. To ensure both the quality and efficiency of its implementation, officials unanimously adopted two slogans: one called for "high-standard planning and high-quality construction" and the other set three implementation milestones for the following decade—"to shape the iconic core area in three years, to lay all the foundational infrastructures in five years, and to construct the entire planned area by the end of the tenth year." The speed and sequence of urban construction announced by Zhengdong at the start of construction symbolize a common rhetorical approach in China new town development: to pronounce rapid, high quality construction in order to build investor confidence, and to ensure political support of the development at higher levels of government,

Since its conception, Zhengdong has consistently received political support from top-level political leadership. Li Keqiang, then-provincial governor of Henan who supported the founding of Zhengdong, has risen to be China's premier and continues emphasizing Zhengdong's development. Proud of their strong political support and seeking to construct development that will attract greater market and political attention than that of competing cities, local authorities claimed that they had aimed at high standards for design and construction and had always searched for and experimented with what they perceived as leading conceptual "innovations" in urban development of the time, such as "eco-cities" and "smart cities."

Zhengdong's officials reflected on their endeavors since the start of the development and suggested that implementing internationally advanced approaches in local contexts demanded tremendous trial and error and consistent efforts of administrative coordination and local management. The implementation of Zhengdong's plan was fraught with risks and uncertainties at its start. Doubts emerged over the plan's feasibility. First, the plan seemed too ambitious—to build a whole new district that was larger than the city's existing urban area. Local officials wondered whether the massive scale could ever be achievable. After all, a master planned mega project was unprecedented in the region at that time. Nevertheless, Henan's provincial government projected massive urbanization in the following decade. To them, building new cities was inevitable, since they perceived upgrading or reconstructing the old urban areas as a time-consuming, socio-politically complicated task that would stir economic and social instability. Local officials recall that although "no one knew what could be possible," both the provincial and municipal governments aspired to "break the record" and change the image of the "underdeveloped," "backward" Central China that had "straggled behind" the East Coast. They were determined to create another Shenzhen through Zhengdong's development by "concentrating effort while making bold moves."

Although Zhengdong's initial development is not documented in an organized, archived manner, senior officials and local planners and architects recalled technical difficulties and skepticism that had challenged Zhengdong's implementation. The implementation of Zhengdong's plan began with state-invested infrastructural construction. Typical urban expansion in China began with building

road networks. In Zhengdong, its initial development largely involved not only the construction of multi-modal transportation networks but also the construction of vast manmade lakes and extensive networks of green spaces. The networks of transportation and green spaces were to be built from scratch within three to five years. Yet, the start of Zhengdong's construction was marked by tensions. At regional and national planning conventions, many experts questioned the practicability of the ecological components of Kurokawa's plan. They warned against the high economic and environmental costs of constructing new ecologies. In particular, the plan to dig vast lakes in a water-scarce city like Zhengdong became the bone of contention. The proposed scales of the new lakes were met with disbelief. For example, Longhu Lake was proposed to be as large as the famous West Lake in the City of Hangzhou in Zhejiang province. The manmade creation of a lake and the ecosystems within and around it garnered skepticism and received criticism from many urban experts and ecologists. The original plan proposed channeling water from the Yellow River into the new lakes. Zhengzhou and other cities nearby, however, all relied on water from the Yellow River to provide drinking water. According to China's policy, the City of Zhengzhou had a limited quota for its annual volume of water channeling. Experts suspected that Zhengzhou would not have sufficient water to fill the new lakes. Zhengzhou's government eventually resolved the water shortage issue thanks to the development of China's South-to-North Water Diversion Project. The latter is one of China's most expensive engineering projects in history, which has increasingly provided drinking water to cities in northern China.[3] While this Project has supplied all of Zhengzhou's drinking water, the previously allowed water usage from the Yellow River has been repurposed for landscaping. The technology-enabled extra water supply has ensured the construction and subsequent maintenance of Zhengdong's new ecologies. While local officials celebrated solving their water resource problem, they were also very proud of China's technological advancement demonstrated by the South-to-North Water Diversion Project. To Zhengdong's officials, the ecological features of the new district were among the best demonstrations of the transformative power of technology and the Chinese state combined.

Zhengdong's officials suggested that building Zhengdong's core CBD and its surrounding infrastructure and landscapes was crucial for supporting the continued development of the entire new district. The initial constructions included building the exhibition hall and its surrounding high-rises, excavating the lakes and connective canals, and constructing several large urban parks and wetlands. Concomitant with the construction of the starting zone were village clearance, resettlement projects, and major roads construction. These large-scale civic projects were enabled by a tremendous investment of public funds, including bank loans, revenues from land-based financing, and additional support from state-owned enterprises (SOEs). The newly constructed core area became the demonstration of the city's potentials and established an image of a modernized city with advanced technology and industry as well as an aesthetic environment and an ecological identity. Zhengdong's builders argued that the completed construction of the CBDs served as a "proof" to investors, the public, and other officials of the possibility of Zhengdong becoming an economically prosperous and livable new city and of the capabilities of its authorities. They pointed out that the popularity of the constructed areas among local and regional citizens had continued reinforcing the CBD's demonstration effect, attracting homebuyers, visitors, businesses, and investors.

Another accelerant factor for Zhengdong's growth is China's high-speed railway network. China saw an expansion of its high-speed railway network over the past few years, with a total length of 29,000

[3] Zhengzhou is considered as part of northern China. Today, this Project supplies all of Zhengzhou's drinking water.

km by the end of 2018, accounting for more than two-thirds of the total high-speed railway in the world (Figure 6). This expanded high-speed railway network increases inter-city connectivity and reshapes the geographical distribution of social and economic activities across and within cities. Numerous new cities have been planned near railway stations. Not all of the constructed new cities have gained economic activities or promoted the development of their municipalities; some were, or have been, vacant for many years. Zhengdong is one of the most successful new cities that are not only surviving but also experiencing increased productivity and wealth, exerting positive spillover effects to its region. This is partially due to the city's central geographic location both in Henan Province and in China. The City of Zhengzhou sits at the intersection of multiple routes, forming a *mi*-shaped node (a sort of network of spokes resembling the Chinese character "米"). Zhengzhou has served as a hub of conventional trains for several years, connecting trains traveling across China. On Sept. 28, 2012, Zhengzhou East Railway Station, located in Zhengdong New District, came into operation with the complete opening of the Beijing-Guangzhou High-Speed Railway. Since then, Zhengdong has risen to be a center of China's high-speed railway network, running more than 300 high-speed trains to destinations in different directions every day. It is within a 3-hour radius of over 700 million people. Local officials attributed the accelerated growth of Zhengdong partially to the construction of the new station. They believed that the city's central location in China had secured the city's position as a transportation hub, facilitated its connections with other parts of China, and brought about new development opportunities.

Despite Zhengdong's current reputation as a "success," its officials recalled that the district's initial construction faced temporary financial difficulties, further complicating the contestation over its massive alteration of the original human settlements, farmland, and ecosystems. The contention between the government and the original, longstanding residents at the start of Zhengdong's construction has largely been dismissed and undocumented in official reports. Local officials suggested that this was because land acquisition and development preparation was always, and hence normally, carried out with forceful erasure of rural villages and original ecologies at the time. They also claimed that villagers near Zhengdong today had been eager to be included in the new development so that they could be lifted out of poverty through tremendous compensation in forms of cash, housing, and other favorable policy. This argument was in fact echoed in 2020 by villagers nearby who expressed confidence of their future with the development expanding towards their villages. One young villager stated, "Knowing that we will soon become part of the planned area of Zhengdong, everyone in my village is feeling hopeful and we have gained more confidence for our future life." Nevertheless, the doubts about Zhengdong's development lingered right after the initial construction since the new district was still awaiting occupancy. After five years of development, the new district was still criticized by media as a ghost city. Nevertheless, Zhengdong's officials believed that the initial development "laid solid groundwork" for subsequent growth. Its development took flight around 2008, when investments from major developers surged. While local real estate companies remained wary of investing in this new area, developers who had made a great fortune from investing in top-tier and coastal cities foresaw Zhengdong's potential and competed to claim their ground in the CBD and near the new high-speed railway station. In the meantime, municipal authorities designated Zhengdong to be the location for all new developments, especially high-rises. Provincial authorities also incentivized major financial institutions, large SOEs, and several universities to relocate their main headquarters and campuses to Zhengdong in clusters with corresponding functions.

Local officials claimed that Zhengdong's development had followed the planned phases: the image of the city, represented by the CBD, was established in three years (by 2006); the main infrastructural networks were constructed by the fifth year (by 2008); and the whole district was mostly built in ten years (by 2013). Since 2008, the acceleration of Zhengdong's growth has been evident in many aspects. By 2010, the occupancy rate of the CBD had reached 90 percent. By 2013, the district had a population of 1.03 million residents. Meanwhile, Zhengdong has attracted large amounts of investment. Its land sales prices became the highest in the City of Zhengzhou. Housing prices and land prices in this area have experienced a rapid and drastic increase (Figures 7 & 8). In 2010, Zhengdong's average second-hand housing price was about 1,400 USD per square meter. In 2014, its housing prices increased 62.3 percent. Generally speaking, Zhengdong housing prices have tripled in the past 10 years. In 2019, Zhengdong's second-hand housing prices were almost twice as high as the average housing price in Zhengzhou, and the increased rate of Zhengdong's housing prices was greater than that of the City of Zhengzhou. Economic studies attest that Zhengdong is a development engine for the whole city (Zheng and Tan, 2020). Meanwhile, land prices and housing prices in the City of Zhengzhou have concomitantly risen with the increase of those in Zhengdong. Media reports and public opinions regard the district as one of the most desirable places in the region for both work and living (Ye, 2019; Yu, 2015; zzloujian, 2017). Its authorities, investors, and the public all anticipate Zhengdong's land and housing values, as well as its economic productivity, to continue soaring.

As of 2020, Zhengdong has been widely promoted by Chinese officials as the exemplar of Zhengzhou's modernization and Henan's economic growth. Its achievements are documented by a series of socioeconomic transformations. For instance, in 2017, Henan's urbanization rate had reached 50.2%, up from 20.8% in 1997. Henan's total GDP was RMB 4.5 trillion in 2017, ranked fifth among all provinces in China. In 2018 over 20% of Henan's total GDP came from Zhengzhou, whose GDP had increased by 9.6 times, from RMB 106 billion in 2000 to RMB 1,014 billion in 2018, ranking first among capital cities in China's northern provinces. Zhengzhou's built-up area and population had increased by 3.58 times and 1.96 times, respectively. In 2019, Zhengdong New District included over 226 national and international financial institutions, forming an integral part of the city's financial systems. With the productivity of its financial sector ranked twelfth among all Chinese cities, local officials are proud to claim that Zhengdong has risen to be not only Henan's but also Central China's financial center. Zhengdong also experienced a period of rapid growth during which many enterprises started up in the district. In the earliest stage of Zhengdong's development (2001-2003), there were only 32 enterprises in the whole area, one third of which were wholesale enterprises. The total number of enterprises rose from 87 in 2004 to 6167 in 2016 (Figure 9). By 2019, the types of industries had also diversified to include wholesale, business service, research and technology, culture, hotel and catering, and construction. The number and variety of large enterprises (whose registered capital exceeds 100 million RMB) also increased over time (Figure 10). Zhengdong has become a popular cradle for tertiary industry. Business owners and local officials argue that Zhengdong provides a variety of infrastructure as well as convenient transportation connections to create an environment suitable for business growth and expansion. Zhengdong's economic vibrancy has been widely acknowledged among government officials, entrepreneurs, and practitioners in China.

Experiencing Zhengdong's Built Environment

Today's Zhengdong New District has largely completed constructing the six main clusters in Kurokawa's master plan (Figures 3 & 11). They are connected by green spaces, water, and highways (Figure 11). Each cluster has a main function: the main CBD, the main living quarter, the second CBD (Dragon Lake area), Longzi Lake university area, science and innovation area, and industrial and technological development area (Xue et al., 2013). The construction of the clusters followed a carefully planned sequence, starting from the civic center and expanding towards main business districts.

The pilot cluster is the CBD, which is also the "demonstration unit" of the new area and where all new constructions began. Its aerial view and skyline have become the iconic images of the whole new district. The CBD has an area of 345 ha (Figures 12 & 13). Its border is a circle of 1000-meter diameter. High-rise office buildings form two rings surrounding the central area of parks and civic structures, including the Convention and Exhibition Center, the Henan Arts Center, and the Marriott Hotel in the 280-meters tall tower. Holding a central position, the tower is fully decorated by golden neon lights at night and is dubbed as the "Big Corn" to symbolize the agricultural history of the region. Buildings on the inner row are all 80-meters tall and those on the outer row are 120-meters tall.

The second cluster is for a mix of logistics, office buildings, and housing in an area of 23 km^2, located on the south side of the CBD. The third cluster centers on the man-made Dragon Lake with its 608-ha of water area, which is indeed even larger than the famous West Lake in Hangzhou. A sub-CBD of 48 hectares protrudes into the lake like a peninsula. Land in this area has the highest value in all of Zhengdong. A 3.7 km-long canal connects the CBD with the sub-CBD, forming the shape of a Chinese *ruyi* (an auspicious icon). The fourth cluster targets higher education, occupying 22 km^2 of land around the Longzi Lake. Canals named "water fingers" penetrate the surrounding area, connecting various institutions with the lakefront. The fifth cluster is a science park of 18 km^2. The sixth cluster is the industrial and technology development zone of 50 km^2.

With the maturity of its early clusters, Zhengdong has been targeting the development of a few new clusters and their surrounding high-end neighborhoods. These include a second CBD, a Smart Island, and Baisha, a new cluster. The original plan did not include Baisha. Zhengdong's authority foresaw the new area's potential to further expand eastward and added Baisha to its administrative territory in 2013. Since 2014 Zhengdong's development priority has shifted from constructing new structures to fostering advanced industries, state-of-art technologies, and cultural tourism. It has formed rapid development mechanisms that are based on clusters of civic centers, educational institutions, SOE headquarters, high-end commercial centers, high-end residential neighborhoods, and advanced service industries (such as finance, technology, and e-commerce). It is worth noting that the original plan by Kurokawa included a cluster for light industries with an area of 30 square kilometers. This was equivalent to an "economic and technological development zone" in China. According to China's central land policy, such industrial clusters must be separated from other functional zones. As a result, the proposed industrial cluster was relocated to other areas of Zhengzhou, leaving Zhengdong New District as a "clean area" with no polluting industries.

Today's Zhengdong presents an image of a developed city with vibrant urban activities and modern design quality in its architecture, infrastructure, and landscape. Local officials, planners, residents, and visitors have commonly praised Zhengdong's modern design of the built environment.

Zhengdong's promotional materials have highlighted a visually impressive CBD with a scenic central lake, glossy high-rises laid out in circles, spacious urban plazas with views of iconic structures, wide roads and smooth traffic, vast greenbelts running in parallel with major roads and waterways throughout the city, large urban parks with carefully sculpted and well-maintained vegetation, very clean public spaces maintained by diligent workers, and lively recreational life after business hours. There are two main ways to enter Zhengdong New District: from the old city and through the high-speed railway station. When leaving the old urban center and approaching Zhengdong on the highways, one is greeted by the iconic image of high-rises in the center of the CBD. The scene is monumental and gives the area a strong identity. Local residents are proud of this new area, calling it "the most desirable area in Zhengzhou or even in Henan." Tourists from Zhengzhou and nearby cities flock into Zhengdong to visit the "Big Corn" and its surrounding parks and civic centers. When entering Zhengdong from the high-speed railway station, one first experiences the convenient transit system, where all modes of ground transportation connect at this station for swift transfers. The areas adjacent to the railway station feature sleek high-rises, including the tallest structure in Zhengzhou—the headquarters of Greenland Company, a state-owned real estate developer. Driving down the roads in Zhengdong, one can observe wide swaths of greenery between roads and neighborhoods and large areas of parks with delicate landscape design (Figure 14). Trucks that spray water into the air run through the city every hour to reduce dust. All construction sites are surrounded by sprinklers for the same purpose. During the day, the entire area is very clean, ordered, and decorated by greenery and flowers, with maintenance workers taking care of the public infrastructures and urban parks. At night, shopping malls and urban parks are filled with families enjoying leisure activities. In particular, the lakefronts and the ring roads at the center of the CBD, animated by colorful lighting, have become a large outdoor recreational complex. One can observe thousands of people dancing, running, cycling, singing, skating, and strolling, including many club sports with large groups of participants. For school breaks, dozens of school buses from Zhengzhou and nearby cities drive into Zhengdong within a single day, creating records of over 1 million visitors per day during tourism seasons.

Zhengdong's major business areas abound with headquarters of major businesses in the high-end service sector. Its industrial parks demonstrate the utilization of the most advanced technologies, such as artificial intelligence for urban management and autonomous vehicles for public transit. Its pilot area—Ruyi Lake Area (the main CBD)—is full of luxurious cars and high-end retailers. Most urban parks in the city are not only lively, recreational spaces for families, tourists, and people doing sports, they are also wildlife sanctuaries. One can hear many birds chirping in their green spaces. Many residents relax in malls, cafes, and parks or meander through the parks, appreciating views of architectural wonders (Figures 15 & 16). Every week the amphitheater is used for public education events and charitable performances (Figure 17). Numerous informal gatherings for leisure activities and sports have emerged, scattered across the new area in urban plazas and parks and along major roads. Zhengdong's officials claimed that the district's success could be proven by its popularity among people, who had "voted by feet"—meaning people voluntarily chose to live in and visit Zhengdong. Accordingly, Zhengdong's officials hoped to take advantage of the district's popularity and concomitant wealth accumulation and build a future with "advanced technologies" and "happy citizens."

Today's Zhengdong is branded as the icon that showcases Henan's prosperity. Its proclaimed achievements are well-known among officials, planners, and developers, which continues bringing popularity, capital investment, political importance, and international reputation to the new district. Henan's provincial government today has been relocated to Zhengdong. Zhengdong's economic success, its clean, modern, and ecological built environment, and its administration's emphasis on achieving outstanding urban management have become Henan's demonstration of its capabilities to develop vibrant cities. Higher-level officials and officials from other cities and provinces often visit Zhengdong to learn from its experience. Zhengzhou's government is proud that Zhengdong has received acknowledgments from China's highest leadership. At the Shanghai Cooperation Organization (SCO) Summit in 2015, Premier Li Keqiang led a group of leaders from among SCO's member countries and toured Zhengdong. He introduced the development of the district to foreign leaders at the CBD. Since then, Zhengdong continues to gain prominence as a successful new city development with an international reputation. President Xi Jinping has remarked that Zhengdong is the model for new city development in the future.

Zhengdong's Claimed Achievements

Today's Zhengdong is domestically known, and further promoted, as a huge success of new city building in Central China. The stated success has been supported mainly by economic development, industrial advancement, the modernization of the built environment, and the urban greening of the public realm. To further promote the district's economic and political importance, local officials continue searching for and experimenting with internationally discussed, forward-looking strategies for city making. Zhengdong has become Henan's largest flagship development project, demonstrating the province's power to create a massive city with economic vibrancy. It continues to be one of Henan's most attractive areas to investors, garnering a total fixed-asset investment of RMB 80.2 billion by 2018. It has received praise from politicians, practitioners, residents, and visitors alike for its modern cityscapes, enjoyable parks, lively recreational spaces, and growing economic productivity. In 2020, it accommodated about 1.5 million people and over 120,000 enterprises, generating dozens of billions in tax revenues. People from nearby cities and provinces come to Zhengdong to seek opportunities for desirable jobs and high-end lifestyles. Its increasing popularity has boosted confidence among governments, developers and residents, all of whom expressed doubts and concerns about the region's growth potential at the beginning. The perceived success so far encourages them to harbor even higher ambitions in the continual development of Zhengdong New District to showcase the provincial and municipal governments' capabilities to continue attracting people and investments. Local officials have been consulting with international designers, scholars, and scientists in search of the world's most advanced technologies in order to improve the development and management of the district. They aim to build a district that demonstrates cutting-edge "eco" and "smart" strategies for urban and environmental design and governance.

Zhengdong New District has maintained its continual development since as early as the year 2000. Local officials and planners consider this an important indicator of the district's success. It is indeed one of China's first new cities holistically planned with comprehensive urban functions. It is also one of the earliest Chinese cities master-planned by internationally renowned designers. In the following two decades, Zhengdong has gradually reputed to be a model for Central China development and a paradigm for planned urbanization. Its officials pride themselves on the transformative power of the Chinese government in creating a city from scratch. Local officials regard themselves as innovative

pioneers in China's new city movement and are proud of the district's achievements thus far. They believe that Zhengdong's success has been widely acknowledged among officials, experts, and the public. The following aspects are frequently mentioned to support claims of its success: 1) the high-level completion of the district thanks to the government's effective execution of a bold plan; 2) the strict conformity between the original master plan and the development output, especially the spatial and industrial organizations; 3) the district's rising economic competitiveness; 4) the realization of an ecological blueprint with advanced design principles; 5) the realization of networked water and greenway systems and observable increases in biodiversity; 6) high standards and strict rules for urban management and public services; 7) high quantity of visitors and lively public spaces; and 8) an agreeable overall environment and enhanced quality of life attested to by residents.

A series of key strategies for Zhengdong's conception have laid a foundation for its continual development. First, local officials insist that the ideologies underlying Zhengdong's master plan have set a solid foundation for its sustained growth at the very beginning. They regard Kurokawa's master plan as a practical vision for coordinated long-term growth which also incorporates rational spatial strategies. Such a vision transcends a static, form-based proposal and was considered innovative in the context of China at its time. Troubled by the disorder in Zhengzhou's preexisting urbanization, its officials embraced a morphologically deterministic blueprint from the start. To them, this blueprint sets an overall framework for a growing city while its cluster-based approach allows for flexibility in a dynamic development process. In practice, Kurokawa's Metabolist ideal of a modern city utilizes megastructures as the foundation for "organic growth." Local officials have stressed that the conceptual relationship between infrastructure and clusters in Kurokawa's plan aligns well with China's political economy of development. On one hand, the Chinese state has always been responsible for infrastructural and civic development, including transportation networks, utility systems, cultural centers, and urban parks, to lay the foundation for urbanization. It constructs open-ended and interconnected "megastructures" which are the permanent "spines" of the city. They fundamentally support growth while ensuring overall control. On the other hand, each cluster grows relatively independently like an "organ" or a "cell" along the spines over time. This incremental, process-oriented strategy incorporates considerations of time, to some extent allowing for flexible adaptation to urban change.

Second, local officials' collective and consistent effort in the faithful implementation of Zhengdong's overarching principles is in fact crucial to the successful creation of a holistic and systematic new district. The term of office for Chinese local leaders usually falls within three to five years. Despite officials' limited terms of office, the implementation of the original principles has been protected by the regulatory power of the master plan. This move was very distinctive among China's new city developments. Zhengdong's development has been directed by several generations of leadership. Each local leader takes charge of a particular phase of Zhengdong's development and focuses on a cluster within which they are granted discretion to experiment with new ideas. Due to the district's political importance, Zhengdong's leaders are usually accomplished party members appointed directly by the provincial government. These officials are young and about to be promoted to the provincial level. Government workers regard these officials as rising stars, who are well-educated, ambitious, and able. They would dedicate themselves to ensuring the success of their focused cluster. In this way, the achievements in the cluster's development showcase the leader's knowledge and capabilities, providing evidence for their future promotion. In the meantime, they are less prone to structural constraints caused by resistance from more powerful senior officials, and are less likely to interfere with other politicians' agendas. The inter-cluster political rivalries also encourage competition in innovative development. Overall, government workers and business

owners have found it easier to get things done in Zhengdong. Local officials point out that the district runs under a new power structure that is less bureaucratic than that in the old areas and, therefore, is more likely to enable progressive changes in the new city.

Third, building upon an ideological advance and faithful implementation, local officials claim that the coordination between spatial design and industrial development strategies at intermediate scales between the region and the architecture is crucial to the sustained growth of the new area. Zhengdong's layout is based on Kurokawa's original calculations of appropriate scales for the clusters and for green spaces. As a result, the new area has an appropriate density of population, businesses and recreational activities which allows key industries within a specific cluster to flourish while forging reciprocal relationships with other clusters. In order to kick start the district's economic development, the provincial and local governments have mobilized SOEs to relocate to Zhengdong in corresponding clusters. Seeking to attract businesses, the municipal government has created various forms of incentives to invite private investment. For example, new businesses can quickly launch the construction of their new offices through an accelerated governmental approval process, called "the synchronization of eight services." This process requires different municipal administrations to work in parallel as opposed to in a series of sequential steps. The eight parallels significantly shorten the procedures of inter-bureau collaboration and hence speed up the approval process of new business entry. The eight aspects are investment invitation, market entry, site selection, planning and design, land acquisition, construction preparation, cultural relic exploration, landscape construction, air pollution mitigation, and land leasing. Speeding up this process avoids lengthy and bureaucratic procedures in China's typical urban development, greatly reducing the initial financial cost for businesses when they enter Zhengdong. Local officials argue that such incentives are only possible in a special district like Zhengdong where its power structure is new and dynamic in nature. In the meantime, all new developments have been complying with the overall spatial strategies to realize the envisioned spatial and functional coordination. The officials claim that the common goal of economic and spatial strategies is to ensure the district's long-term growth.

Fourth, Zhengdong's administration also prides itself on its high-standard management of green spaces and environmental quality (especially monitoring air and water quality and mitigating pollution). They consider the district's popularity among residents, workers, and visitors and the increasing numbers of wildlife as the most evident proof of Zhengdong's achievements. Zhengdong's reputation of having an agreeable environment is key to attracting residents, enterprises, and investors. Local officials believe that despite its tremendous economic cost at the beginning, creating an ecological quality of the built environment is crucial to enhancing the city's livability, human capital, and economic competitiveness. It has led to a higher density of urban populations across the district's civic centers, parks, commercial areas, and residential neighborhoods. Zhengdong's builders express the hope that a good balance between ecological and economic development can foster a healthy environment for businesses to thrive and potentially allow more people to benefit from the development. It can also allow the local economy to sustain and, in turn, provide a solid financial foundation for enhanced urban management and public services.

Fifth, local officials stress that the interconnected ecological components of the city have greatly enhanced the quality of the environment and brought joy to citizens. Officials who have been overseeing the district's plan also emphasize that Kurokawa and his associates had carefully calculated the spatial dimensions of green spaces in Zhengdong to ensure they would form viable ecosystems. They believe that Kurokawa's plan has introduced varied benefits from ecosystem

services to local planners. The realization of the ecological components has largely made these benefits evident, informing decision-makers. Experiencing these benefits has served to educate officials, practitioners, and citizens who have been engaged in the district's transformations. Zhengdong's planners believe that the new development has fostered new wetland, forest, grassland, and aquatic ecosystems, especially in designated ecological zones. These ecosystems have been functioning in a healthy relationship with each other and with society. They perform as sanctuaries for wildlife, increasing both their quantity and diversity. For humans, these ecosystems offer various environmental and cultural benefits, including cleaning the air, reducing heat island effects, improving the quality of drinking water, providing places for recreational and spiritual activities, and enhancing human mental and physical well-being. The planners also believe that residents and workers in Zhengdong show more appreciation for ecosystem services and are more aware of issues such as environmental protection and public health. Local officials put a high valuation on Zhengdong's ecology, which to them has greatly contributed to the district's skyrocketing land and housing values.

Local officials have revealed that the smooth execution of massive shanty town clearance during early phases of development had greatly facilitated the realization of Zhengdong's holistic plan. The construction of Zhengdong's starting zone began without land transactions or village clearance, since the site of the old airport was owned by the state. When the starting zone was mostly constructed, it demonstrated the image of a promising new city, which helped to mobilize shanty town and village clearance in the rest of the planned area. The administrators of Zhengdong's initial development recalled that such wholesale clearance, although undocumented, was challenged by the resistance from the original residents. The development authority believed that the original residents resisted the development because they hoped for more compensation. In the end, the wholesale demolition was carried out with force, since forceful land acquisition and demolition was yet to be questioned in China at that time. The government cleared the entire area and resettled the original, longstanding residents within the district during its initial phase of construction. These original rural residents received cash compensation and market housing units. The original members of each village were relocated as a whole into a new gated community. Some original villagers expressed that their communities were in general satisfied with the compensation, although if the villages could hold out their land until later phases of the development, they might have more bargaining power to seek higher compensation. In contrast, local officials were pleased that wholesale demolition was carried out early on, which avoided the escalation of disputes over compensation in later phases of the development. The massive land title transition from rural to urban, accompanied by massive demolition and relocation, has ensured smooth growth in the coming years. Accordingly, an unspoken fact of Zhengdong's economic success is the significant appreciation of land value over the course of its development, which financially enabled its state-led infrastructural construction, including transportation and ecology. The original, longstanding residents, many of whom had an average household income of 1,000 yuan (about $150) per year from farming, have celebrated being lifted out of poverty thanks to housing relocation, cash and housing compensation, and potential urban jobs in the district. They have benefitted from the development and gained some security in transitioning into urban livelihoods. The alignment of interest between the state and the original rural landowners formed a growth coalition that has supported Zhengdong's continual development.

Building a new city is a long-term project with plural dimensions of strategies. In particular, the ecological dimension of Zhengdong's development was realized over time with consistent state support and strong centralized coordination. The construction of new ecosystems requires vast land and sufficient financial investment. Local governments created various state-invested agencies,

mainly SOEs, to take charge of the financing, construction, and management of the new ecosystems. The outcome of ecological investment, especially the benefits from ecosystem services, could only be perceived after years of continual input. Many benefits, such as cultural and spiritual ones, can hardly be quantifiable; others, such as environmental benefits, are difficult to assess based on mere monetary terms. Zhengdong's builders—including its officials, planners, rural land owners, and construction and management companies—all believe that such a massive and generative infrastructural project has drastically altered the economic, social, cultural, and environmental geographies of the district, the city, and even the region. The consensus is that leading such an ambitious multi-dimensional and pluralistic development attempt should be the responsibility of the state. It is only the state, especially a strong one like China, that can have the power to realize such a development with efficiency and effectiveness.

Local officials repeatedly emphasize that Zhengdong's governance has always maintained a high quality, from generating conceptual design to financing the implementation, from laying infrastructural groundwork to attracting businesses, and from the government's internal collaboration among different administrations to its dedication to everyday maintenance of the district. The city's leaders have always been learning from best practices in top-tier cities in China and from reputable sustainable developments beyond China. Local officials believe that Zhengdong's development has transitioned from an "urbanization-led industrial growth" to an "industry-facilitated urbanization." The latter marks a new phase of growth, during which the finance sector and the technology services sector will be the dual engines driving economic and social transformations. Gradually, Zhengdong has risen to be an area that has concentrated local and regional resources, nationally and internationally famous expertise, and political support from China's top leadership. Zhengdong is designated as China's highest-level development zone for smart technologies and free trade, with a special focus on adopting big data analysis and building digital platforms in its management and future development. It is one of the nine "Central Cities" to receive favorable policies for development from the central government. It is also an important member of the "Yellow River Economic Belt" proposed by President Xi Jinping—one economic-ecological zone with the same level of political importance as the Yangtze River Basin and the Guangdong-Hong Kong-Macau Greater Bay Area. The concentration of resources and effort in this new district has generated a privileged territory for top-class citizens and enterprises in Central China. Henan's residents awe its political status, its economic success, its cultural symbol, and its cutting-edge experimentation with urban development.

Zhengdong's Eco-Environmental Effort

Since the start of Zhengdong's development, China's central government has initiated a series of legal and regulatory reforms that favor ecological and environmental protection (discussed in Chapter 3). These national eco-environmental reforms have introduced new policies and new regulations, which are often tested locally in new developments, especially in new districts like Zhengdong. Zhengdong's authorities suggest that they have adjusted governance measures and implemented new policies according to these national reforms. Over the past two decades, Zhengdong's eco-environmental effort has diversified along a few dimensions. On one hand, asserting that urban expansion was inevitable, local officials considered the commitment to Kurokawa's vision as a major investment in decarbonization through shaping urban nature as opposed to prioritizing short-term economic gain. They believe that Zhengdong's master plan is a

locally initiated strategy that is proactive and comprehensive and that sets a framework for long-term growth based on ecological principles. Zhengdong is one of the first master planned mega projects in China that has constructed vast green areas (including retained and reconstructed ecologies) and incorporated ecosystems planning into urban expansion. As of 2020, Zhengdong's total green area coverage was over 50 percent. The district included over 18 square kilometers of green spaces and over 40 urban parks. The development also carried out ecosystem restoration and water cleanup in a river area that was about 30 kilometers long. In addition, over 200 main roads and streets and over 50 bridges in the district provided additional green spaces that were decorated with trees and plants (Baike, 2021; Liu and Wang, 2010; Ma and Huangpu, 2020; Shang and Dong, 2012; Sohu News, 2020; Yue, 2020). On the other hand, Zhengdong's administration has been actively integrating new measures according to national policy recommendations, especially those on environmental governance, an Ecological City, a Livable City, and the Sponge City. It continues emphasizing its eco-city identity with symbiotic relationship between human and nature. As of 2020, it has diversified its green approaches into four main aspects:

a) Constructing new ecology and promoting biodiversity
b) Increasing environmental management (establishing regulations or incentives to limit industrial emissions; reduce local pollution from industries and transport;)
c) Establishing decarbonization services and programs(e.g., bike sharing systems, rapid public transit systems, discouraging car use, pollution mitigation, air quality control, water quality monitoring, reforestation, etc.; using renewable energy sources and cleaner production techniques)
d) Emerging green governance (state-led climate activism, waste management programs, energy saving programs; encouraging civic engagement in environmental stewardship, low-carbon travels, energy saving, and waste management; promoting public health through neighborhood-led and grassroots recreational activities)

There are a few exemplar attempts highlighting Zhengdong's eco-environmental effort. First, Zhengdong has carried out a series of measures for pollution reduction and mitigation. Water pollution control is mainly achieved through closing down polluting factories and monitoring water quality in nearby water bodies. The construction of the new district has also enhanced collection and treatment facilities for cleaning stormwater and wastewater respectively. For air pollution control, Zhengdong's administration has been diligently monitoring air quality and mandated strict dust control. In addition to the single air quality monitor installed by the central government in the district, Zhengdong's administration installed extra monitors across the district to gather more detailed air quality data. It requires all construction sites to take precautions to limit the spreading of dust and dirt. Water mists are sprayed regularly at each construction site. Unpaved surfaces must be covered at all times. Trucks must be cleaned before they exit any construction sites with preventive measures against water and dust leaks. The district also runs gigantic "mist cannons" (Nield, 2015) on the road every two hours from early morning to late night. These cannons spray mist into the air to reduce dust, although rumor says that they run more frequently in the vicinities of air quality monitors. The environmental protection branch of Zhengdong's administration also works in collaboration with designated SOEs (which employ civil engineers and environmental scientists) to manage the district's green spaces and water bodies, maintaining environmental cleanness and ecosystem health. Hence, although Zhengdong has been under construction over the past two decades, it is widely reputed to have a clean, agreeable, and ecological environment that provides aesthetic enjoyment to its citizens. Local residents are proud of Zhengdong's environmental quality, praising it for matching that of popular global cities such as Singapore and Hong Kong.

Second, Zhengdong's administration has carried out experiments with low-impact development. For instance, the central government has introduced new guidelines and new standards for the Sponge City, a model for low-impact development. As a pilot experimental area for the Sponge City, Zhengdong incorporated these technical guides and standards into the detailed designs of roads, green spaces, and paved areas. It constructed greenways, canals, and wetlands to retain, filter, and clean stormwater. Local planners argue that the ecological technologies for treating stormwater has been effectively cleaning Zhengdong's water bodies. They believe that with extensive and interconnected ecological networks, Zhengdong has been designed as a "sponge city" from the start. Local planners also suggest that some technical guides are very specific yet not always applicable in practice. When the specificities for permeable paving and bioswales were applied to Zhengdong's constructions of roads, plazas, and parking lots, the constructed surfaces were not strong enough to support human or vehicular uses. Local engineers had to defy the national standards and redesign these infrastructural elements according to specific site conditions. In these processes, some ecological considerations were compromised for economic and practical considerations.

In the meantime, Zhengdong has seen growing public-private partnerships (PPP) in reducing carbon emissions in public transportation. Using Zhengdong as the pilot area of infrastructural modernization, local government has invested tremendous effort to build rapid transit systems (including subway and buses), bike lanes, and pedestrian paths—all connected throughout the district and between Zhengdong and other parts of Zhengzhou. Almost all bus lanes, bike lanes, pedestrian paths are clearly demarcated for safety purposes. The ones in dense urban centers are protected by planters, greenways, or fences. The authority believes that proper safety measures and traffic management can encourage more usage of public transit or behaviors such as biking and walking. In addition, the city of Zhengzhou has adopted electric vehicle (EV) technology in its bus systems. A local EV manufacturer, Zhengzhou Yutong Group Co., Ltd., has become the supplier of 95% of Zhengzhou's EV buses, contributing to economic development, the development and popularization of green technologies, and the decarbonization efforts in the city.

One important example of Zhengdong's new PPP in decarbonization is the integration of low-carbon transit systems. A private enterprise, sponsored by the municipal government, has been established to operate the point-to-point bike sharing system, starting in Zhengdong New District. This company takes charge of the system's management and expansion, as well as app and equipment upgrading. It also collaborates with the district's administration on advertisements and management measures against car usage and illegal parking. The company carefully selected popular areas with busy public access, such as bus and subway stations, park entrances, shopping mall entrances, workplace entrances, and residential community gates, to install bike docks. Their goal is to use the shared bike services to supplement the rapid public transit systems while encouraging low-carbon travels. Local media reports that the public services provided by this company has brought tremendous convenience to local residents, especially when subway construction is still underway. The point-to-point bike sharing system has massively improved transportation and greatly encouraged bike usage. However, the company's operation was disrupted when privately owned dockless bike sharing systems flourished in the district. The dockless bikes were spawned all over the district with little or no management, blocking traffic, including garage gates, subway station entrances, and pedestrian passages. The point-to-point bike sharing company voluntarily took on the role of arranging dockless bikes until the city banned those private systems due to the disorder and extra cost in management. Today, the city of Zhengzhou largely relies on this state-sponsored company to operate its bike sharing system. The company has become a main advocate encouraging

low-carbon travels in the city. It adopts more advanced technologies to improve its bike models, stations, public interfaces, and virtual platforms, aiming to create more accessible and convenient services for more users. Similarly, other companies experimenting with new products for green transportation are also eager to carry out pilot projects in Zhengdong. For example, a major Chinese manufacturer of buses has been operating one line of shuttle bus services, using electrically powered autonomous vehicles, on Zhengdong's "Smart Island." While it is still testing technologies for driverless cars, the district and the company together have planned a second line in a larger area in Zhengdong's university cluster. In order to reduce transport-related carbon emissions, Zhengdong has also required companies providing shipping and delivery services to only use electrically powered vehicles within the district.

Last but not least, Zhengdong has begun taking part in new eco-environmental initiatives on both regional and neighborhood scales. At the regional level, the provincial government has designated vast ecological protection zones along Jialu River which runs through the city on the north of Zhengdong New District (Figure 18; Tencent News, 2021). Billions of yuan are to be invested in environmental protection within the zones along the riverbanks. Accordingly, Zhengdong's authorities have been developing detailed plans for ecological restoration and agricultural development within the ecological redlines. On the neighborhood scale, each street-level government has been organizing communal campaigns to encourage all residents within its jurisdiction to participate in programs for energy saving and waste management. Local officials suggest that due to Zhengdong's rising political importance, its key decision-makers are at the forefront of advancing China's nationwide movement of ecological civilization. These influential actors' leadership will drive the district's strategies for eco-environmental governance to further diversity and mature in the near future. While Zhengdong will continue being a place that is willing to test new policies and new standards unified at national and provincial levels, it will also continue searching for locally grown strategies for innovation. Its builders learn from these experiments through trial and error. In turn, Zhengdong's officials concur that the district will become a regional and even national model for China's ecological transitions.

A Genuine Eco-Smart Future or Greenwash in New Developments?

After two decades of intensive construction and economic development in Zhengdong, the district's officials have been eager to explore new approaches to urban and environmental planning and management, as well as infrastructural modernization. Zhengdong's officials claim that they have paid increasing attention to exploring new technologies for decarbonization and artificial intelligence in the development of its newer clusters in order to continue building a demonstration project of a futuristic city. For example, a multi-layered, multi-modal transportation system incorporating digital infrastructure is planned in its second CBD—the Longhu Subcenter; state-of-art technologies and artificial intelligence are supposed to be adopted for public service on its Smart Island; and an eco-tourism zone with landscapes restoring the water systems and showcasing Yellow River Basin cultures is planned in Zhengdong's floodplain area. Zhengdong has been designated as a pilot experiment zone for China's smart-city development. Its goal for the next phase of growth is to integrate digital infrastructure into traditional urban infrastructure and build a virtual platform for data collection and data-aided management in the meantime. In this way, local officials seek to utilize China's massive public surveillance and collect extensive data that could potentially be analyzed by artificial intelligence for improved public services and urban management.

The convergence of eco- and smart-city strategies is evident in many new city developments today. New city governments emphasize improving eco-environmental quality and using digital technologies to solve urban illnesses. Green-growth approaches, such as pollution mitigation, ecological restoration, environmental monitoring, environmental protection, low-impact development, green finance, and green governance, are being explored in concomitance with the upgrade to 5G networks, the construction of digital infrastructure, the installation of sensors and digital surveillance systems, and the collection, storage, and analysis of big data. Since 2020, China's strategies for controlling the spread of COVID-19 have accelerated the widening coverage of digital surveillance. Zhengdong's authority has claimed to be at the forefront of these realms of technology-enabled urban management.

Although Zhengdong is experimenting with and exploring future-oriented innovations, it remains a product of twentieth-century planning. It was largely shaped by a growth-driven mindset at the start of China's globalization against the backdrop of concomitant acceleration in socioeconomic transformations. Zhengdong's alleged green and ecological achievements must be understood in this historical context of peak urbanization. In 2021, China's administrations and institutions that govern its urban development have begun changing. Since 2010, for example, Zhengdong's new CBD, Longhu Subcenter, has undergone a phase of planning adjustments. Local officials invited Arata Isozaki to redesign the area. The revised plan is anchored in principles of a low-carbon city, incorporating underground highways and autonomous vehicles for Personal Rapid Transit systems. With the newly proposed highways, high-end villas and office buildings, and artificial green spaces, it remains contentious whether the new phases of Zhengdong's development could be as "ecological" as its initial demonstration phase. Critics have warned that without quantifiable evidence of Zhengdong's achievements in constructing new ecologies and fostering a green economy, its claimed achievements remain rhetorical and are highly contested. Without genuine investigations into the ecological and environmental performance, Zhengdong's ecological approaches would be appreciated merely at a superficial level. Without scientific guidance for ecological design and environmental planning, new phases of its development could become pure greenwash.

While Zhengdong claims to continue exploring the world's trending approaches to eco-smart growth, deadly floods hit the City of Zhengzhou. On July 20, 2021, after a record rainstorm ravaged Henan Province, the City of Zhengzhou was submerged, causing hundreds of casualties (Agencies, 2021; Global Times, 2021). This devastating disaster has disproved the claimed progress on the "sponge city" experiment carried out in the City of Zhengzhou, which has cost 53.5 billion yuan (about 8.3 billion) (Worldjournal, 2021). It has also revealed the fundamental limitations of China's growth-oriented green urbanization strategies. While Zhengdong has been promoted as "a livable city south to the Yellow River" (Wang, 2020), the 2021 floods have given such claims a heavy blow. The irony in Zhengdong suggests that China's rapid urbanization has created cities that are ill-equipped to face extreme weather. With rapid urban growth leading to the massive coverage of floodplains with impermeable concrete, studies have shown that about 98% of China's 654 major cities are vulnerable to flooding and waterlogging (Stanway, 2021). Scientists have warned that climate change would make such heavy rains more common in the future. This means cities need to brace for more floods. Zhengdong's tragedy—as well as similar environmental disasters across China—has revealed that Chinese cities have largely neglected disaster prevention, environmental risks mitigation, and climate change adaptation (Feng, 2021). A recent *New York Times* article has correctly issued a timely warning: "As china boomed, it didn't take climate change into account.

Now it must" (Myers et al., 2021). Moving forward from the 2021 disaster, more genuine environmental actions should be prioritized on Zhengdong's future agendas for green development and governance.

Images:

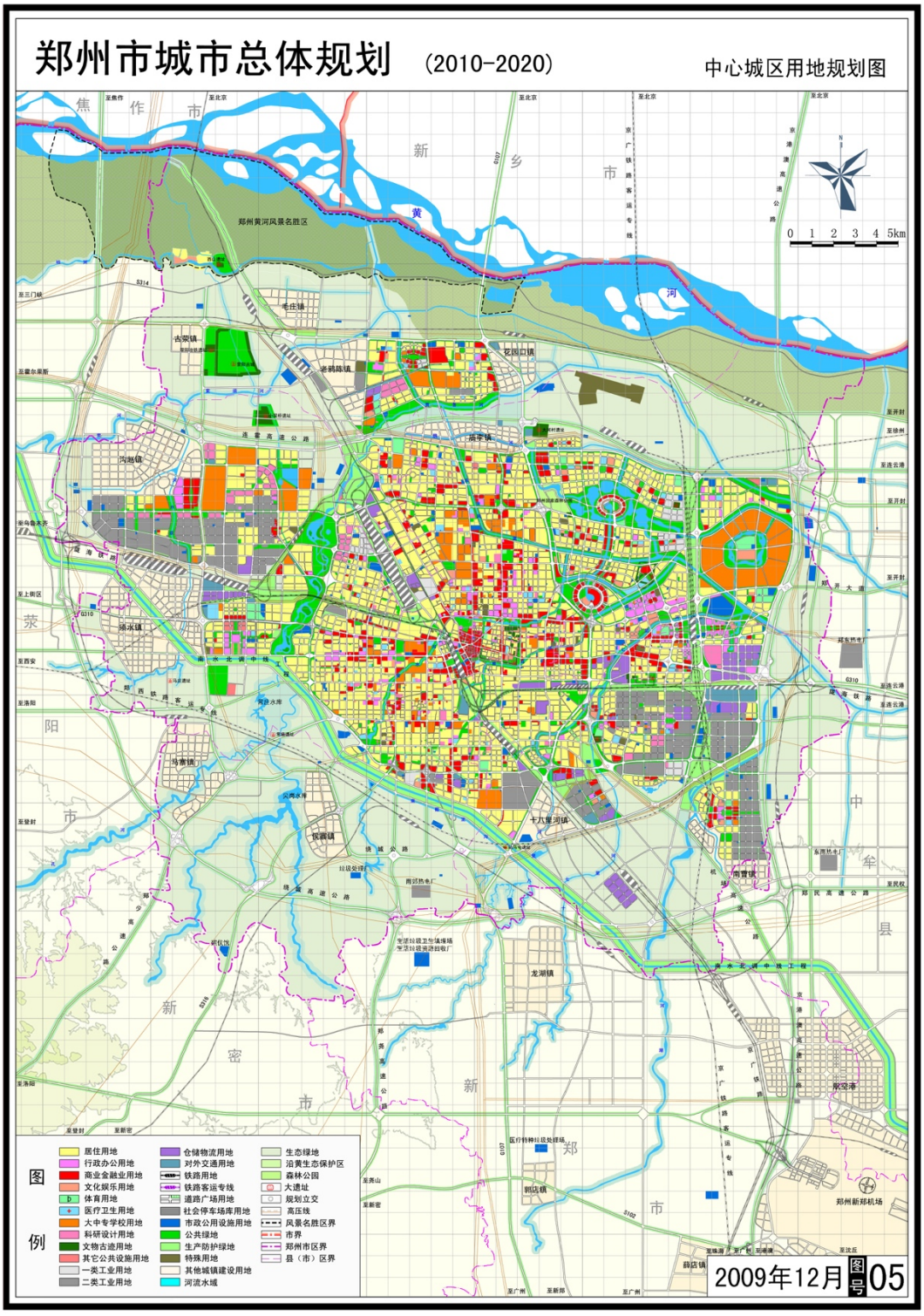

Figure 1. The Master Plan of the City of Zhengzhou
Source: Zhengzhou Municipal Government

Figure 2. Zhengdong New District Locator Map
Source: Administrative Committee of Zhengdong New District

Figure 3. The Original Master Plan of Zhengdong New District designed by Kisho Kurokawa and Associates
Source: Administrative Committee of Zhengdong New District

Figure 4. The Old Military Airport Outside the East Border of the Old City of Zhengzhou (2002)
Source: Administrative Committee of Zhengdong New District

Figure 5. Viewing Zhengdong's Old City Center from the Old Military Airport (2002)
Source: Administrative Committee of Zhengdong New District

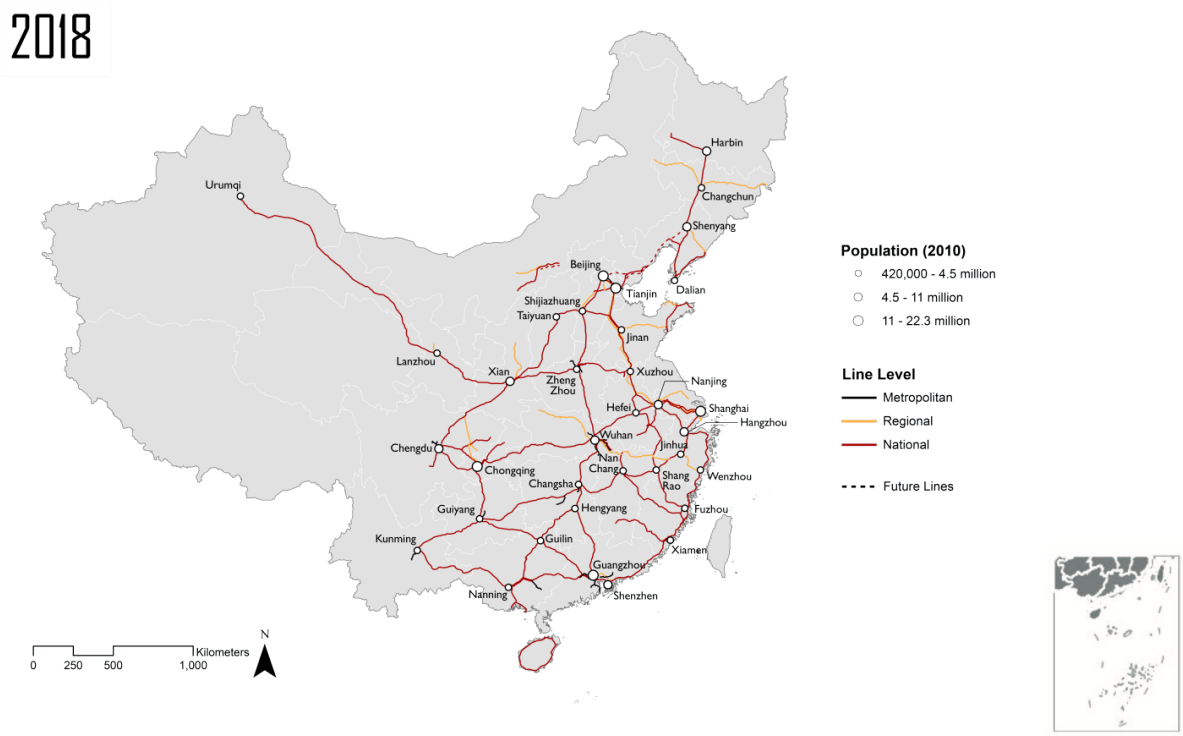

Figure 6. China's high-speed railway network in 2018
Source: MIT-China Future City Lab; (Zheng and Tan, 2020, p. 127)

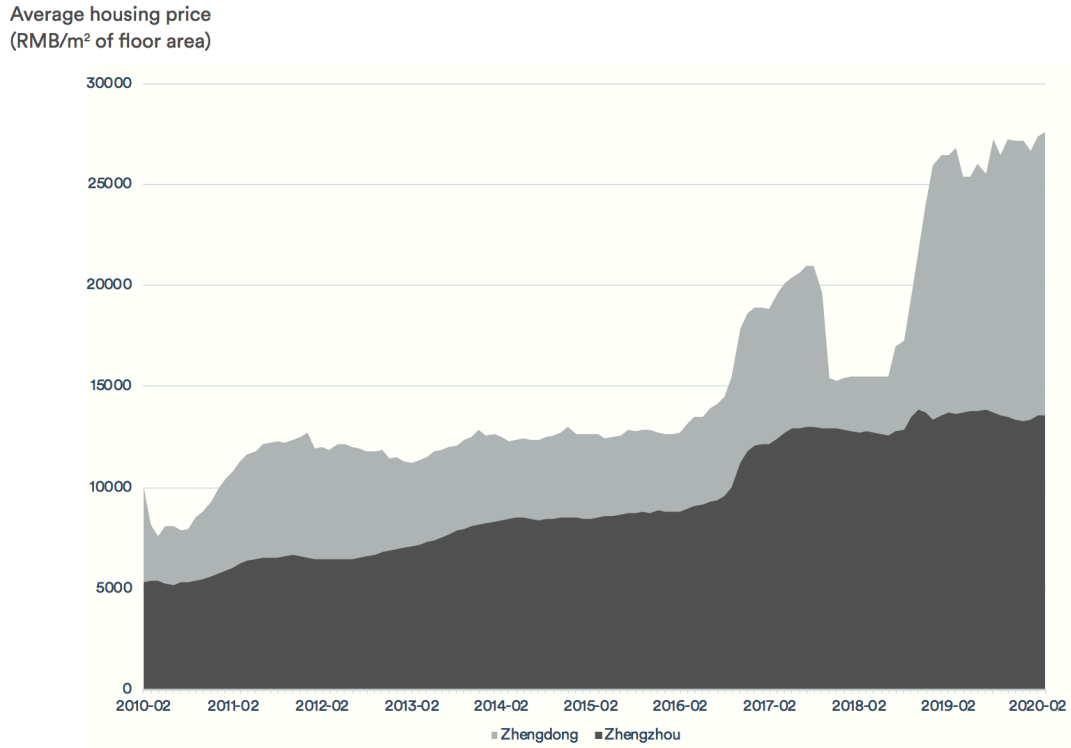

Figure 7. Second-hand Housing Price in Zhengdong from 2010 to 2018
Source: Anjuke Henan Information; (Zheng and Tan, 2020, p. 124)

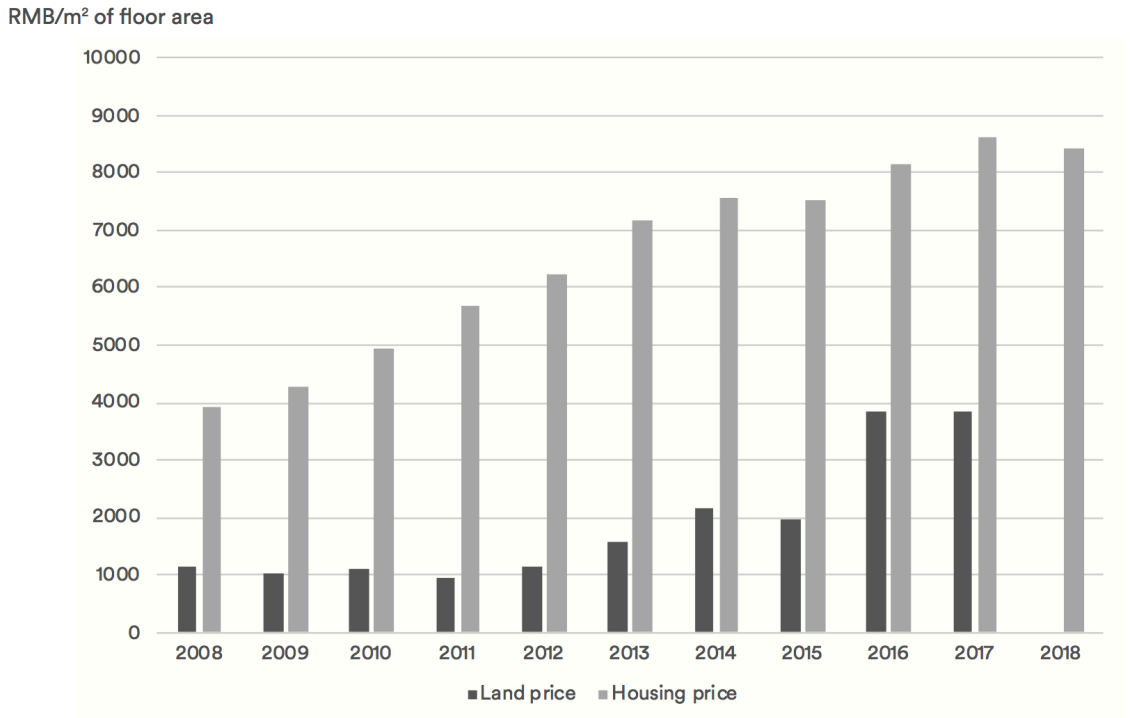

Figure 8. Average Selling Price of Commercial Housing Price and Land Price in Zhengzhou
Source: State Information Center (http://www.crei.cn); (Zheng and Tan, 2020, p. 124)

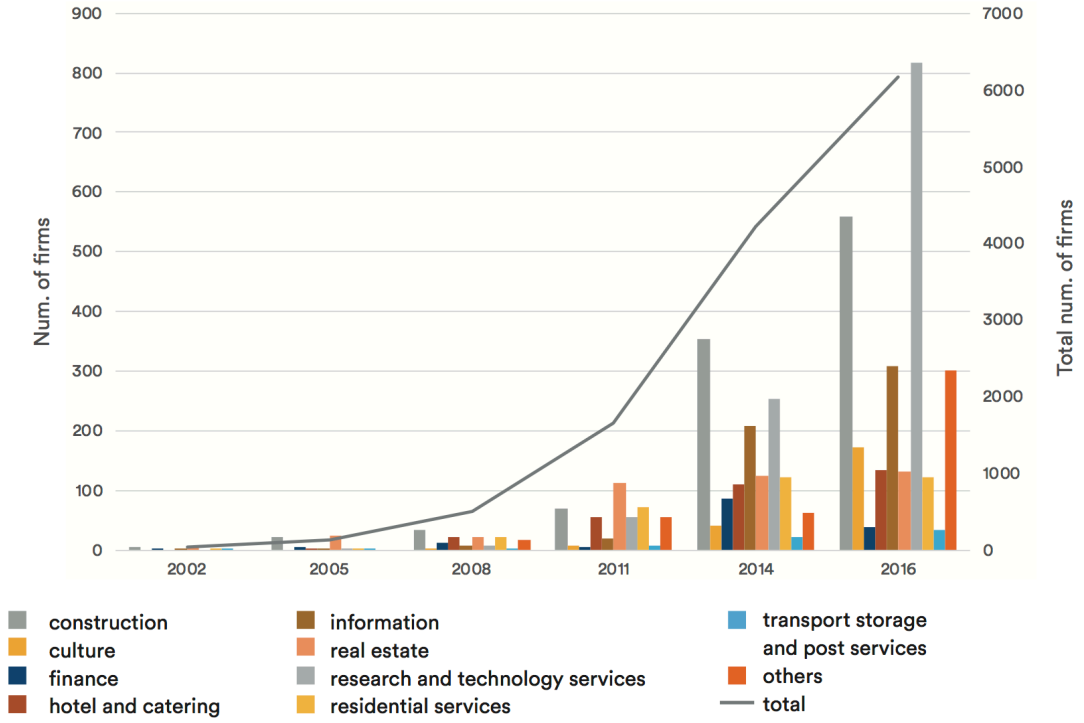

Figure 9. Time Trends of Newly Registered Firms in Zhengdong
Note: Only part of industries are listed; (Zheng and Tan, 2020, p. 121)

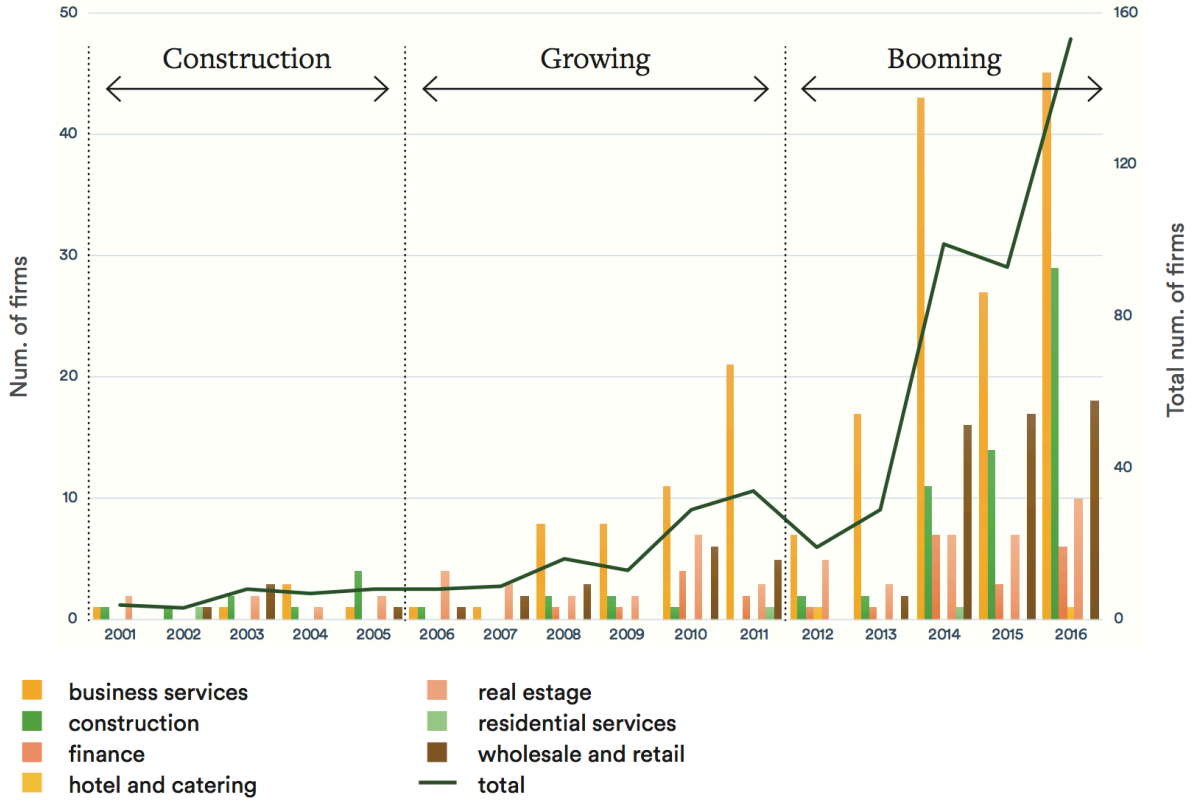

Figure 10. Number of Zhengdong's Large-scale Enterprises (Registered capital > 100 million RMB)
Note: Only part of industries are listed; (Zheng and Tan, 2020, p. 121)

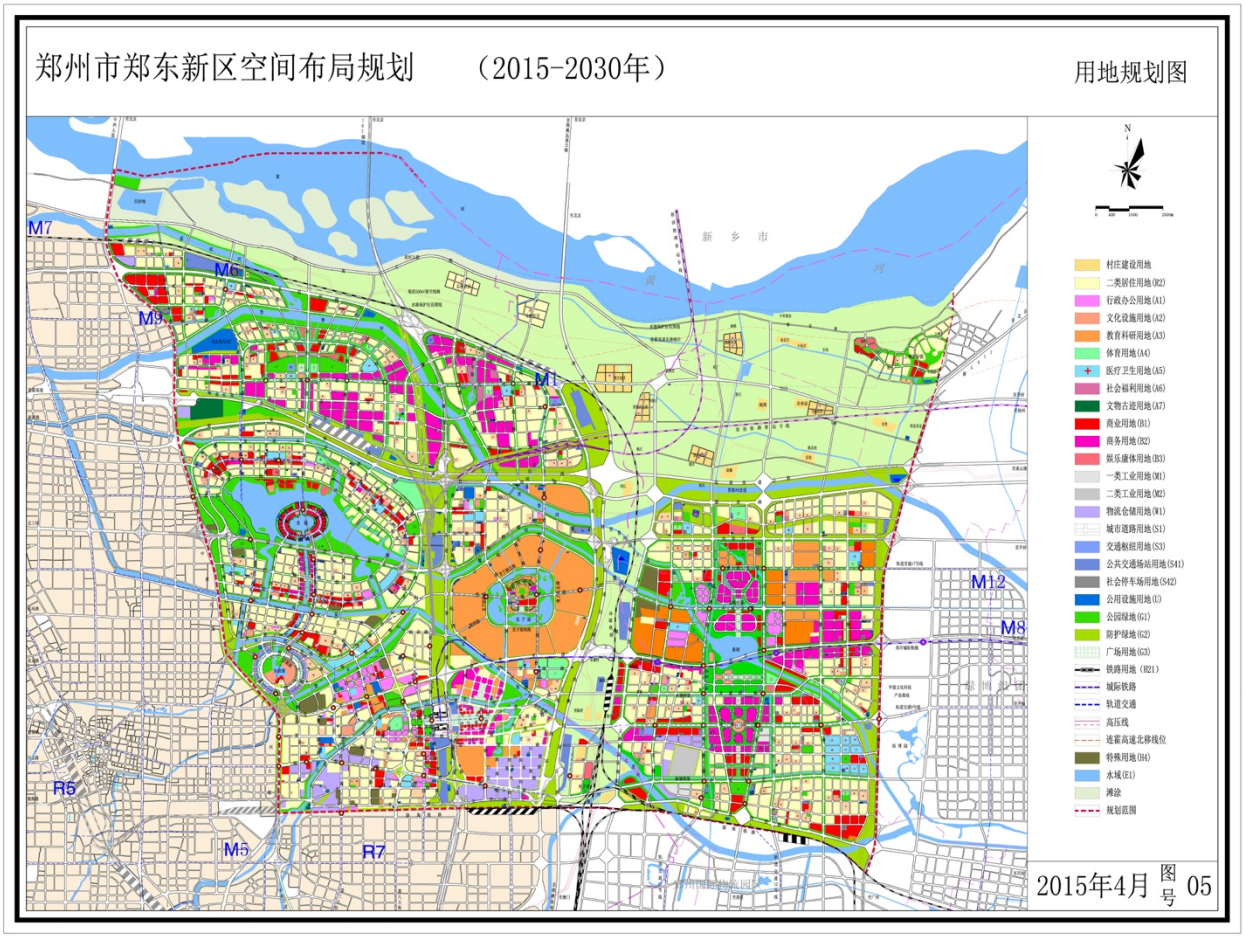

Figure 11. The Master Plan of Zhengdong New District (2015-2030)
Source: Administrative Committee of Zhengdong New District

Figure 12. Aerial view of the CBD Area
Source: Administrative Committee of Zhengdong New District

Figure 13. Towers in the CBD Area
Source: Administrative Committee of Zhengdong New District

Figure 14. Green Spaces in the CBD Area (pictures by author)

Figure 15. Citizen's Leisure Activities (pictures by author)

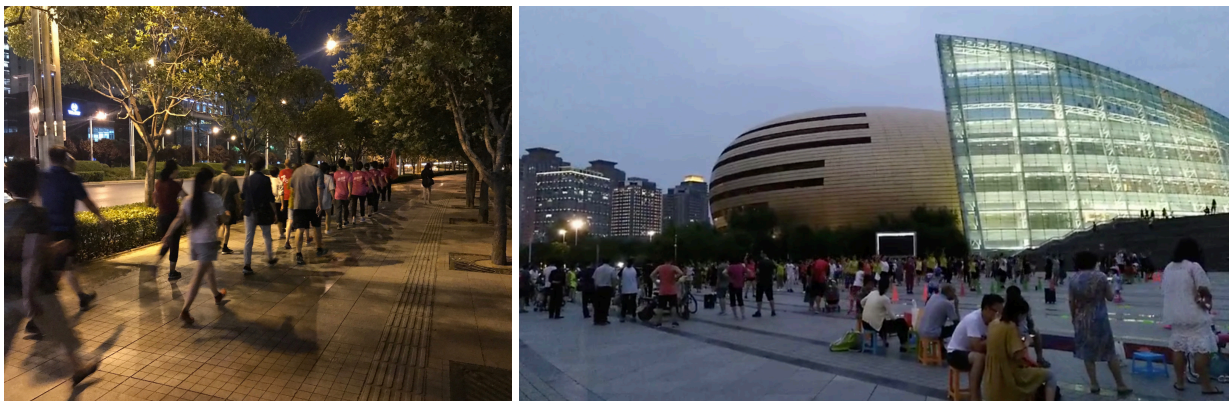

Figure 16. Grassroots Organization of Daily Leisure Activities in the CBD Area (pictures by author)

Figure 17. Public Education Event on "Green Development and Energy Saving" (picture by author)

Figure 18. The Master Plan of the Northern Area of Zhengdong New Area (showing the ecological protection zones along the rivers)
Source: Administrative Committee of Zhengdong New District

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Chapter Five.
Nanhu Eco-City: Transforming a Mining Field into Tangshan's "Green Lung" through Brownfield Utilization and Ecological Restoration

This chapter introduces the other focused case—Nanhu Eco-City, which is located in the City of Tangshan in Hebei Province. The strategy for developing Nanhu Eco-City is similar to that for Central Park in New York City—building the park first and then developing the city around it. This chapter has adopted a similar structure as Chapter Four to describe the planning, design, and construction of Nanhu. The methods and time frame for data collection resemble those for Zhengdong's study. The purpose underlying the paralleled methodology was to collect information in similar aspects and from similar perspectives so as to set the foundation for cross-case comparisons. The following sections introduce Nanhu's development history, design and planning rationale, spatial characteristics, and claimed achievements according to governmental and media reports as well as the assessments of local officials and Nanhu's planners and designers.

Nanhu Eco-City is hailed as a picturesque new landmark of China's top steelmaking city, Tangshan (Figure 1). Its development has been imbued with an ambitious desire to permanently alter the collective trauma of Tangshan residents. The City of Tangshan is famous for its importance in China's industrial history as well as its trauma from the deadly 1976 earthquake. Tangshan is located in Hebei Province on the coast of Bohai Bay. Historically, the city abounded in natural resources, including coal, iron, gold, oil, and natural gas. Its industrialization began with resource extraction, marked by the opening of Kailuan coal mines in 1870. Tangshan is widely known as China's "cradle of industrialization" and the birthplace of a series of industrial developments. For example, China's first standard-gauge railway, the first railway plant, the first steam locomotive, and the first cement factory were all developed in Tangshan (Henan & Tangshan Governments, 2014; Li, 2003). Until the early 2000s, Tangshan's economy had been largely supported by heavy industry, such as mining and the production of steel, ceramics, and energy. Tangshan's industrialization did not grow without destruction. In 1976, a magnitude 7.8 earthquake shook the city, which flattened 78 percent of Tangshan's industrial buildings and 97 percent of its residential buildings. The official death toll was reportedly 240,000, although foreign sources estimated at least twice that of the official tally (Chen, 2005). Shortly after the earthquake, the Chinese Communist Party pooled resources across the country and led a political campaign to rebuild Tangshan. The city quickly restored the development of its heavy industry and was largely reconstructed within the following decade.

In the twenty-first century, Tangshan has become an important node in the Jing-Jin-Ji City Region (including Beijing, Tianjin, and Hebei Province). Its geographic importance on China's central political agenda has brought new changes to the city. The idea of forming a city region that includes Beijing (Jing), Tianjin (Jin), and Hebei Province (Ji) was known to have emerged in early 1980s (Lu, 2008). Yet, it was not highlighted on China's central political agenda until 2014, when President Xi Jinping and Premier Li Keqiang emphasized the "coordinated development" of Jing-Jin-Ji Region (Zou, 2015). In 2005, the central government decided to relocate Shougang Group—a major state-owned steel company—from Beijing to Caofeidian Area. The latter is a remote district 85 kilometers away from Tangshan's urban center. It is located on Tangshan's southeastern coast on the shore of Bohai and is mostly built from land reclamation. Shougang's move, motivated by the intention to reduce pollution during the 2008 Olympic Games, had greatly raised the political importance of Tangshan in the plan for Jing-Jin-Ji integration. Tangshan was expected to carry the mission to

continue growing heavy industry in northern China. For this purpose, it received favorable policy from the central government that targeted industrial development in Caofeidian Area. The Caofeidian Eco-City, located within the Caofeidian Industrial Area, was supposed to provide a livable environment for local workers. Tangshan's municipal leaders also ambitiously planned a series of new cities surrounding the old city center to deindustrialize the old city center while expanding its urban area in all directions (Sina News, 2009). However, Tangshan's central urban area has been struggling with natural resource depletion, population shrinkage, and environmental deterioration since the 1990s. In particular, a highly polluted environment has become a major casualty of Tangshan's century-long industrialization. In 2017, Tangshan was ranked as China's sixth most polluted city (and the top five were also in Hebei) (Gardiner, 2017). Local officials have realized that Tangshan's industrial characteristics compromise the quality of life in Tangshan and prevent the city from attracting productive populations who would facilitate economic restructuring. Tangshan's urbanization must confront its past, especially a highly polluted environment and the abandonment of old industrial sites in the city's core. While Beijing has been eager to minimize pollution across northern parts of the country, Tangshan had begun tightening pollution controls by shutting down factories and controlling emissions (Xu and Singh, 2019; Zhang and Singh, 2019). It has also been searching for opportunities to foster cleaner industries. As a crucial component of Tangshan's deindustrialization endeavor at its center, Nanhu Eco-City emerged as a major intervention for urban revitalization through brownfield utilization and ecological restoration.

The Conception of Nanhu Eco-City

Today's Nanhu Area surrounds a massive urban park that is named Nanhu Central Park. This area is indeed centrally located at the heart of Tangshan's urban core (Figure 2). Before the existence of Nanhu, this was known as a vast abandoned area of 21 square kilometers, located less than one kilometer south of Tangshan's commercial center. This area was a coalmine for over 130 years and has been suffering from surface subsidence. Rainwater and sewage from urban areas flood this area. Tangshan's chief planners recall that, Nanhu's original site had gradually become a "dump" of the city. Before any development was initiated, this area was a "barren and polluted wasteland." It was "pitch-dark" where "no one would visit." It was also a deserted area where any formal management was absent. Most former residents had moved away from the center of the subsiding area to its periphery. Low-income residents, including local villagers and migrants, had built informal settlements nearby, forming massive shanty towns that housed about ten thousand households. The area was also the unauthorized, yet generally acknowledged, disposal ground for municipal solid waste (commonly known as trash or garbage) and coal combustion residuals (commonly known as coal ash). It was known as the city's "junkyard," taking in 290,000 tons of garbage per year (Gardiner, 2017). Solid waste accumulated since the earthquake had reached 4.5 million tons in total, piled into a "garbage mound" of over fifty meters high (Figure 3). A coal-fired power plant nearby had continued disposing coal ash into surface water within this area. In addition, what was culturally ominous was that many victims of the earthquake were buried here (Figure 4). Local officials recall that this land of abandonment and contamination was often described as "hell on earth."

Despite the "hell-like" condition at Nanhu's original site, its adjacency to Tangshan's growing urban center brought opportunities for its drastic transformation. After collecting garbage, construction and industrial waste, and domestic sewage for over two decades, the fate of this area was about to change course. In the 1990s, most cities in China anticipated vast urbanization and huge economic

growth from land-based financing. Tangshan, like most Chinese cities, was scouting developable land to increase fiscal revenues. Its municipal officials realized that the city could no longer turn its back on its massive "junkyard" which was preventing the city's southward expansion. The condition in this area had greatly compromised its land value as well as that of abutting areas. The officials determined that this area was the "scar" of Tangshan, ruining the image of the city. They also started to acknowledge the fact that severe pollution in this area was jeopardizing environmental safety and public health. Starting in 1996, Tangshan began a series of measures to restore the subsiding area, which included five aspects: 1) solid waste removal, 2) massive urban greening, 3) treatment of contaminate water bodies, 4) city beautification through landscaping, and 5) construction of infrastructure for transportation and utility networks. These attempts continued during the decade to follow.

Tangshan's ambitious restoration initiatives were promoted with the slogan: "to make waste into treasure, to turn the disadvantage to an advantage, and to transform the rotten into the miraculous." In 2006, Tangshan's then Municipal Party Secretary Zhao Yong resolved to speed up the restoration of the subsidence area lying right south of the city center. He led a series of projects that gave birth to Nanhu Eco-City (literally meaning "south lake eco-city"). As of 2006, the surface subsidence in Nanhu caused by coal mining had affected an area of 28 km^2. In 2007, the city involved the Tangshan Branch of China's Coal Research Institute to carry out a scientific study of ground conditions in the contaminated subsidence area. This study identified geological hazards in the area, assessed the feasibility of urban construction, and proposed solutions for water and soil treatment (Figure 5). It opened the conversation about the area's potential for repurposing. In the same year, the city organized a design competition and shortlisted several schematic designs for the area. The winning design teams included Tsinghua Tongheng Planning and Design Institute, China Academy of Urban Planning and Design, ISA Internationals Stadtbauatelier (Germany), and J.A.O.Design International Inc. Led by Tsinghua Tongheng's planners and designers, a final master plan for "Nanhu Ecological Park at the Urban Center" emerged from the synthesis of 27 projects proposed by the international design teams (China News, 2010). The goal of the master plan was to foster cultural-ecological tourism industry at Nanhu so as to replace heavy industry and drive Tangshan's future economic growth. Tongheng's planning and design team also involved experts in the fields of geology, ecology, urban planning, landscape design, pollution control, and building construction in their design development. They suggest, "We carried out detailed site surveys to guarantee a scientific process of planning and construction."

The master plan of Nanhu Park was delivered with both visual representations of spectacular scenery and rhetorical commitment to transformation (Figure 6). Conceptually, the project was dubbed as the "Nirvana of Phoenix," which carries the symbolic meaning of "rebirth." According to Tongheng's planning and design team, the cultural connotation underlying their scheme was crucial to their winning of the design competition. They state, "The cultural meaning of "phoenix shows the vision of courageous growth of new Tangshan based on the humanistic spirit of thankfulness, fraternity, openness, and transcendence." Their concept was allegedly well received by local leaders, the public, and experts of different fields for representing the complete overhaul of Nanhu's site through ecological restoration (Figure 7).

On March 1, 2008, the construction of Nanhu Central Park broke ground. Before then, Tangshan's government had already built some lakes and planted trees, aiming to establish a local park. However, the newly planned park is a much more ambitious project. The construction began with expanding existing water bodies, removing garbage, and constructing massive cultural complexes. These cultural amenities mainly include the Tangshan Earthquake Museum and the Civic Center (Figures). The latter mainly consists of a theater, an art center, an exhibition center, a library, a shopping center, a food court, plazas, and huge parking lots (Figure 8). The landscaping construction included heavily engineered projects that aimed at creating a massive urban ecology from scratch (Figure 9). Nine manmade lakes were formed and several hills were built to contain preexisting solid waste. In the meantime, road and utility networks were built and massive afforestation was carried out. On May 1, 2009, after only fourteen months of construction, Tangshan's residents witnessed the official opening of a brand new urban park on its former "junkyard" (Figure 10).

The Opening Ceremony of Nanhu Central Park was a highly political event. At the Ceremony, Party Secretary Zhao Yong remarked with a great sense of fulfillment:

> Today, Nanhu Central Park—a place that embodies all Tangshan citizens' longing for a good life—is officially open. This marks a historic milestone in Tangshan's transition from an industrial city to an eco-city... On the same day last year, this was still a site flooded by polluted water and buried by garbage; today, it has become an ecological paradise with clean water, green mountains, thriving trees, and blooming flowers... The completion of Nanhu Central Park... is a remarkable achievement of Hebei Province's "Three-Year Great Transformation" plan that aims to enhance the image of Hebei's cities and counties. The park is an important demonstration of scientific development and happy civic life... To a city, water brings reiki, greenery brings vigor, whereas culture brings spirit. Nanhu integrates nature, culture, and history. The preserved coalmine derricks symbolize industrial civilization, whereas the scenery around us symbolizes ecological civilization. Nanhu is a place where traditional industrial civilization and modern ecological civilization add radiance and beauty to each other. Gathering amid such scenes, we witness Tangshan's firm steps progressing from industrial to an ecological civilization.

Zhao Yong further stated the goals underlying Nanhu's development:

> We build Nanhu Central Park to drive urban transitions and build an eco-city. As a resource-dependent city, Tangshan must carry out, and is undergoing, transitions. One important objective is to build an eco-city through scientific approaches. Nanhu provides momentum for spreading transitions around the park across the city. We are confident to take advantage of Nanhu's development to establish a world-class eco-city, where water is cleaner, the sky is bluer, and the ground is greener and which is more livable and more nurturing for new businesses. Nanhu will pool resources from all around to establish a platform for development. Its continued opening up will draw people, material, talent, information, and capital from Beijing, Tianjin, and other places in the world. We will develop cultural and creative industries, the high-tech industry, and modern service industries (including financial, commercial, and residential services) around Nanhu. We will also build special industrial parks around Nanhu. The goal is to turn Tangshan into a hotbed for modern industries with a new exponential rate of economic growth.

Lastly, Zhao Yong connected Nanhu's ambition with happiness of Tangshan's citizens:

> We build Nanhu Central Park for the happiness of generations to follow... When you and your family walk around Nanhu area, you will be reminded of the preciousness of life and a happy sense of living will be evoked. All we do is for our citizens' happiness, including building Nanhu Central Park...

Zhao Yong's closed his remarks with a series of promises:

> Thanks to Nanhu, Tangshan will be more attractive... Tangshan's citizens will gain a sense of belonging and feel proud... Tangshan's residents and workers will experience enhanced quality of life... We all will have more hopes and dreams... Nanhu's achievements demonstrate the resolution of numerous city builders to overcome difficulties... With such a spirit, we can handle the financial crisis well, turning crises into opportunities and difficulty into momentum... Following today's first step of the grand opening, we will build Nanhu into a world-class urban park, a national base for sports and recreation, and a world's base for extreme sports. Our goals certainly will be achieved!

This new park consists of 11.5 square kilometers of water areas and 16 square kilometers of green spaces. Its builders proudly point out that Nanhu's water area is twice the size of Hangzhou's West Lake. The park also includes five islands and over 120 places of interest. Their names refer to popular symbols in ancient Chinese art and culture, such as peach blossom, springs of water, clouds, dragon, phoenix, and tea. The park is divided into two zones by Tangxu Road running northeast to southwest. The foundation of the northern part was stable enough to support more construction while that of the southern part was partially unstable. Accordingly, the northern zone integrates large areas of landscapes with recreational facilities (such as Yunfeng Island for theatrical performances and Jinlin Island for fishing), whereas the southern zone is designated for ecological protection, with existing natural features preserved and restored. The southern zone has also incorporated technologies for water purification and soil improvement in order to foster locally adaptive plant communities and thus create favorable habitats for wildlife (Figure 11 & 12).

Nanhu Central Park initially opened as an enclosed park with an entry fee. Millions of residents from Tangshan and the Jing-Jin-Ji Region had visited the park before it started free admission in 2018. The park has gradually gained a domestic and international reputation as a popular tourist destination and successful experimentation of ecological design and (re)development in an industrial city. In 2009, Nanhu Central Park was awarded the "National Model for Demonstrating Ecological Culture." In 2010, the project was promoted at the Shanghai Expo as Hebei Province's "Best Urban Practice." In 2011, it was recognized as one of "the best international practices" of "landscape design and environmental restoration" by both the British Association of Landscape Industries and the *Torsanlorenzo Gruppo Florovivaistico* in Italy. In 2012, Nanhu won China's State Science and Technology Progress Award and the Green Good Design Award from the European Centre for Architecture Art Design and Urban Studies. In 2013, it was recognized for its excellence in planning and design by the Chinese Society of Landscape Architecture. In 2016, the Park became the site for the World's Garden Expo. The curation of the Garden Expo decorated the park with neon lights, music, and water fountain shows, turning Nanhu Central Park into a dazzling place for recreational activities at night (Figure 13 & 14). Since April 2018, the park has officially waived entrance fees while continuing the Garden Expo-themed fountain shows over weekends.

In parallel with Nanhu Central Park's construction, Tangshan's officials had begun a more ambitious plan in 2008 to develop more urban functions around the park (Figure 15). This new master plan expanded the scope of development beyond the park itself and renamed a larger area of 105 square kilometers Nanhu Eco-City. The goal of the eco-city plan was to build four more subdistricts in a total area of 91 square kilometers surrounding the touristic central area. The new plan included an eco-city index system which consisted of 141 indicators. Tangshan government established Nanhu Eco-City Investment Company to oversee all future developments. The company is main responsibilities include accelerating land leasing processes, establishing new projects, attracting investments, identifying new resources, paying off debts, and financing new developments. In 2010, 95 new subsidiary projects, with a total budget of over 50 billion yuan, began construction as part of Nanhu Eco-City. Tangshan's municipal government also formed coalitions with 11 investment companies from Beijing, Singapore, and Macao to establish a series of touristic programs, including agritourism, kennel club, boating club, outdoor paintball, and gallery of ancient Chinese art. These programs were later overwritten by the Garden Expo. Spectacular exhibitions and water fountain shows were carefully curated for this international event to emphasize Nanhu's transformation, remarking it as a demonstration of Tangshan's achievements. Those programs celebrated China's state power by exhibiting the nation's accomplishments in industrial development and modernization. Over the summer of 2019, the government reopened the water fountain shows to the public. Every weekend, huge crowds would start gathering an hour before the showtime. During the show, thoughtfully interwoven water rose high up in the air, dancing in concert with music. The fountains formed water screens with colorful light and propaganda films projected onto them (Figure 16). The fountain shows have become a famous touristic attraction for their spectacular scenes, evoking nationalist sentiments.

By 2021, Nanhu Eco-City has become the most frequently mentioned symbol of Tangshan's new cultural identity on Tangshan's municipal development plans. The rhetoric about Nanhu's "achievements and potentials" promoted by the Zhao Yong administration has been disseminated widely through networks of officials, state planners, developers, and media. Governmental authorities, planners and designers, and online blog posts frequently refer to Nanhu as a success in creating new ecosystems through fully engineered ways and as a demonstration of Tangshan's promise of deindustrialization through ecological transitions. Xinhua News Agency, China's biggest and most influential media organization, praises Nanhu as the Tangshan's "green lung" turned from its former "industrial scar"(Xinhua News, 2017). Despite the huge fiscal cost of brownfield treatment and park development, Tangshan's officials are proud of confronting this "scar" of the city. They report that land surrounding the Central Park has been all leased out for future development by 2019. Officials, planners, and developers consider this fact as a key indicator of Nanhu's achievements in addition to city beautification. Multiple new projects have been proposed according to the park-centered eco-city master plan, fostering new clusters for housing, technology industries, cultural amenities, and industrial heritage redevelopment. Local officials anticipate that Nanhu's ecological characteristics would bring economic and environmental sustainability and turn Tangshan into a livable city.

Nanhu's Ecological Ideas

The urban planning, urban design, and landscape design of Nanhu Eco-City was commissioned to Beijing Tsinghua Tongheng Planning and Design Institute. This Institute consists of five subdivisions: 1) urban and rural planning (including both planning and urban design), 2) Chinese landscape architecture (*fengjing yuanlin*, which literally means "scenery and gardening"), 3) architecture (focused on buildings), 4) urban infrastructure and transportation, and 5) technology and media. A few senior planners from Tsinghua University and Tsinghua Tongheng suggested that employees in different subdivisions did not collaborate often. They also pointed out that this siloed division of both expertise and responsibility was common in China. In a typical project, planners would primarily focus on determining functional zones and setting boundaries and technical standards for each zone. Some planners would also carry out urban design and generate the spatial layout of architectural elements (including buildings, blocks, and road networks) at an intermediate scale. Landscape architects would mainly design elements that were considered "natural," including terrains, green spaces, water bodies, and plants. Architects would be responsible for designing all aspects of individual buildings or building complexes. In a conventional process, architects and landscape architects would work within determined zones, the boundaries of which were set by planners. In this way, landscape architecture was a supporting profession for spatial planning and urban design. Landscape architects' role in a development was often limited to laying out plants as ornamental elements in predetermined parcels and ensuring the survival of these plants.

In the case of Nanhu's conceptualization, the entire plan began with the premise of utilizing a brownfield. The goal of prioritizing ecological restoration in Nanhu's master planning had shifted the relationship between different design professionals. Nanhu's chief designers argued that the premise of ecological restoration had led to relatively more integration between urban planning and landscape design during the planning process. Due to surface subsidence, the area cannot support large buildings or high-rises. Therefore, Nanhu's land use planning relied on findings from scientific site surveys, and its design was guided by geological and ecological considerations. The rest of the eco-city plan grew from a central park and the programming of the rest would respond to the city's broader development agendas. Nanhu's designers believed that the inherent constraints of repurposing a brownfield were a key factor contributing to a non-conventional approach to development as well as more creative design and planning for the area.

A former head of Tangshan's planning bureau, who oversaw the birth of Nanhu's plan, argued that Nanhu's emphasis on an ecological approach to urban design was partially due to the organization of Tongheng's design team. Nanhu's chief designer is Hu Jie, a well-recognized landscape architect and the vice president of Tongheng. Hu is experienced with designing large-scale urban ecological projects. He is best known as the chief designer of Beijing Olympic Park. The Olympic Park not only contains diverse urban functions but also influences urban development in its abutting districts. Hu insists that the planning and design of Beijing Olympic Park involves both urban and ecological considerations that are much broader and more complex than those for a traditional local park. Tangshan's former chief planner believes that Hu has integrated similar ideas that underlie Beijing Olympic Park into Nanhu's design. Nanhu Park is another example of a highly curated urban park, that includes carefully designed amenities and landscapes to facilitate both recreational sports and large-scale events. Tangshan's planners and officials acknowledged that Hu's experience in designing Beijing Olympic Park had granted him, and proven his, capabilities to design large-scale urban projects beyond the scope of traditional landscape projects in China. Thanks to this experience, Hu became the leading designer for Nanhu at Tongheng, coordinating the collaboration between the

planning group and the landscape group. He also contributed to decisions on both landscape design and land use planning. At that time, this cross-professional practice that merged different expertise was uncommon in China.

Nanhu's designers highlight a few aspects of their ecological ideas: Ideologically, they claim that Nanhu's guiding principles for design have adopted China's ancient philosophies of a "Shan-Shui City" and, hence, its ecological principles are more appropriate for Chinese cities (Hu and Han, 2019; Hu and Wang, 2017). Spatially, they suggest that the physical layout of the eco-city is based on the organization of "green fingers," which would connect ecosystems in the park with urban functions in the city. Socially, Nanhu's designers believe that Nanhu Central Park not only has replaced a highly polluted brownfield but also can enhance public health in the long run. It gains popularity among residents for its recreational facilities amid an agreeable environment. While Tangshan in general lacks recreational facilities that are affordable or free for all, an open park has greatly encouraged the public to engage in physical activities.

Nanhu's chief designer Hu Jie suggests that his approach to ecological design can be captured by what he calls a "Shan-Shui-City"—a concept depicting an ecological city with Chinese characteristics (Hu, 2010). Hu suggests that Chinese people have a common passion for living near *shan* (mountain) and *shui* (water) due to long-lived ideologies about "nature and humanity" in Chinese traditions (Figure 17). The concept of "Shan-Shui City" was promoted by Chinese scientist Qian Xuesen in 1990 as an approach to integrating traditional Chinese gardens into modern city design, which would allow people to live within a garden-like environment (Bao, 2010). Hu explains that this concept emphasizes the symbiosis of nature, humanity, and city so as to improve "the natural environment, the picturesque image, and the spiritual state" of a city. Hu believes that this concept encompasses Taoist understanding of human-nature harmony. This school of thought is represented by the famous masterpiece *Tao Te Ching*, written by Laozi, a Chinese philosopher who lived during the Warring States period of the 4th century BC (Kohn, 2000). Hu claims that he has incorporated Taoist philosophy of human-heaven integration in the design of Beijing Olympic Park in order to create harmony between human and natural environments. Hu states, "The [Taoist] ideology that man follows the Earth and the Earth follows heaven blended perfectly with the park's natural environment." Hu argues that "to attain sustainability and environmental balance, design should find a way to involve both human activities and animal behavior" (Ma, 2019). Considerations of a "Shan-Shui City" has become Hu's design principles in his practices since Beijing Olympic Park. He believes that the designs of both Beijing Olympic Park and Nanhu Eco-City are based on Taoist philosophies and, hence, manifest characteristics of a "Shan-Shui City."

Hu refers to Nanhu Eco-City as a "typical case" of a "Shan-Shui City." Human-nature harmony in Taoist philosophies is appropriated to justify the utilization of brownfield for "the transformation from a resource-based to an eco-city." In fact, this harmony is interpreted as a symbiotic relationship between social function and economic growth. He states, "The Central Park is planned and designed to not only provide a park for leisure and entertainment to Tangshan residents, but also significantly drive the development of urban economy" (Hu and Wang, 2017). This view is supported by the Management Committee of Nanhu Eco-City. One employee of the Management Committee explains:

> On one hand, as the park is only 1 km away from Tangshan Department Store, the urban commercial center, the construction of eco-city can directly affect and promote the urban area to change the investment-attracting structure and develop new industries; on the other

> hand, a great deal of exploitable abandoned land around the scenic lake area provides sufficient space for urban development and great advantages.

In fact, Nanhu's heavily engineered alteration of a massive and historically problematic area had left some investors in disbelief at the start. An experienced local planner recalled that no one was confident whether this ambitious project could be a reversal of fortunes in the area or even the whole city. What was foreseeable was its tremendous state-led investment and its huge financial cost upfront. Land leasing in the planned area of Nanhu Eco-City took over a decade to complete, which means the financial burden of construction and paying off debt had mainly been on the local government. The economic return of the Nanhu investment remained a speculation as of 2019. In 2019, local officials suggested that the development rights of the planned area around the Central Park were fully sold. Whether the project could stimulate continued economic growth remained unclear to local officials. Nevertheless, Hu firmly believed the value of an ecological element of the city. He predicted in 2019, "with the gradually improved development and construction of Nanhu, the driving effect of the Central Park on urban economy will further spread; hence, it has become a consensus that Nanhu Eco-City will further provide strong impetus for the transformation of Tangshan."

In addition to the proclaimed Taoist connotations in Nanhu's design, its ideas and spatial layout indicate influences from the field of landscape architecture in North America. On one hand, Hu was formally promoting the Chinese origin of his ecological approach to design and development. He suggested that it was important to accept the prevailing political trend and "go with the flow." As a principal of a design institute affiliated with a prestigious university, he learned to work around China's bureaucracy in both governmental and academic administration. On the other hand, as an American Chinese, he pointed out that the combination of Chinese and American influences in his general approach to design derived from his education and professional experience in both China and the United States. Hu expressed that although the government prioritizes economic rationales in urban development, he always incorporated social and environmental considerations into his design.

In fact, among Chinese landscape architects, Hu is one of the earliest to be exposed to theories and practices of ecological urbanism in the U.S. Hu first studied garden design at Beijing Forestry University with Sun Xiaoxiang, an influential pioneering landscape architect and educator in China and a recipient of the prestigious Sir Geoffrey Jellicoe Award from International Federation of Landscape Architects. In 1988, Hu went to the University of Illinois at Urbana-Champaign to study landscape architecture. Hu recalls that at UIUC Ian McHarg's *Design with Nature* was an important textbook. Hu also took a class taught by Douglas M. Johnston about the environmental research on Mississippi River Delta. Johnston studied landscape architecture at Harvard Graduate School of Design and introduced the theory and pedagogy by Carl Steinitz. Steinitz holds a PhD in urban design from MIT Department of Urban Studies and Planning and has been Professor of Landscape Architecture and Planning at the GSD since 1973. Hu believes that these educators in landscape architecture and their ideas have greatly shaped his own philosophies of design. On one hand, Hu remains a firm believer in Chinese garden design and its principles of framing scenery grounded in Chinese culture; on the other, studying in the U.S. has broadened his understandings of landscape architecture to include ecosystem-based environmental planning at a larger scale. After graduate studies, Hu worked for Sasaki Associates' Boston office for over a decade, participating in projects that involve interdisciplinary expertise in landscape architecture, urban design and planning, ecology, and civil engineering (Adona, 2015). He has also been inspired by James Corner Field Operations' practices, especially the transformation of Fresh Kills landfill into a park. Hu stresses that an

understanding of both Chinese and Western ecological ideologies and a mixed approach to comprehensive master planning have become his strengths.

Reflecting on his practice in China, Hu suggests that in order to realize his design ideas, he often needs to perform as the facilitator for conversations across different expertise and various governmental administrations. It has been challenging to work around China's bureaucracy when implementing ecological ideas. This is due to two main reasons: First, ecological projects usually require long-term development. It necessitates the contribution of different expertise, including design, planning, engineering, and construction professionals. These experts work on different phases of the project. Without sophisticated legal or regulatory mechanisms to monitor the implementation process, Hu typically has to spend extra effort on overseeing the process from design to implementation. He would take on responsibility beyond what is expected for a designer to communicate with parties involved in order to ensure the realization of ecological features. He recalled in 2019:

> The political divide among different governmental bodies—especially the separated administration of architecture, infrastructure, land, water, and other natural resources—has led to tremendous structural barriers to realizing ecological design and environmental planning on a trans-jurisdictional scale. In general, implementing ecological ideas should entail combined scientific, ideological, and political interventions. But in China, the current regime emphasizes the political and ideological function of ecological design and environmental planning more than the scientific performance of such projects.

Second, ecological components of a development transcend the territorial boundaries and categories of ecologies demarcated by various state bureaus. Realizing proposals of "integrated" or "symbiotic" social-ecological systems often necessitates working around local politics across parallel administrative units which have competing powers. These units have rigid definitions of their responsibilities and prefer to carry out "business as usual." They are typically uninterested in operations beyond their juristic territories. For example, the standard demarcation of developable areas includes seven types of planned juristic boundaries: 1) "redlines" for boundaries of constructed components, such as roads, buildings, and blocks; 2) "green lines" around green spaces; 3) "blue lines" around water bodies (which include islands in the water as well as greenery and paths along water borders); 4) "yellow lines" to preserve land for crucial infrastructures that serve the whole city; 5) "purple lines" for cultural and historical areas; 6) "black lines" for the grid system; and 7) "orange lines" for high-risk zones (such as nuclear power plants and storage zones for oil and biochemical products). Each type of zones is administered by a designated administrative unit. In addition, each municipality consists of several districts. Each district government is only concerned with affairs within its juristic territory. Planning a new ecosystem often involves action that crosses multiple juristic boundaries. Therefore, designers must justify the necessity to include certain areas into the new ecosystem and request the approval of re-demarcation of boundaries or rezoning. Such processes often require the mayor's signature, which would then facilitate conversations among different subdivisions of the municipal administration. He recalled the difficulties navigating local politics and unrealized ecological ideas due to the bureaucratic barriers. Reflecting on his practices in Beijing and Tangshan, Hu insisted that from ecological design and planning to the implementation of such a master plan, the process necessitated value alignment across governmental bodies, multi-expertise collaboration, and cross-sectoral cooperation (Hu, 2019). In Hu's opinion, China's emerging reforms of the planning system centered on "the coalescence of multiple regulatory plans" (*duo gui he yi*) was a promising structural change that would favor the principle of "ecology first" in

future practice. This opinion was also echoed by chief planners in Tangshan and at Tsinghua Tongheng.

Overall, the most acknowledged, and perhaps most important, strategy for Nanhu's development remains the attempted ecological restoration of a vast brownfield. Tangshan's officials stressed that Nanhu was a pioneering attempt at urban revitalization in industrial cities, for it even predated China's national legal reforms that began in 2014 to curb pollution. While the urbanization of many Chinese cities unfolded with industrialization, especially in northern China, Tangshan was one of the earliest and remains representative of challenges in these cities. Tangshan's officials and planners believed that Nanhu had set an innovative paradigm for cities undergoing post-industrial transitions. This message had been widely circulated through networks of officials, professionals, and developers, and media.

Ecological problems caused by the mining and consumption of coal are indeed very common in industrial cities across China. China's modern economy has largely relied on manufacturing, which has primarily been fueled by coal. From 1990 to 2018, China increased its coal consumption from 0.99 billion tons to 4.64 billion tons. In 2017, China's industrial sector consumed about 95 percent of the country's coal. In 2018, coal made up 59 percent of China's energy use. Since 2011, China has consumed more coal than the rest of the world combined (Figure 18; CSIS China Power Project, 2020). The CCTV China Economic Forum Crew estimated in 2006 that China had up to 80,000 coalmines in history and still had 25,000 to 30,000 running coalmines as of 2006 (S. Liu et al., 2013). This has left tens of thousands of coalmines decommissioned and then abandoned in Chinese cities. Tangshan's planners projected that industrial modernization and clean energy transitions would result in more abandoned coalmines. For that reason, they believed that the regeneration of abandoned extraction sites would become a trend in old industrial cities' future development. Their key concern was "how to rationally utilize available land, develop subsiding areas, and exert its uttermost economic, ecological, and social values through regeneration so as to turn abandoned sites into new driving forces of urban development." They claimed that Nanhu's approach was an "organic integration between coal mining subsidence area and urban space" (Hu and Wang, 2017).

Reflecting on Nanhu's transformation, its planners stressed the necessity to begin tackling land pollution and abandonment in post-extraction sites in a developing country like China. They argued that brownfields would not only jeopardize public health but also hinder urbanization, especially in a political economy where land remained an essential resource for growth. They studied precedents of brownfield treatment in Western countries and observed evolving approaches in foreign practices. Initial brownfield redevelopments in post-extraction sites focused on environmental cleanup of contaminated soil, groundwater, and surface water, involving a range of remediation technologies such as pollution source removal, soil replacement, water cleanup, revegetation, ecosystem restoration, and waste treatment. In later projects, they found increasing practices of land recycling in brownfield redevelopment, especially the repurposing of former mining fields for mixed uses. Inspired by foreign practices, Nanhu's planners and designers advocated that abandoned coalmines could be reclaimed for forestry development, agriculture, or recreational purposes so as to generate economic productivity. Their idea of "turning waste into treasure" seemed to highlight the promise of added land value by reclaiming brownfields. In fact, pointing to the economic promise of ecological projects has proven to be an effective strategy to mobilize governmental support, especially favorable policy and fiscal investment.

Due to its proximity to China's capital, Tangshan was designated by the central government as the city to take over heavy industries, such as the Shougang Group, relocated from Beijing to Tangshan to support the capital's deindustrialization and construction of venues for international mega events. Ironically, public media still regards Tangshan as one of the most ambitious cities in northern China that have sought to confront the legacy of its industrial past(Shi and Chang, 2016; Sina Financial News, 2020; Sina News, 2009). Its officials were proud of the city's huge investment in ecological restoration in tandem with industrial heritage repurposing. Although Nanhu's actual ecological performance and environmental improvement has yet to be scientifically monitored or sufficiently measured, local officials and Nanhu's planners and designers all asserted that the project had greatly improved air quality and cleaned up water and soil based on both observable changes and their own perceptions (Figure 19). They adopted a similar approach in the Phoenix Mountain area to the north of its urban core, and planned new ecological and restorative projects along the Dou River at the city center and in Donghu Area to the east of the city center. The goal was to reuse factory structures, restore the ecosystems in the former industrial areas, construct new ecologies, and foster non-polluting industries. In this way, Tangshan hoped to gradually erase its stigma of a polluted city by proclaiming an "ecological" identity during its post-industrial transition.

Nanhu's Claimed Achievements

Nanhu's planners and designers argued that the project's success was reflected by its planning principles and restorative technologies in the central park area. First, they believed that creating a park as the connective tissue of the city was an appropriate approach to reclaim a coalmine for urban activities. The park was considered as not only a recreational harbor open to all residents in Tangshan but also the drive for future transformations of the whole city. Site preparation for Nanhu's development excavated 8 million cubic meters of garbage, 8 million cubic meters of coal ash, and 4 million cubic meters of coal gangue. It also demolished all the preexisting "illegal" structures, the materials of which amounted to 600,000 cubic meters. After the reconstruction, a total land area of 205 hectare was prepared for nurturing 303,000 plants. The outcome allegedly satisfies both ecological wellbeing and social-cultural needs while creating a local economic engine of urban development. To Nanhu's planners and designers, the ecological, social, and economic functions of the park aligned well with sustainable development goals.

Second, Tongheng's experts claimed that they had integrated landscape design with scientific studies of the site through forming inter-disciplinary design and planning team. Turning a brownfield into an urban park necessitated the mitigation of soil and water pollution and land subsidence. The experts took advantage of this unique opportunity to experiment with ecological technologies. They generated a plan "based on objective understandings of historical and current conditions of pollution and potential geological risks of subsidence." This "objectivity" was achieved through the analysis of "rules for ecological succession, demands of human activities nearby, and historical transformations," as well as assessments of "coal mining subsidence risk, seismic risk evaluation, and lake expansion safety" (Figure 20). Experts from multiple disciplines, including geology, coal mining, water conservancy, planning, construction, and ecology, collaborated on comprehensive site analysis and risk assessment. Considerations of geological stability, natural habitat conditions, and construction suitability took priority over aesthetic considerations. Nanhu's design and planning team suggested that it was innovative at its time to base design schemes on scientific site surveys.

Other experienced planners and scholars have agreed that the comprehensiveness of the site studies carried out at Nanhu remains uncommon in China.

The scientific grounding of Nanhu's ecological design was attributed to the application of remote sensing and geographic information system (GIS) analysis. These technologies were adopted to study the evolution of land use and land cover in the planned area and to predict geological hazards such as land subsidence, ground sinkholes, landslide, and earthquakes. Tongheng's ecologists also constructed ecological security patterns based on the assessments of the site's ecological value, ecologically sensitive areas, and existing and potential ecosystem services. Nanhu's designers argued that their spatial strategy—using a "Green Palm" as the structure of public spaces—emerged according to the patterns derived from the geological and ecological studies (Figure 21). They also designed plants following the ecological security patterns—existing healthy vegetation was preserved, whereas new wildflowers, sterile- and pollution-resistant plants were planted.

In addition, Nanhu's designers incorporated several pro-environmental strategies in the project's construction, including pollution mitigation, green technologies utilization, and material recycling. Mitigation strategies included pollution source removal, garbage containment, and water pollution treatment. Surface soil in the area was relocated to a coal ash yard and covered with clean surface soil. The project also cleaned up waterways and connected them with broader water systems. Nanhu's plan also proposed the utilization of renewable energy (such as solar energy, biological energy, and wind energy). Energy-saving technologies were incorporated into the development through products such as lamps, trash cans, and vehicles. During Nanhu's construction, coal ash on the site was recycled to produce bricks, cement, and aerated concrete. It was also used as a material for the foundation of artificial landforms. Garbage was contained and sealed in a man-made mountain, which was built on the former disposal ground for solid waste (Figure 22, 23 & 24). This technique utilized all the aforementioned 4.5 tons of garbage and formed a green area of 130,000 square meters. The garbage mountain was covered with 0.8 meter of subsoil and 1 to 3 meters of topsoil. This range of soil depths is sufficient for planting bushes and trees. A few engineered systems were installed for the collection and treatment of waste liquid and gas and for the collection, monitoring, and discharge of surface water (THUPDI, 2015).

Nanhu's construction also adopted low-impact technologies for solving ground subsidence (Figure 25). For example, existing tree branches on site were utilized to form flexible embankments through a braiding and bundling technique. This protected riverbeds for the long term while creating habitats for insects and small aquatic animals. In soft grounds composed of coal ash, sludge, and impure soil, short timber piles were used to reinforcing ground stability, reduce foundation subsidence, and enhance bearing capacity (Figure). Gabion revetments were also put in place to support retaining walls, preventing deformation and collapse. Gabion retaining walls were less prone to cracking caused by ground subsidence and deformation. Their malleability helped to prevent water loss and soil erosion and therefore maintains slope stability. Low-cost techniques were also applied to building constructions in the park, which all adopted wooden, light-frame structures (Figure 26). These structures performed under the ground's bearing capacity while ensuring the durability of buildings. The buildings' styles and structures also resembled ancient Chinese wooden architecture and hence revived traditional culture. Nanhu's designers argued that the park's construction exemplifies the integration of cultural revitalization with low-impact development (THUPDI, 2015).

Lastly, Nanhu's designers, planners, and local officials were proud of the project's culturally sensitive strategy and its potential power in engendering social transformations. Nanhu's designers described Nanhu as "a phoenix rising from ashes," which was meant to embody the meaning of revival and the hope of sustainability. They named the garbage mountain "Phoenix Terrace" to imply that Tangshan—dubbed as a "phoenix city" reconstructed after the earthquake—would be "reborn once again as an eco-city out of a resource-depleted city." They highlighted "phoenix" as a mythical creature of "rebirth" in Buddhist culture and incorporate it into their rhetoric to symbolize Tangshan's overturn from desolation to life. The alteration of a massive area of abandonment in the center of Tangshan marked a turning point of citizens' collective memory. It reshaped the collective consciousness of Tangshan's society by establishing an impressive new image of the city. Temples were built on top of the garbage mountains as memorial spaces for people to remember Tangshan's traumatic history and to awe the grandeur of the new scenery. Nanhu's designers stated that the new landscapes follow the Taoist principle to "imitate nature" and, hence, "resemble the scenery of traditional Chinese gardens." They described views of the park as "harmonious scenes" that were "reborn exuberantly from an abandoned land," resembling "an ancient Chinese painting decorated with islands, pavilions, and landscapes" (Figure 27 & 28). They advocated that the regeneration of Nanhu area could showcase "a perfect combination of modern science and technology, traditional Chinese culture, and distinct local characteristics" (THUPDI, 2015).

Tangshan's planners highlighted that the city's ambition to develop ecotourism and protect bird species could also be attribute to influences from the East Asian-Australasian Flyway Partnership (EAAFP). Tangshan is in fact on the East Asian-Australasian Flyway. The city has sought to become an eco-city so as to contribute to the EAAFP's Arctic Migratory Birds Initiative. After the completion of Nanhu's Central Park, Tongheng's experts assessed the park's ecosystem service. In 2013, studies reported that Tangshan's average minimum temperature has increased 3 to 4 degrees Celsius, whereas its average extreme maximum temperature has decreased 3 to 4 degrees Celsius; Tangshan's forest coverage had increased from 41.57% to 44%; and more than 140 wild bird species were observed in the area (Sun et al., 2013) (Figure 29). Among those, more than 30 species were migratory birds that stopped by Nanhu's park in winter while migrating from Siberia to Australia and New Zealand. The park was visited by more than 100,000 people per day during holidays and weekends (Figure 30). By 2019, land leasing prices at the park's peripheries had increased by at least 110 billion yuan. Tongheng's planners and designers praised Nanhu's "success" and remarking:

> This once-abandoned land has become a treasure in the eyes of the society... Nanhu Eco-City has become a "baton" of the city's transformations in planning, construction, and management. It has resumed its vitality and is becoming a new growth point of Tangshan's urban development of Tangshan. Generally speaking, Nanhu's land use planning is based on a good ecological pattern... The reconstruction of ecological landscapes by making use of discarded materials simultaneously preserves urban development patterns and rebuilds the natural environment (THUPDI, 2015).

Tongheng's planners and designers suggested that resource-depleted cities typically suffered from problems of fragile ecological environment, soil and water pollution, and geological risks. As a result, abandoned industrial areas had become "forbidden zones" in urban planning. They believed that brownfield regeneration could become "a brand new field of practice" in China. Favoring the adoption of Nanhu's approach in other industrial cities, they stated:

> The restoration and conservation of ecological landscapes should be the important premise of reshaping urban charm and human space in resource-depleted cities. The question of how to transform brownfields into useful spaces and even driving factors for urban development is the bottleneck of future development. Nanhu's revitalization of coalmine subsidence areas combines urban ecological security with human demands. It is a transformative practice turning a formerly abandoned land into a livable and safe public space. It shows that a brownfield can be replaced by magnificent lakes and natural garden scenery and serve as a city's new brand image. This approach not only promotes urban development and the appreciation of real estate value but also greatly improves public spaces and urban residents' quality of life (THUPDI, 2015).

Nanhu's designers and planners have appropriated both foreign approaches of urban renewal and traditional mindsets of urban living in the reimagination of Tangshan's future image. In order to win political support, they have been advocating both the physical outcome and economic promise of Nanhu's development. They pointed out that Tangshan was a city with four types of brownfields—old factories, obsolete infrastructure, mining sites, and landfill. They argued that Nanhu demonstrated the regeneration of coalmines and landfill while contributing to urban renewal of industrial and infrastructural heritage nearby. They believed utilizing brownfields for new urban usage could generate a reciprocal relationship between nature and the urban—new functions bring life to these abandoned sites, whereas regenerated brownfields could be economically productive and environmentally friendly. Environmental engineers further advocated the project's meaning in China for its pioneering experimentation with deeper integration of science and design. They believed that Nanhu had set a paradigm for redeveloping industrial cities during China's era of "ecological civilization" because its approach could concomitantly transform the environment and the economy in old industrial cities. Considering the prevalent environmental degradation caused by malpractices during China's rapid industrialization and urbanization, they argued that brownfield treatment and regeneration would be an integral component of urban renewal while the latter had become crucial to China's next phase of urbanization.

Landscape architects argue that Nanhu has heralded changes in both development practice and academic fields. On one hand, many cities in China are undergoing post-industrial transitions. They have initiated ecological and restorative developments that involve brownfield regeneration. Thanks to Nanhu's reputation, Tongheng's experts have been commissioned several projects each year across China to apply a similar approach to new sites. In recent years, China's ecological turn on its political agendas has led to the growing recognition of their expertise. These experts now feel more empowered at the local level, for they have been contributing to rezoning attempts that aim to restore and expand existing ecosystems in concomitant with new urban development. They also intervene in decisions about reforming old planning regulations according to new eco-development initiatives. On the other hand, the integration between ecological design and environmental science has increasingly become a promising direction of urban design innovation highlighted at conferences for environmental practitioners and educators. Tongheng's experts believe that this integration has become more important for both practice and research. In practice, experimentation with eco-development allows designers, planners, ecologists, and environmental engineers to learn to collaborate. In academia, scholars in design and planning increasingly call for the cross-pollination among disciplines such as landscape architecture, ecology, environmental planning, and environmental engineering. Tongheng's experts anticipate an increase in interdisciplinary

collaborations among environmental practitioners and researchers across the world in the near future.

Despite Tangshan's well-recognized achievements in drastically transforming the city's "scar," some scholars—both domestic and international—have criticized Nanhu's proclaimed approaches of "brownfield treatment" and "ecological restoration." First, Nanhu's so-called brownfield treatment did not carry out proper cleanup and, therefore, remains superficial when assessed using American or European standards. These scholars cautioned, "What is allowed [for environmental cleanup] in China is considered illegal and unsafe in the U.S. or in Europe. Proper regulations for brownfield treatment are yet to be established in China." Since environmental laws and remediation standards had been inadequate throughout Nanhu's transformation, they doubted that the contaminants were ever treated properly to ensure public safety. They also suspected that Nanhu's site was yet to be clean enough for living. These critics challenged Tangshan's claims and argued that Nanhu could be considered as a practice of "brownfield regeneration," yet without sufficient "brownfield remediation."

Second, some ecologists cautioned not to overstate Nanhu's accomplishments as "ecological restoration," since it had prioritized aesthetic considerations and placed branding over "scientific effectiveness." After all, a major reason that motivated Tangshan's government to develop Nanhu was to capture the economic value of available land and to drive up that of adjacent areas through beautification. These ecologists argued that there was little preexisting nature to be "restored;" rather, the city constructed a whole new ecology through a heavily engineered, unnatural way. In addition, designers and planners of Nanhu emphasized the spatial connectedness of "green" and "blue" patches of the city. Environmental engineers argued that this "connectedness" did not equate the actual symbiosis of ecological systems. They suggested that the techniques of environmental engineering and the science of ecology had been greatly understated in assessing the success of Nanhu or that of any proclaimed ecological projects in China's development today. To these experts, effective brownfield treatment or ecological restoration had yet to exist in China due to a vacuum of regulations at the municipal level.

While China's environment continues deteriorating with its rapid urbanization, its environmental policy has been largely inadequate. The Center for American Progress has criticized China's relaxed environmental oversight, describing its environmental policy as similar to that of the U.S. before 1970 (Hart and Cavanagh, 2012). Despite that China's central government issues fairly strict regulations, their actual monitoring and enforcement is mainly undertaken by local governments, who typically are reluctant to compromise economic growth for the environment. Local practitioners argued that this broader institutional barrier would fundamentally hinder the effectiveness of eco-developments despite genuine intentions by their conceivers.

Can Nanhu Eco-City Continue its Growth?

In 2021, the Nanhu Eco-City still awaits more constructions to occur in areas surrounding the Central Park. Due to the fact that the park was originally designed as an enclosed touristic area, it

remains a vast green enclave, spatially disconnected from its surroundings for the most part. Entry to the park is limited to five entrances. With free park admission, it has become an everyday public space popular among Tangshan's residents. In 2019 before the pandemic, there were residents organized group activities and club sports every night. Many residents living nearby took strolls and went running along the trials in the park every day. Visitors from farther away could commute to the area through over ten bus lines. They could also rent shared bikes and boats within the park for touring. However, many visitors preferred to take a 10- to 20-minute ride to this area for faster access and for freedom to travel within the park. Parking lots at the Civic Center were the main entry to the area. They were typically fully packed in the evenings. Thanks to the concentration of visitors, the park and Civic Center had also become one of the areas with pop-up vendors and self-organized sports activities, such as dancing and roller-skating. The Civic Center was also where restaurants and retails were functioning. Most visitors arriving by car would first enter the park through the Civic Center, stop by the most iconic water fountains, and then disperse into the rest of the area.

In contrast, businesses outside the borders of the park showed signs of struggles even before the pandemic hit China. In 2019, hotels and restaurants were closing down for lacking businesses. Industrial areas in the southern area of the eco-city remained mostly vacant. While the northern part of the eco-city was decorated with colorful lights at night, the southern part was dark at night and quiet throughout the day. Unlike the design of Chinese garden-themed landscapes and ancient-style architecture in the northern part, the southern part featured landscapes and forests that mimicked the wilderness. Other than the Civic Center and the northern part of the park, the rest of the eco-city remained remote from the city, lacking efficient access. Business activities and visitors were largely absent here and access to this area greatly relied on cars.

An Eco-City Awaiting Development: Development Stagnancy Despite Ecological and Social Benefits

As of 2021, Nanhu remains China's largest brownfield revitalization project, rising to domestic and international prominence. The entire project began with the plan to turn a brownfield into a park, which is expected to stimulate surrounding development (Figure 31). This transformative project indeed required huge fiscal investment from Tangshan's government. Due to the prevalent land-based financing mechanism in China, revenues from Nanhu's surrounding developments are crucial to paying off debt incurred by the construction of the park and infrastructure in the eco-city. Although all land in Nanhu Eco-City had been leased to developers by 2019, some local officials suggested that the city has yet to profit from this massive development by 2021, especially considering the impact of the pandemic. The current management authority of Nanhu Eco-City has unwillingly admitted that the idea of fostering eco-tourism as Tangshan's next economic drive has yet to become fruitful. Tangshan still faces financial difficulties due to the lack of return in previous new city investments and has yet to find a clear solution for the ongoing industrial decline. Tangshan's financial difficulty could jeopardize the continued maintenance and further investment in the ecological and social aspects of the Nanhu Eco-City. Local planners suggested that the city had been struggling to attract businesses or industries to support its continued growth. Therefore, Nanhu Eco-City's growth so far has largely relied on real estate development, especially market housing sales in the surrounding areas of the central park. Despite its uniqueness in China as a pioneering restorative approach to transitioning a declining industrial city, Nanhu's ongoing slow growth raises questions about the sustainability of such strategies in the event that China, especially

its post-industrial northeastern region, becomes more fiscally straitened. Such challenges have also been evident in projects that have adopted principles of landscape urbanism in American shrinking cities (Ryan, 2014).

Nevertheless, many experts and scholars of China's urban development acknowledge that the development of Nanhu has created a spectacular public amenity—one that has risen to be Tangshan's icon, a popular everyday space for recreation, and a regional tourist attraction. Despite that economic rationale remains dominant in the birth of Nanhu Eco-City, the project is generating environmental and social benefits. However, admitting such benefits, environmental experts have questioned how much genuine attempts at "environmental cleanup" and "ecological restoration" have been realized. They argue that most contaminants were "relocated" and "contained" rather than being "removed" or "neutralized." They also suggest that rigorous and scientific environmental assessment has yet to be conducted to understand how much effects of cleanup and restoration have been achieved through this massive brown-to-green transformation. Still, they acknowledge the general lack of environmental awareness and investment in China's urban development and hence praise Nanhu's achievements in generating massive urban greening and observable ecosystem services. Even with all its limitations, many Chinese planning and design experts and scholars believe that Nanhu Eco-City is "greener" than a typical development, especially one that is in a declining industrial city. It showcases promises of transforming resource-developed areas. It sets a reputable precedent in China that can potentially influence the country's development policy in an era when increasing resource-exhausted cities are undergoing transitions. Moreover, the project reveals that despite the sincere intention to generate ecological and environmental benefits to transform a polluted city, the eco-environmental effects of such a massive development with progressive ideas remain unknown. This is due to the fact that China largely lacks effective, scientific measures to monitor and assess the environmental performance of a restorative project. It also lacks an institution that would incorporate ecological and environmental costs and benefits into decision-makers' considerations of trade-offs in a development. Future attempts at brownfield regeneration and ecological restoration must combine design with science and institutionalize a systematic approach to the planning, monitoring, measuring, and evaluation of the ecological and environmental performance of a development.

Images:

Figure 1. Birds Eye View of Nanhu Central Park
Source: Tsinghua Tongheng Planning and Design Institute

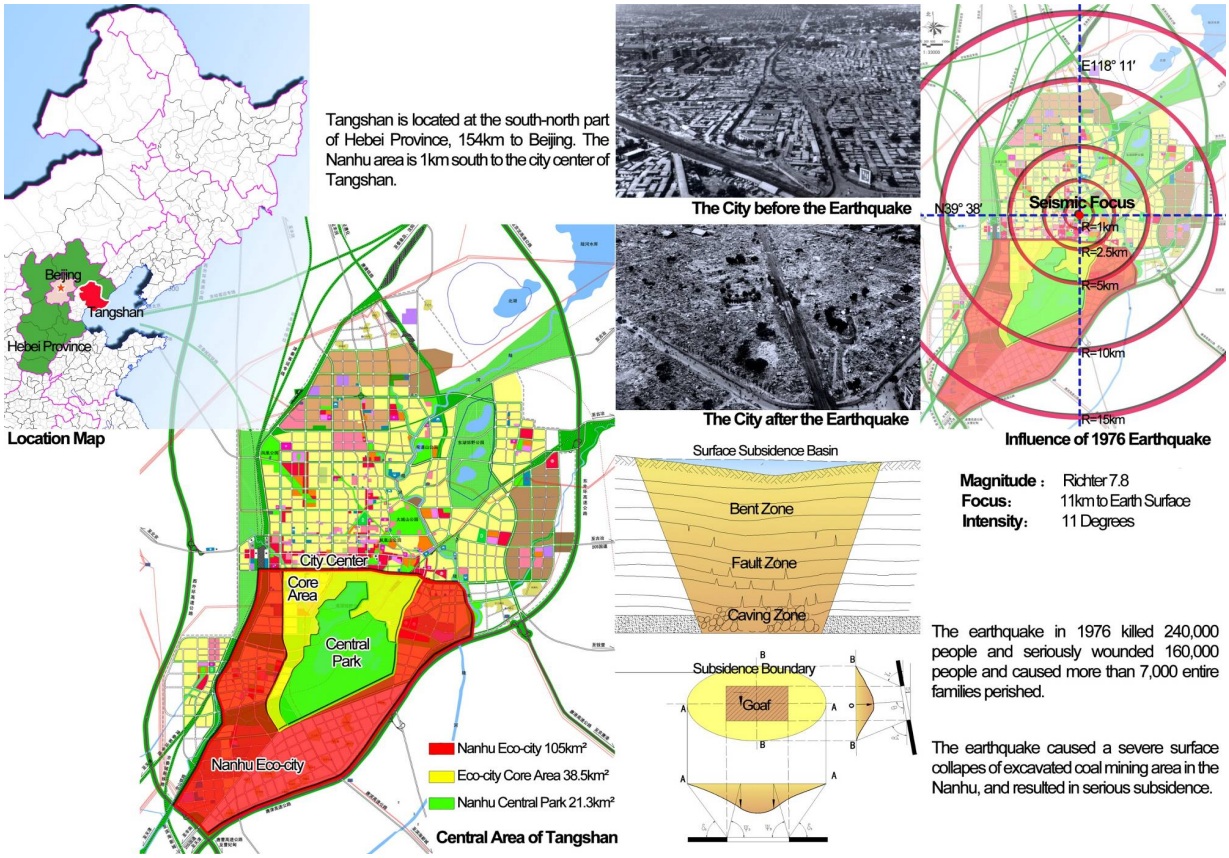

Figure 2. Location of Nanhu Eco-City
Source: Tsinghua Tongheng Planning and Design Institute

Figure 3. The Original Garbagy Mountain (Dandu, 2020)

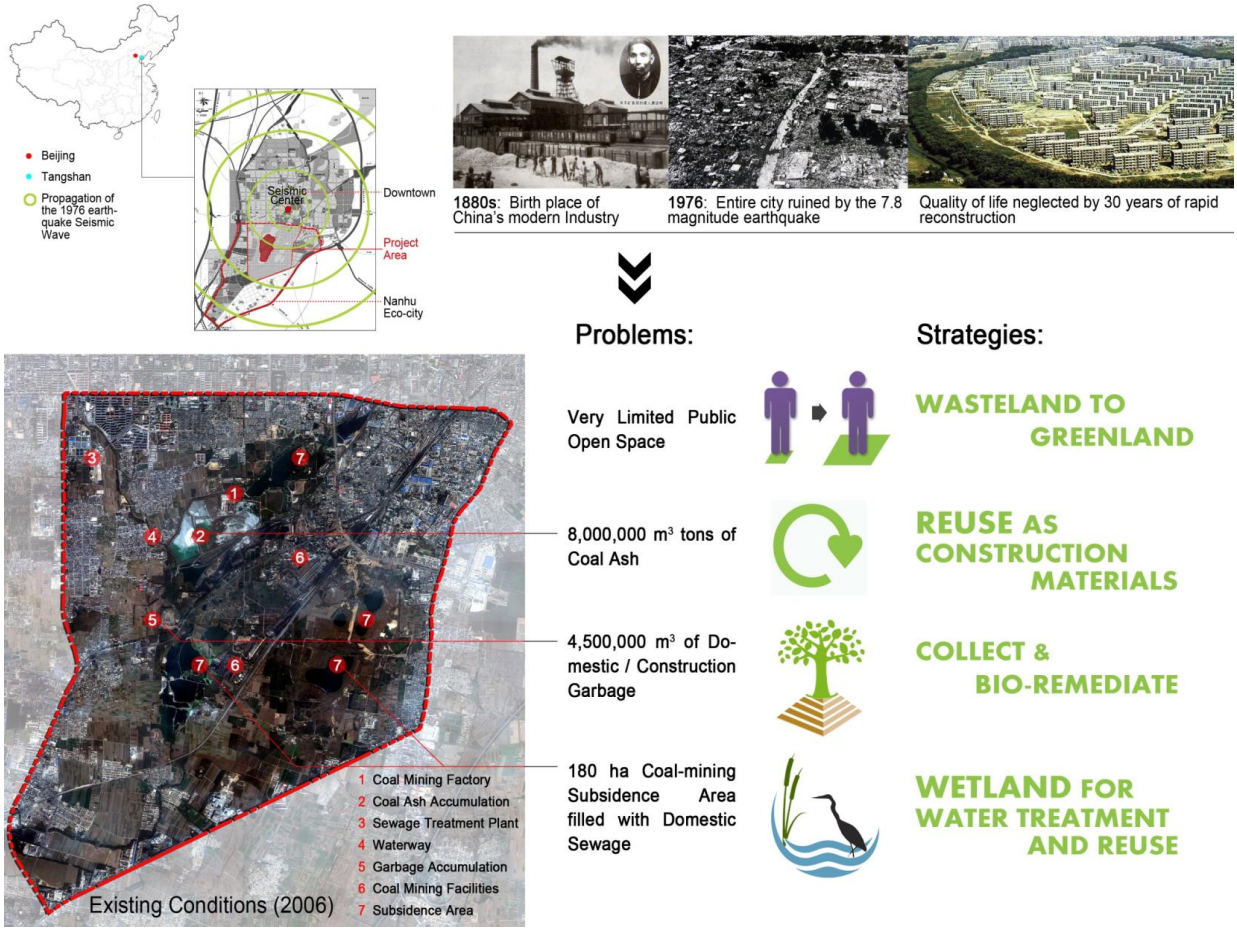

Figure 4. Nanhu's Original Site Condition
Source: Tsinghua Tongheng Planning and Design Institute

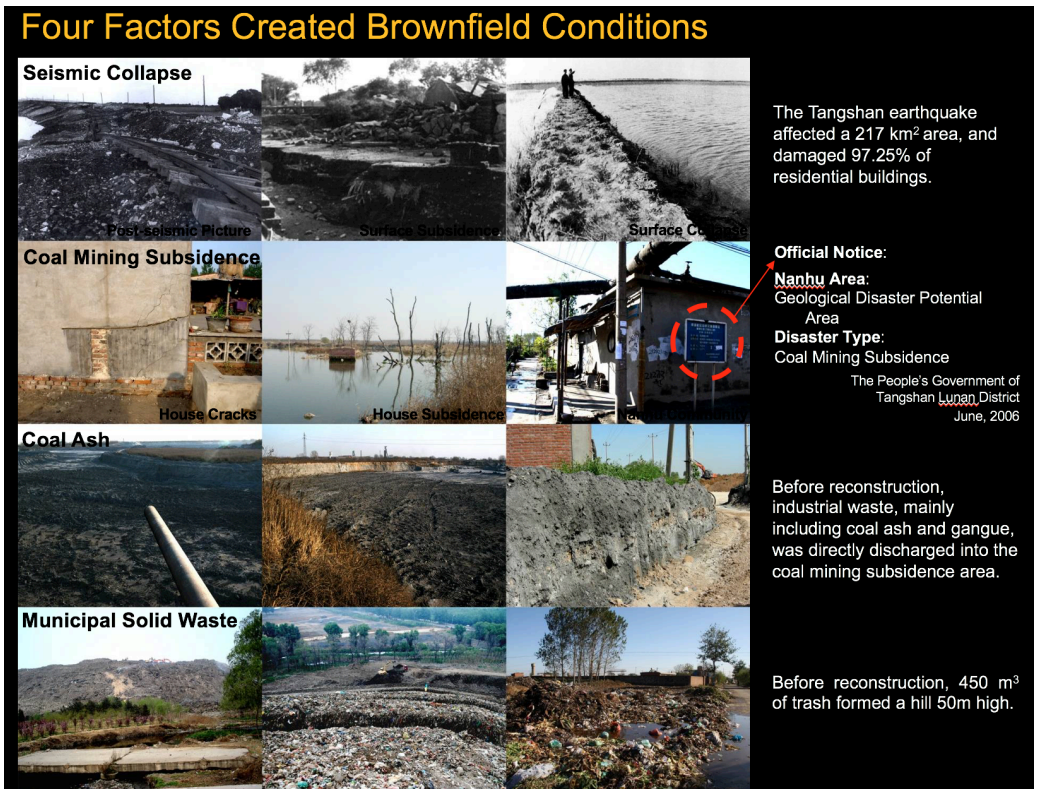

Figure 5. Site Condition Analysis
Source: Tsinghua Tongheng Planning and Design Institute

Figure 6. The Master Plan of Nanhu Central Park
Source: Tsinghua Tongheng Planning and Design Institute

Figure 7.1: A Mining Subsidence Area Turned into an AAAA Touristic Area (Shunjian, 2017)

Figure 7.2. "The Miniature of the Rebirth of New Tangshan" (Demeipiaowu, 2018)

唐山世园会粉煤灰山建设前后对比

唐山世园会粉煤灰山建设前后对比

唐山世园会垃圾山建设前后对比

（来源：正和恒基）

唐山世园会垃圾山建设前后对比

（来源：正和恒基）

Figure 7.3. Contrasts Before and After Nanhu Central Park's Construction (Huanbaozaixian, 2019)

Figure 7. Before-and-After Contrasts Widely Promoted by Media

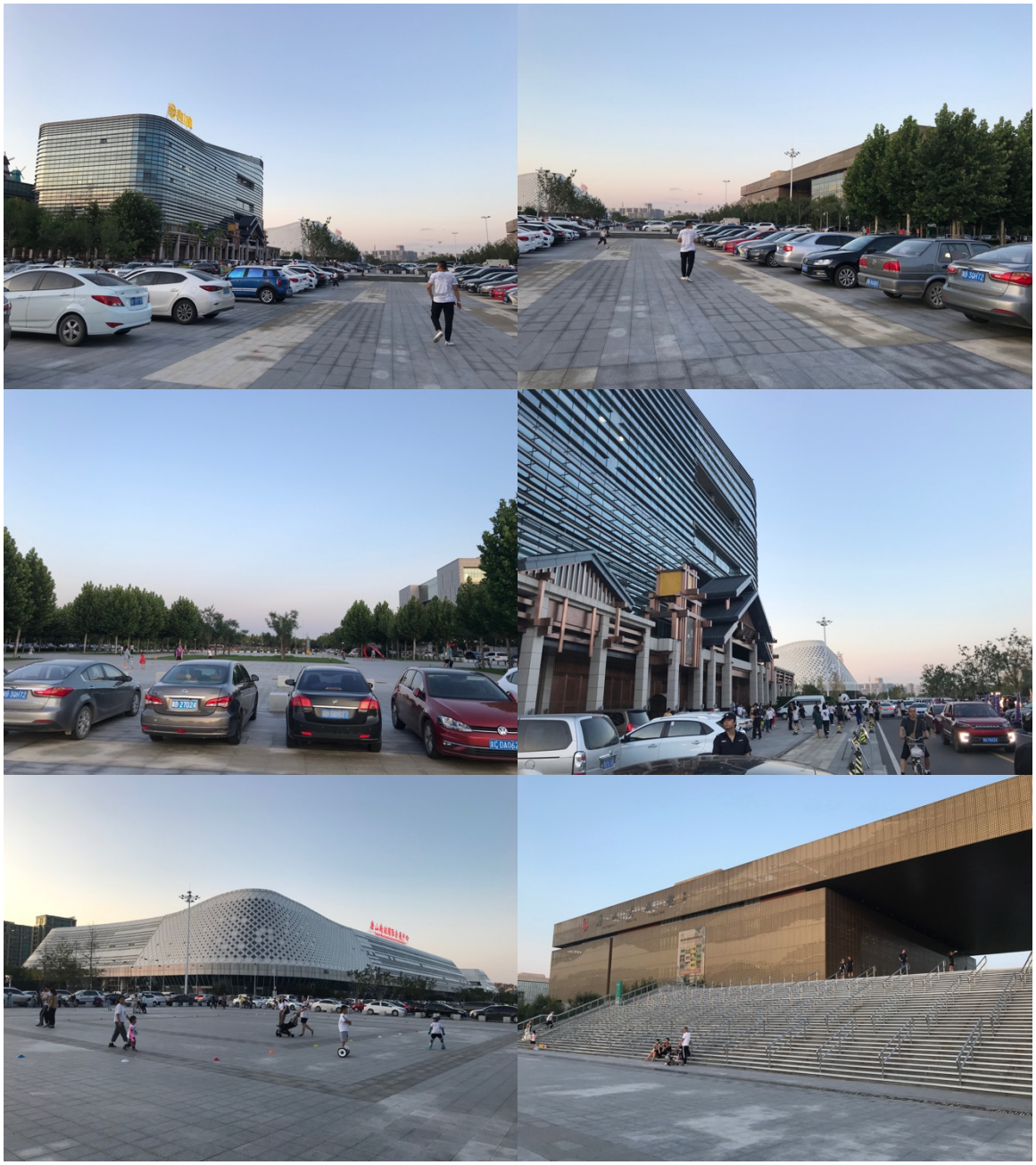

Figure 8. The Civic Center (photos by author)

Figure 9. Scenery of Nanhu Central Park
Source: Tsinghua Tongheng Planning and Design Institute

Figure 10. The Grand Opening of Nanhu Central Park
Source: Tsinghua Tongheng Planning and Design Institute

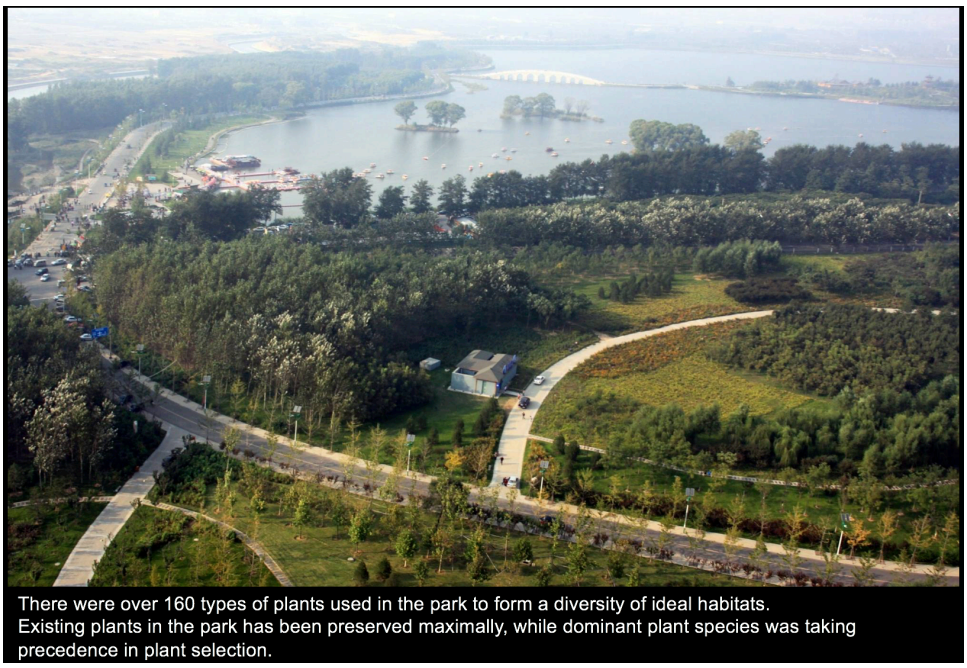

Figure 11. Landscapes of Nanhu Central Park
Source: Tsinghua Tongheng Planning and Design Institute

Figure 12. Cedars and Grassland
"Constrained by lower ground bearing capacity in the south part, this very gently-sloped peninsular provides large open space for recreational activities like kiting. Organic revetments making use of recycled plant materials were applied along the shoreline to increase bank stability."
Source: Tsinghua Tongheng Planning and Design Institute

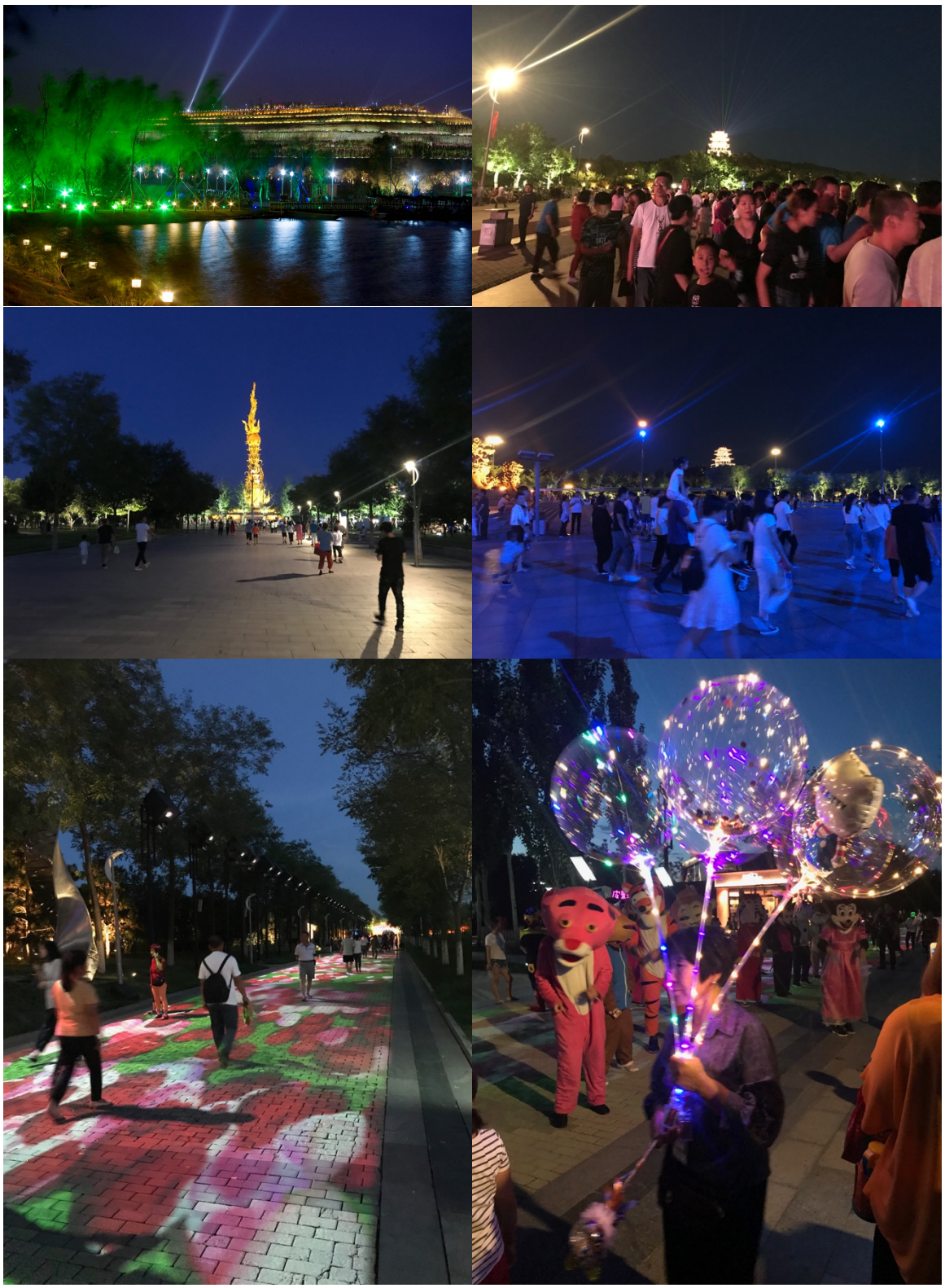

Figure 13. Colorful Lighting at Night in Nanhu Central Park (photos by author)

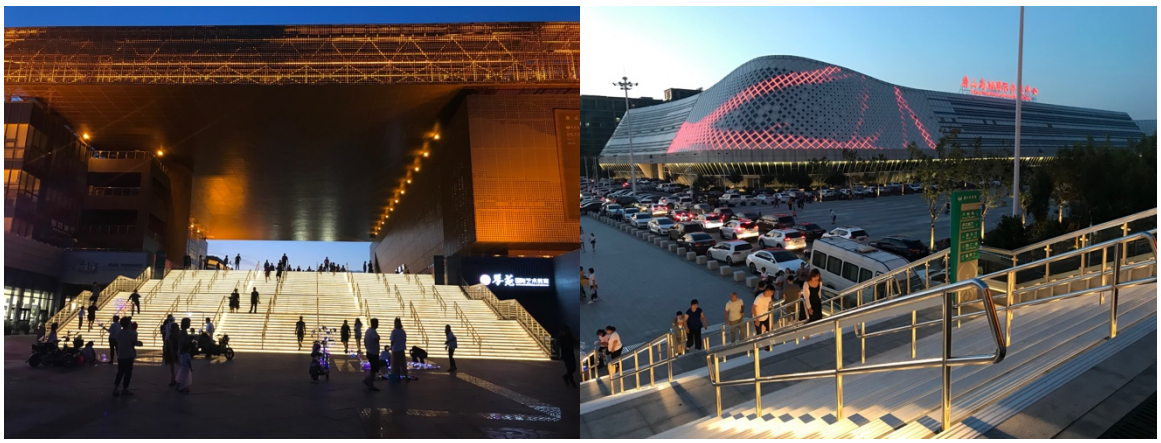

Figure 14. Colorful Lighting at Night at Nanhu Civic Center (photos by author)

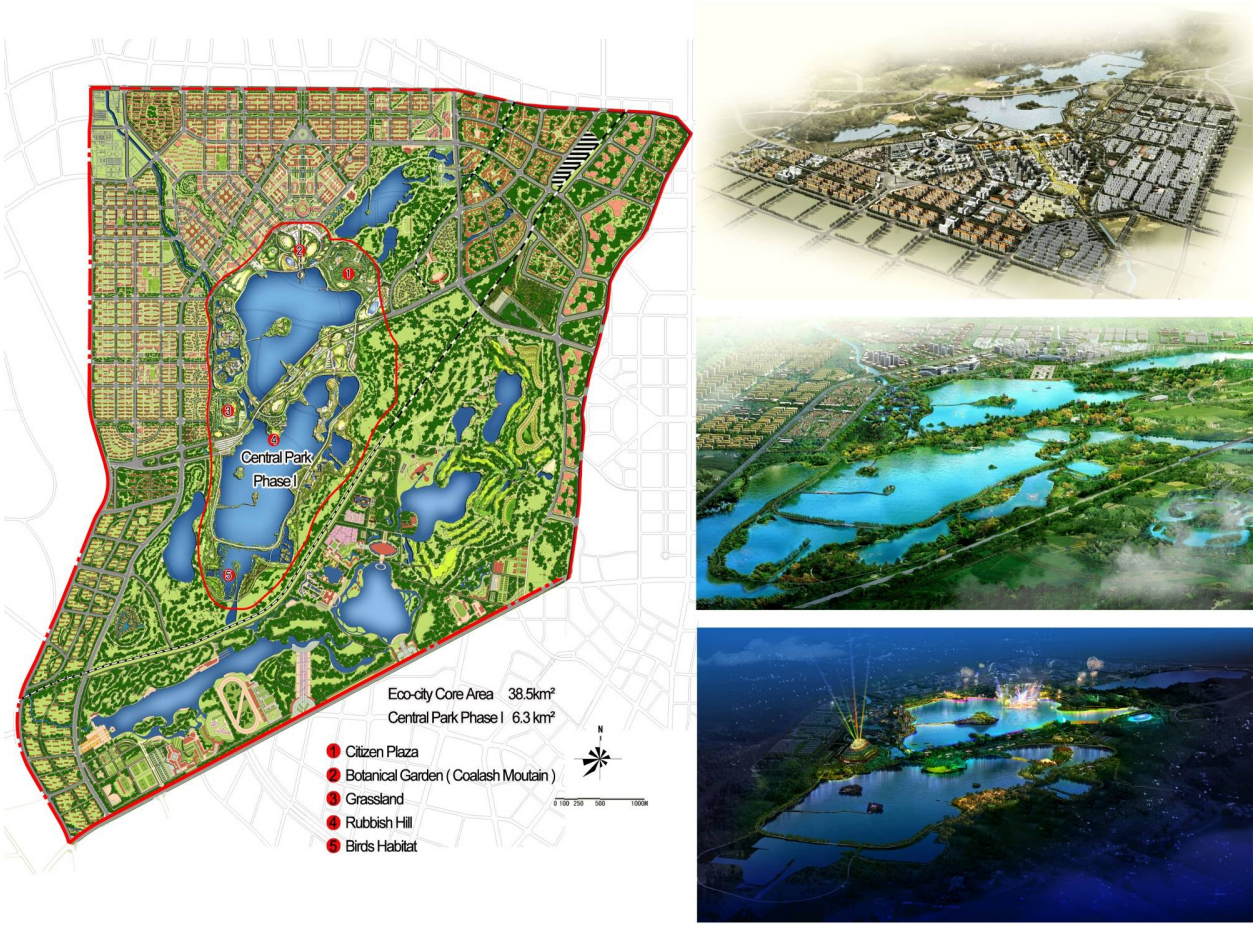

Figure 15. The Master Plan and Renderings of Nanhu Eco-City
Source: Tsinghua Tongheng Planning and Design Institute

Figure 16. Water Fountain Show (photos by author)

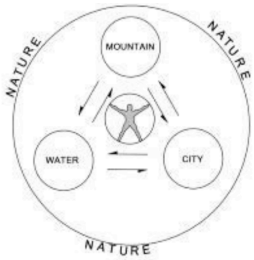

Figure 1 **"Mountain-Water-City" Model (From "Introduction to Sciences of Human Settlements", Wu Liang-yong)**

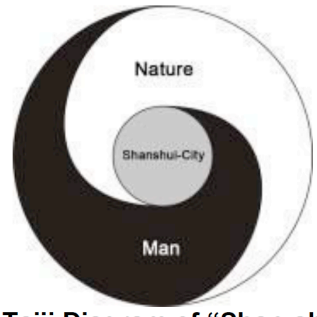

Figure 2 **Taiji Diagram of "Shan-shui City"**

Figure 17. Shan-Shui City Diagrams (Hu, 2010)

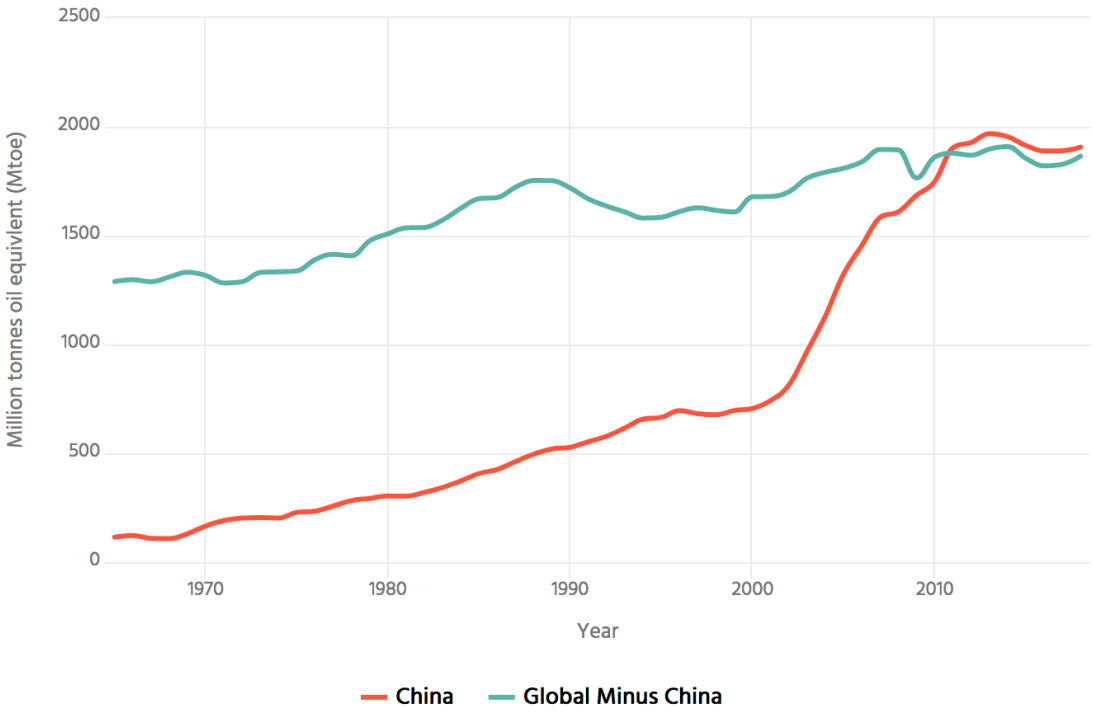

Figure 18. Mainland China vs Global Coal Consumption
Source: CSIS China Power Project

Figure 19. Pictures of the Lakes and Stated Water Purification
Source: Tsinghua Tongheng Planning and Design Institute

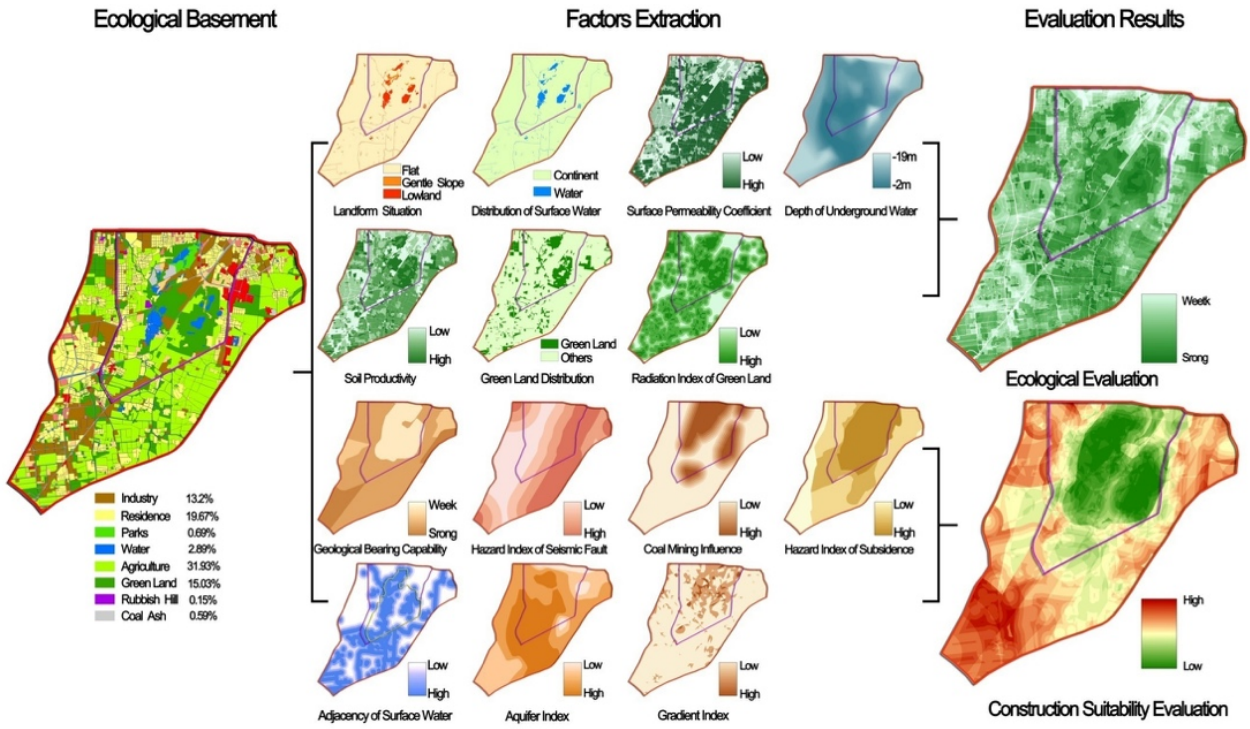

Figure 20. GIS Site Analysis of the Site of Nanhu Eco-City
Source: Tsinghua Tongheng Planning and Design Institute

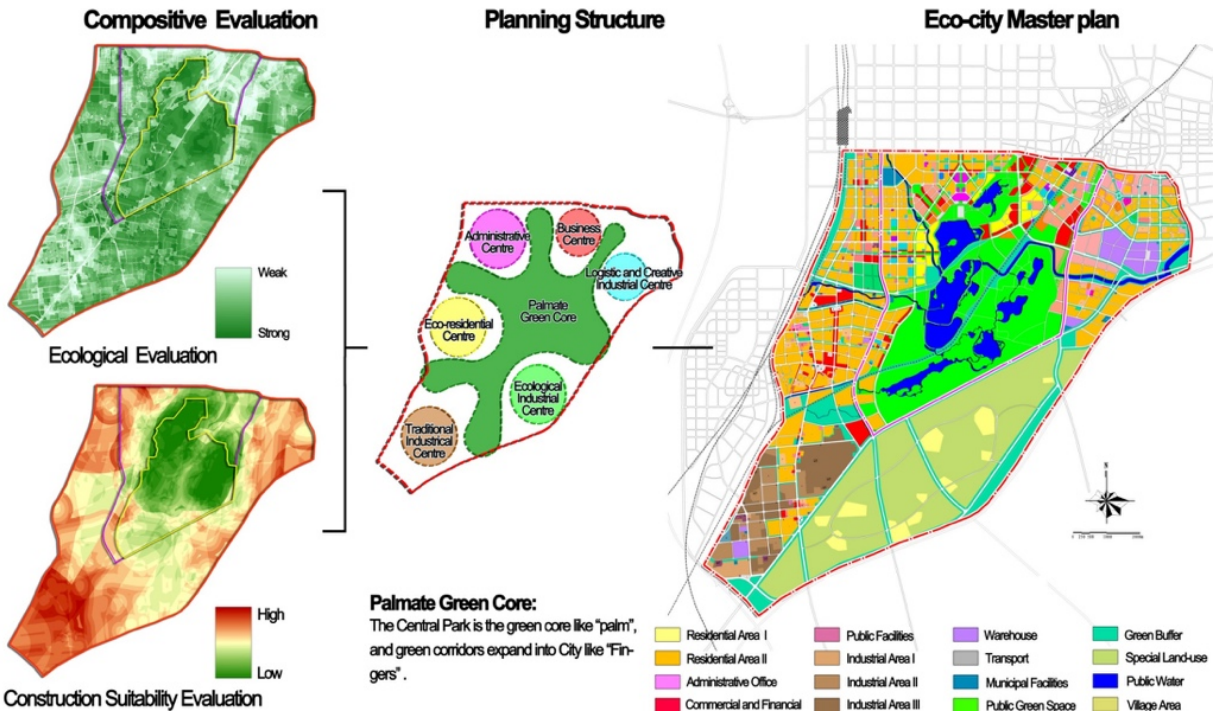

Figure 21. Nanhu's Spatial Design Based on Site Analysis
Source: Tsinghua Tongheng Planning and Design Institute

Figure 22. Building the Garbage Mountain (Dandanzan, no date)

Figure 23. Garbage Mountain "Reformation"
Source: Tsinghua Tongheng Planning and Design Institute

Figure 24. Reconstructed Garbage Mountain—Phoenix Terrace
Source: Tsinghua Tongheng Planning and Design Institute

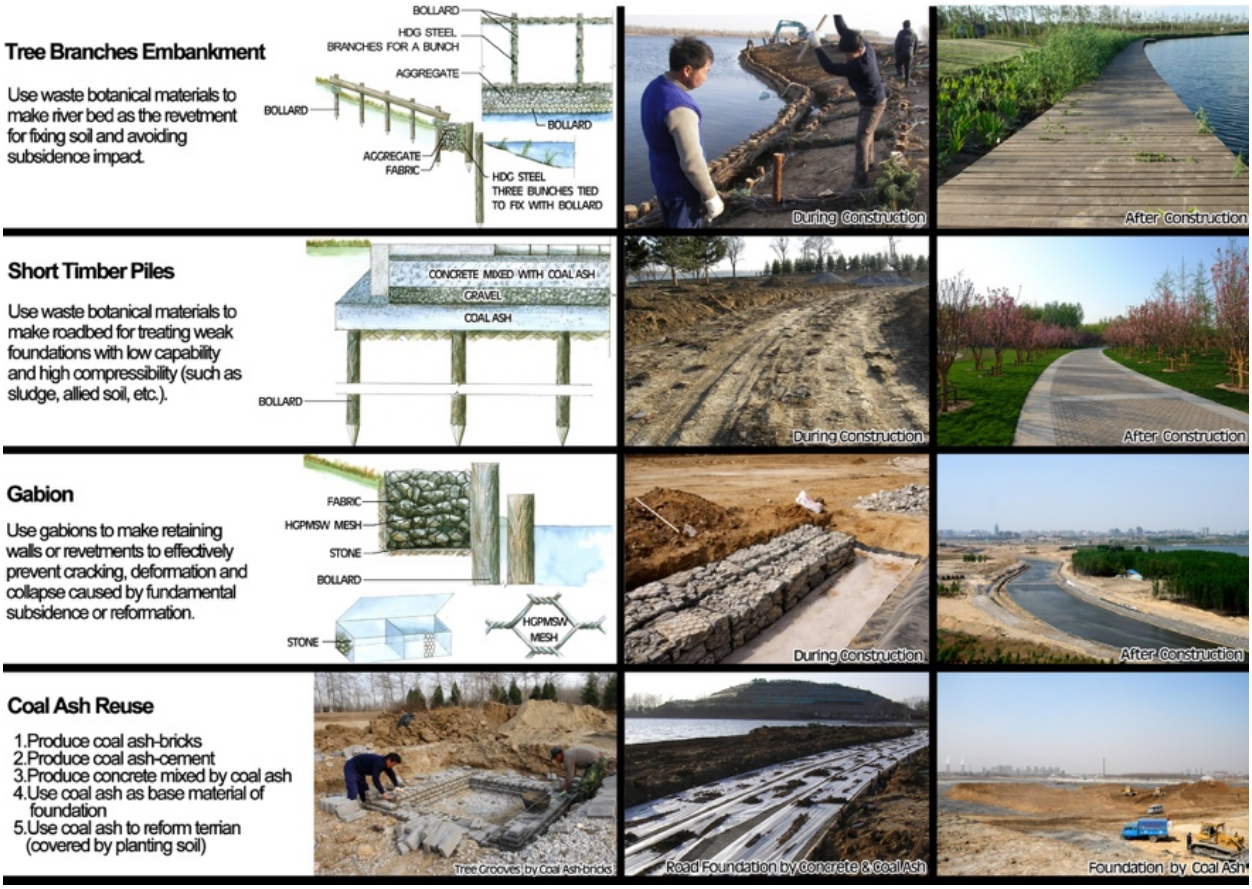

Figure 25. Waste Material Reuse and Low-cost Ecological Techniques
Source: Tsinghua Tongheng Planning and Design Institute


Figure 26. "Light timber framed buildings were built in consideration of limited ground bearing capability, traditional Chinese culture, resource and energy consumption, and environmental effects on the park."
Source: Tsinghua Tongheng Planning and Design Institute

Figure 27. Lotus Planted in the Northern Park of Nanhu Central Park
Source: Tsinghua Tongheng Planning and Design Institute

Figure 28. Viewing the Old City Center from Phoenix Terrace
Source: Tsinghua Tongheng Planning and Design Institute

Figure 29. Birds in Nanhu Area
Source: Tsinghua Tongheng Planning and Design Institute

Figure 30. Recreational Activities in Nanhu Central Park
Source: Tsinghua Tongheng Planning and Design Institute

Figure 31. Developments Surrounding Nanhu Central Park in Nanhu Eco-City
Source: Tsinghua Tongheng Planning and Design Institute

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Chapter Six. The Evolution and Limitation of China's Eco-Development

During China's rapid urbanization, the experimentation of eco-development has been a key component of China's roadmap for sustainable development. Developments featuring an eco-environmental vision—named eco-cities, low-carbon cities, or otherwise—are often designated as special development zones that have received favorable economic policies from central or local governments. These zones carry the mission to not only become new growth engines during industrial transitions but also to demonstrate lasting, replicable ways to integrate ecological protection and environmental governance into physical and social urbanization. The eco-developments examined in the foregoing chapters, despite the alleged uniqueness of each project's vision and development strategy, share some commonalities as state-promulgated innovation during China's growth-oriented urbanization. Chapter Three presents some of the most high-profile ecological new cities, or what I call China's earliest model eco-cities. These were privileged projects designated as national development zones and built during China's fastest decade of urbanization (roughly 2000-2012). The conceptions of these projects commonly feature the idea of a universally applicable model, "the eco-city" (Register, 2002), which can be built holistically from scratch (a concept introduced in Chapter One). Accordingly, China's earliest model eco-cities were built as new exclaves far from existing city centers. Despite the tremendous investment of domestic resources and the involvement of well-known global firms and experts, these model cities have been challenged by stagnant implementation and have been widely discussed as "failures" by foreign critics. Chapters Four and Five introduce two eco-developments conceived during the same period and are still evolving today. These two projects—Zhengdong New District and Nanhu Eco-City—were also built from scratch. They were conceived according to local considerations and have become lively new areas integrated with the original urban areas. Although these two projects were initially conceived to fulfill local developmental needs and to propel local industrial or post-industrial transitions, they have risen nationally and even internationally with a reputation of "success," setting practical paradigms for green urbanization and popularizing principles of sustainable planning and design in cities pursuing industrial, physical, and social transitions. Their tangible achievements—especially the continued development, the constructed ecological spaces, and the popularity among citizens—have helped to reinforce their reputation as paradigms of green urbanization. Their approaches to ecological design and environmental planning are emulated and reinvented in subsequent developments, inspiring continued experimentation of eco-development.

This chapter further discusses the abovementioned well-known practices of "failures" and "successes" of China's eco-development. The rest of the chapter first compares the model eco-cities with the locally conceived projects to reveal commonalities among all these cases as well as differences between the perceived "failures" and "successes." The chapter then parses the major characteristics of the two "success" cases. The analysis reveals the evolution of China's eco-developments over the past two decades and sheds light on the limitations of China's approaches to green urbanization so far. Assessing China's eco-developments against the backdrop of rapid urbanization suggests both barriers to and accelerant factors for China's ecological transition in urban development.

The Earliest Model Eco-Cities: Experimenting with A Technocratic, Utopian Model

As introduced in Chapter Three. All the examined eco-cities were initially master-planned by global design firms and were developed with intergovernmental coalitions between China and a more developed country. China's central government established these privileged projects to demonstrate national strategies for sustainable development. These projects have competed with each other to stand out from conventional projects, establish a replicable model for new developments, and set standards for China's green approaches to urbanization. Chapter Three has introduced some commonalities across these early attempts at eco-developments:

- Overly ambitious and doomed to failure
- Eco-modernization and technocracy
- Growth machine and green capitalism
- Self-contradictory and eco-labeling
- Global "master planners" and a universally applicable model
- Impractical appropriation of foreign approaches

As of 2021, most parts of China's earliest model eco-cities have remained unpopulated, suggesting the difficulty in building a brand new city from scratch. Calling these projects "failures," foreign critics have highlighted that these so-called eco-cities have worsened land speculation and environmental devastation and that their planning and design has been hyped by greenwash and a technocratic utopia (Caprotti, 2014; Chang & Sheppard, 2013; Joss & Mol, 2013; Shiuh-Shen, 2013). Such criticism was rejected by China's earliest eco-cities builders as well as the practitioners who were recalibrating the design and planning of these projects. They cautioned that the earliest eco-cities should not be regarded as total failures. They stressed that only Dongtan Eco-City—the first model eco-cities proposed in China—was unrealized. But it still had a huge impact on the planning and design for other eco-developments, including the subsequent planning and development of Chongming Island—the supposed site of Dongtan which is turning into an eco-island. Others projects—such as Tianjin Eco-City and Shenzhen Low-Carbon City—had successfully attracted businesses and residents. In 20201, they are still undergoing re-planning and redesign based on changes within the cities and in their broader contexts. Their planners and designers argued that recalibration could lead to more effective eco-environmental strategies since such recalibration was done based on experiences. As for Caofeidian Eco-City, although also undergoing re-planning, its development remains largely stagnant in 2021. With industrial decline happening in the broader region, Caofeidian's planners found it difficult, or even unnecessary, to build another new city. In contrast, located in Shenzhen, one of the most "sustainable" Chinese cities (Baldinger, 2019), the International Low-Carbon City has taken on a more innovative path by favoring environmental and cultural conservation, inclusive negotiation with various stakeholders, and equitable processes of benefits distribution. These principles have become more aligned with what is considered progressive for ecological design and environmental planning in Western societies. Highlighting the differences in the ongoing changes of the model eco-cities, China's eco-city builders suggested that the geopolitical positions of the projects within China, as well as the nuanced cultural differences across China, could influence the projects' development trajectory. Nevertheless, China's eco-city builders argued that these projects had been experiments and should still be regarded as models. After all, they believed, the importance of experiments was not to show failures as an end in itself but rather to allow for trying it again after one failed attempt. Accordingly, they cautioned that it could still be too early to conclude the assessment of these ongoing projects as failures.

The incompletion of China's model eco-cities has partially been caused by their grandiose scales. Some Chinese planners who worked on several eco-developments argued that incomplete projects were very common in China since the recalibration of design and implementation strategies was inevitable in large-scale developments. Nevertheless, most of these eco-cities were master-planned as ambitious megaprojects and are yet to profit from the investment input, let alone becoming local or regional economic engines. Their stagnant development is widely criticized for needing huge fiscal spending and drowning municipalities in debt (Rapoport, 2014). For example, Caofeidian New District, including an industrial area and China's first "techno-scientific eco-city," was highly promoted by Zhao Yong, who was appointed Tangshan's Party Secretary in 2006 (and who also promoted the development of Nanhu Eco-City). During his leadership in Tangshan, Zhao emphasized large-scale new development and branded Caofeidian as the "Number One Project" in Hebei Province. He invited high-level officials in China's Ministry of Commerce and Ministry of Foreign Affairs to moonlight as Tangshan's vice mayors and participate in planning Tangshan's new growth. He also proposed a plan for 30 billion yuan's worth of industrials equity funds, which were supposed to attract over 300 billion yuan's worth of capital investment in developing Caofeidian. In addition, Zhao established a state-sponsored investment firm to lead Caofeidian's development, which was supposed to go for initial public offering. He also proposed to establish Caofeidian's own agricultural and commercial banking services. Despite all the political attention and public resource investment, these proposals were never implemented. Caofeidian's development has led to tremendous municipal debt that generated daily interests worth tens of millions of yuan. In 2013, Hebei's provincial governor reflected on Zhao Yong's leadership in Tangshan, remarking that "Zhao was eager to achieve his ambitions, and was capable of, and passionate about, undertaking the challenges. However, he was often too impatient, and overattentive to massive scale, high-profile branding, and formality. As a result, some of his ideas were divorced from reality." Reports about ineffective city making attempts, municipal debts, and increasing air and water pollution combined have revealed the political vulnerability of the Chinese government. Gradually, the promotion of these high-profile projects has quieted down.

Debates about the model eco-cities have shown some common shortcomings in China's early attempts at promoting sustainable development. These common shortcomings compromise all three domains of sustainability—economy, society, and environment. First, these special development zones have yet to drive local or regional economic growth. Despite the huge fiscal investment, the implementation of these model green cities has been suspended or significantly slowed down due to local governments' huge financial burden to pay off municipal debts. In addition to incurring financial distress, these projects are criticized for lacking genuine, systematic pro-environmental achievements. The built environment in these places turns out to be rather generic, largely lacking ecological characteristics. "Eco" has become merely a label of the development for branding purposes. Socially, equity issues remain largely neglected in the grandiose conception of these early eco-developments. Even the proposed urban-rural integration seems far-fetched. With businesses and neighborhoods in these places struggling to gain vibrancy in an area poorly connected with the existing city centers, these developments have yet to provide sufficient jobs to migrant workers or to incorporate rural populations into the urban economy. Furthermore, these developments have targeted affluent residents and high-skilled workers by constructing high-end amenities and fostering advanced industries. They still include many suspended subprojects and have yet to attract enough people to form vibrant places. Large areas of these development zones resemble ghost cities, lacking visitors, residents, and workers. Even in places that are relatively more populated, such as the center of Tianjin Eco-City, only those who can afford new housing in the area, including those who have multiple housing assets, can benefit from the new development. Its eco-features have been realized

in a piecemeal fashion by profit-driven sub-projects. Hence, its ecological components are reduced to patchworked green spaces and sparsely distributed green technologies such as scattered wind turbines and solar panels. Since these early attempts largely relied on real estate development at the start, these projects—like many other projects designed with ecological ideas (Mostafavi & Doherty, 2010)—have become enclaves—and privileged ecological exclaves in the case of these model new cities—designed to concentrate desired populations while creating privilege in these special zones.

Despite all the aforementioned shortcomings, China's central government continues promulgating these early eco-developments as important signifiers of potential ways to improve urbanization in a sustainable manner. The unflagging enthusiasm in exploring a greener urban future has led to nationwide pilot programs that encourage hundreds of cities to transform themselves into "eco-cities" and "low-carbon cities." Such programs stress the necessity to protect sensitive ecological zones, reduce energy consumption, reduce carbon emissions, and mitigate pollution during the processes of urbanization. Nevertheless, these goals are difficult to achieve within China's existing economic and physical systems. China's typical growth model of urbanization—together with the spatial distribution of functional zones, industrial bases, transportation systems, and lifestyles in existing cities—greatly hampers China's eco-environmental initiatives. Inspired by the nation's enthusiasm for greening its urbanization, local governments and practitioners have proposed new projects to explore effective approaches to realizing eco-development in a developing context like China. The conceptions and developments of these explorations have involved internationally well-recognized experts and ideas. In addition to China, authorities of underdeveloped regions, especially those in developing countries, have also shown strong interest in establishing systematic, actionable, and replicable paradigms of eco-development that would scale up eco-environmental initiatives to improve urbanization. Zhengdong and Nanhu exemplify two well-known eco-developments that emerged shortly after China's earliest attempts at building eco-cities. They present alternative approaches to greening urbanization. Their approaches have reached partial successes and have been introduced to other developing areas—both domestically and internationally—to inspire sustainable urbanization that would grow a city in a more environmentally sensitive way. The sections below reflect on the achievements and limitations of Zhengdong and Nanhu to reveal lessons from these widely discussed successful eco-developments.

Locally Conceived Approaches to Greening Urbanization

Although most parts of Zhengdong New District and Nanhu Eco-City were built during the decade of China's fastest urbanization, the conception of these two projects emerged in the late 1990s in response to local urbanization challenges. As mentioned earlier, Zhengdong and Nanhu were not initially designated as model eco-cities by China's national government. Rather, their plans have derived from their municipal agendas for both continuing and improving urbanization—one that would facilitate industrial upgrading from manufacturing and heaving industries to consumption and financialization. After over a decade's continuous development, both Zhengdong and Nanhu have gained a reputation as "successful," "innovative" urbanization approaches, for integrating ecologies into urban areas which, in turn, has created an ecological image of the city, modernized urban infrastructure, and enriched social life. Each development has become its city's flagship project signaling a green, ecological outlook and renewing a backward image of a city previously dominated by agriculture or heavy industries. Their proclaimed "ecological" approaches to design and planning are considered effective and systematic in promoting economic prosperity, socioecological interconnectedness, and environmental sustainability. Their design and development approaches

have incorporated internationally recognized, forward-looking ideas. Appropriating such foreign, advanced ideas for development from the developed world has been an important strategy for China to enhance its urbanization strategies, gain international recognition in the development sector, and illuminate a promising path to sustainable development in developing contexts. Therefore, eco-developments serve as the city's name cards and they create ecological spaces that effectively facilitate place and city branding (Bonakdar & Audirac, 2020; Dinnie, 2010; Florian et al., 2002; Kavaratzis et al., 2015). Urban branding is arguably an effective tool for promoting sustainability in urban development and for enhancing political representation on the global stage (de Jong, 2019; Rehan, 2014; Vanolo, 2015). More importantly, the ecological principles and approaches to their operationalization evinced by these local eco-developments have generated cultural and political impact. Their eco-concepts and strategies for implementation have been institutionalized and incorporated into municipal and even regional development agendas, greening political ideologies and public rhetoric in local societies.

The proclaimed success of the two projects must be examined in the context of local development conditions against the backdrop of China's enthusiasm for urbanization during that period. The following sections examine the apparent differences and commonalities between Zhengdong's and Nanhu's eco-approaches and development outcomes. The focused comparison of the two local flagship developments will be positioned in a synchronic comparison with China's earliest model eco-cities. Patterns of China's eco-development revealed by comparisons set a foundation for subsequent discussions about broader trends of evolution in China's approaches to green transitions in urbanization.

Table 1. Summaries of the Development Profiles of Zhengdong and Nanhu

	Zhengdong New District	Nanhu Eco-City
Political support	Provincial, municipal, and central	Municipal
Timeline	3, 5, and 10 years as development milestones to complete the initially planned district, followed by eastward district expansion	2 years of concentrated effort to construct the central park, followed by incremental development surrounding the park
Siting strategy	Extension of old city, rural hinterland	Old urban center, abandoned industrial site
Motivation of the development	To facilitate urban expansion, ease crowdedness in existing urban areas, attract investment and talent, absorb rural populations into an urban economy, promote consumption and financialization, build a modernized regional center in the provincial capital city, thrive in regional and inter-city competitions	To regenerate the deteriorating urban center during a post-industrial decline, improve the environment, build livable neighborhoods, foster eco-tourism, build a cleaner economy, establish a new identity of the city, replace the industrial image of the city with an ecological one, redress urban shrinkage, attract new residents and new businesses
Physical planning and design	Holistically master-planned Cluster-based layout and expansion plan	Master-planned in stages Park-centric layout

	Cluster-based, comprehensive urban programming Functional zoning with each cluster focusing on a major urban function Networked infrastructure connecting the clusters Open, interconnected layout Modernist city plan, architecture, and landscape A concentric layout of the CBD as the central cluster Green spaces are designed to be open as part of the city Co-locating urban parks and massive, modern civic structures and event facilities in the center	Expanding from a theme park to develop incrementally into a comprehensive urban district Flexible/unspecified urban programming A green, inward-looking enclave to be opened up to the city Traditional Chinese style architecture and landscape Restored undisturbed ecological zones An enclosed layout of a theme park, initially planned for an international garden exhibit and opened later to the public Co-locating a central park and tourist facilities next to a modern, massive civic center with cultural facilities
Main actors	Driven by local and regional political leaders, led by officials in planning and public administration	State-initiated, led by experts in urban design, landscape architecture, and planning, involving environmental scientists and engineers
Regional importance	Economic center	An icon of art and culture
Scale of space	New development in a new district, with wide roads and hierarchical transportation systems	An old area in the old city, old road networks, compact neighborhoods
Financing and economic conditions	Initial state investment plus subsequent land-based financing Anchoring state-owned enterprises to boot the economy Economically thriving with successful promotion of consumption and financialization	Initial state investment plus subsequent land-based financing Park-fueled real estate development and land leasing Lack of anchoring industries while undergoing an industrial decline Financially costly to maintain the park, relying on real estate development to generate revenues, the tourism industry remains stagnant
Public life in public spaces	Lively public life with massive crowds in the central cluster, green spaces, and commercial centers A popular destination for everyday recreational activities Abundant self-organized fitness and recreational activities, Frequently visited by local residents and regional tourists Central green spaces are frequently used for formal and informal events	Lively public life with massive crowds in the central park and in the civic center Popular destination for everyday recreational activities Abundant self-organized fitness and recreational activities, Frequently visited by local residents and regional tourists Curated weekly events in the central park attract large numbers of local residents

Development management	Upgrading green strategies Incorporating new green ideas and new technologies for environmental and urban governance Building regional environmental initiatives Relatively higher-standard environmental monitoring and ecosystem stewardship	Management limited to the park Tourism management as a key strategy Lack of a holistic vision for the surrounding areas

Commonalities and Differences between Zhengdong and Nanhu

A thorough literature review of English and Chinese literature on eco-concepts and eco-projects reveal four main categories of principles that constitute an eco-development: *ecological design, environmental planning and management, green economy, and green governance*. These literatures are drawn from fields related to design, planning, development, and policy and include both theoretical discourse and practical strategies. They are published by internationally renowned experts and national authorities (see Appendices for details). The synthesis of these literatures can be captured by the framework presented in Figure 1.

The literatures commonly suggest that an eco-development must tackle some major eco-environmental concerns, such as climate change adaptation, resource saving and management, pollution mitigation, environmental protection, ecosystem protection and recovery, water conservation, and natural disaster prevention. In order to do so, an eco-development often follows principles in one or more of the four dimensions:

1) Ecological design: The spatial configuration and physical design should provide the framework and infrastructure to allow for green transitions.
2) Environmental planning and management: The development creates a new urban ecology that remediates past eco-environmental damages and fosters long-term wellbeing of humans and the environment.
3) Green economy: The development helps the city or the region transition towards a greener economy.
4) Green governance: The development incentivizes pro-environmental action in the private sector through new forms of public-private partnership.

According to the common principles, both projects have made some progress on the right path. Both Zhengdong and Nanhu have some piecemeal achievements in all four aspects.

Table 2. Summaries of the Partial Achievements in Zhengdong and Nanhu

	Zhengdong New District	Nanhu Eco-City
Ecological design	Newly constructed and interconnected green spaces and water systems, with a total area of	Massive brownfield utilization with ecological restoration A central park with an area of 13 km^2

	75 km² in the originally planned district Greenbelts and green networks integrated into public infrastructure Constructed wetlands and forests Clustered development connected by holistic systems of infrastructure and green spaces	Green fingers connecting the park with the city Constructed ecosystems with local species Growing the city surrounding the park
Environmental planning and management	Ecosystems preservation, construction, and maintenance Water cleanup and water quality monitoring Air quality monitoring and control Constraining developmental boundaries to protect ecosystems Regional plans of preserving and restoring sensitive ecological zones Building the core ecosystems and green spaces first to kickoff subsequent development Industrial pollution control and mitigation Emerging waste management	Holistic park design turning a vast brownfield into new ecosystems A decade-long afforestation Landfill removal through garbage mound construction Low-cost construction and material reuse Low-impact development techniques Geological and ecological analysis as scientific references for developmental decisions Scientific ecosystems planning Building the ecosystems and open spaces first to kickoff surrounding development Water and soil quality restoration
Green economy	Anchoring financial institutions and state-owned enterprises have ensured economic productivity Shutting down polluting industries Growing non-polluting sectors, such as the service sector and the financial sector Building rapid transit systems and low-carbon commuting systems Adopting green-tech products	Lacking thriving industries Ecological restoration and urban greening has accelerated real estate development and land leasing Park management remains subsidized by the public Eco-tourism has failed to become a key industry to support the local economy Unclear direction for economic development in surrounding areas, since land was just leased out to private developers
Green governance	Public education and civic engagement programs about energy and resource saving and waste management Emerging neighborhood-centered green initiatives coordinated or assisted by street-level governments Emerging grassroots civic engagement in environmental stewardship	State-sponsored management of the park Lack of additional green initiatives or measures of civic engagement

Like the earliest model eco-cities, both Zhengdong and Nanhu have been built from scratch through a *tabula rasa* approach. However, while the early eco-developments have been located near the ocean far from existing cities, both Zhengdong and Nanhu are more connected with preexisting urban centers. Both projects feature an ecological environment in the center that attracts residents, investors, and visitors from the rest of the city or region. Nevertheless, assessed from an urbanist point of view (Figure 2), one can still observe "urban illnesses" in these places resembling problems prevalent in Chinese cities (Table 3). These issues are consumption- and growth-driven in nature and hence conflict with principles of eco-development or urban sustainability. For example, China's urban development today increasingly promotes car-dependency, excessive infrastructure networks with wide roads and huge parking lots, enclosed superblocks and gated communities, and exclusionary commercial districts, which all lead to traffic congestion, disordered parking conditions, skyrocketing housing price, vast impervious surfaces and urban heat islands, and widespread yet unquestioned gentrification. These characteristics are all present in Zhengdong and Nanhu. This suggests an unsustainable nature of China's urbanization model, which the two "successful" eco-developments have yet to address. Therefore, the observable achievements of these two eco-developments remain piecemeal and are realized on limited geographic scales. Green spaces remain largely ornamental with limited restorative performance. The alleged successes are limited to the green enclaves of the city. Being "eco" remains a branding strategy on the political agenda to stimulate economic growth. Equity issues remained largely neglected beyond the original legal residents of the jurisdictions. The unsustainable built fabric and concomitant equity issues at large suggest strong path dependencies in the formation of China's built environment and new societies due to regulatory, cultural, and institutional barriers. Therefore, the eco-environmental attempts in Zhengdong and Nanhu must be appraised against the broader context of China's peak urbanization and its emerging global ambition. Their "successes" have been limited in scope, The alleged innovation in their eco-environmental approaches is relative to ill-practices in China during their time of conception. Their eco-environmental approaches have suffered from broader institutional constraints. Zhengdong's recent disaster has proven that piecemeal "environmentalist" strategies are far from being sufficient for dealing with the environmental crisis. Examining the limitations from a political-ecological view, they suggest the need for more fundamental structural reforms in China's administration of design, planning, and construction as well as in the practices of related industries.

Table 3. An Urbanist Assessment of Zhengdong and Nanhu

	Common characteristics of Zhengdong and Nanhu
Accessibility: low-cost movement or communication between activity locations	Car-dependency, wide roads, lack of parking, fences, gated communities
Adequacy: sufficient quantity and quality of basic facilities	Not enough schools and hospitals, only large shopping malls, lack everyday markets and small retail, but new delivery services are emerging
Diversity: a wide range of variation of facilities and activities finally mixed in space	Large-scale retail, high-end services dominate newly developed areas, limited small retail and affordable facilities, but new online services are changing access and diversity
Adaptability: low cost of adaptation to new functions and the ability to absorb sudden shock	Some low-cost development (e.g. recycled materials, sponge city development), piecemeal and small-scale adoption
Comfort: an environment that does not place undue stress on the individual, particularly regarding communication, climate, noise, and pollution	More comfort provided by the park and new facilities; pollution control, especially air pollution mitigation, are visible and perceived to be very effective; people appreciate environmental management attempts and hence psychologically feel the environment is cleaner; relatively, these places are perceived to be more comfortable than other districts; residents are in general pleased with the development outcomes, the ecological spaces, and the management of the district

* The assessment is based on both interviews with local residents and a questionnaire-based survey distributed to local residents, workers, and visitors.

Despite the common illnesses of China's rapid urbanization, the piecemeal achievements in Zhengdong and Nanhu have shown to their decision-makers potential ways to improve on typical developments. These limited but observable improvements have been recognized by local residents, practitioners, and authorities, who have been impressed by the observable enhancement of environmental quality and enjoyed seeing increased numbers and diversity of wildlife in urban spaces. They have witnessed and therefore begun to appreciate the benefits of ecosystem services. Local planners and development authorities expressed that they had intentionally incorporated new ecological design and development standards for subsequent projects, hoping to scale up the partial achievements in these eco-developments. In turn, these partial yet tangible successes have inspired local authorities to impose eco-environmental principles on continued urbanization and environmental governance.

Apparent Differences between Zhengdong and Nanhu

Builders of Zhengdong and Nanhu believe that their project has outperformed the earliest eco-cities in aspects such as effective plan implementation, continued development, and popularity among local citizens. These two projects each represent a unique approach to eco-development which their builders attribute to their widely perceived success. While Zhengdong and Nanhu increasingly become paradigms of eco-development studied by other cities, a closer examination suggests apparent differences and commonalities between the two promoted successes.

Table 4. Summaries of Apparent Differences between Zhengdong and Nanhu

	Zhengdong New District	Nanhu Eco-City
Local developmental trend	Zhengzhou was under rapid industrialization and urbanization The local government expected increased rural-to-urban migration and population growth	Tangshan was undergoing an industrial decline in its old urban center The population had begun shrinking in the urban core
Relation to the old city	The expansion of the old city Building a new district right outside the boundary of the existing city Extending the old city into rural hinterland Urbanizing rural villages and incorporating rural communities into the urban economy Retaining parts of the greenfield adjacent to the city Providing improved housing to residents in the city	Post-industrial regeneration of the old city Revitalizing the core of an industrial city Repurposing a vast brownfield at the old urban center Cleaning up a landfill above a mining area Clearing informal settlers in the abandoned area Attracting new and more affluent residents from other cities
Main development objective	To facilitate growth To chart new urban territories To accommodate anticipated population and urban growth in the region	To confront decline To redress damage from the past To enable post-industrial transition and establish new drivers of economic growth
Main design idea	Metabolist ideal/eco-modernization	Ecological Urbanism/ecology first/city in nature + Shan-Shui City/living with nature
Implementation	Strong state intervention and coordination throughout the development	State-invested park development and maintenance followed by private capital-driven developments
Major "eco" strategies	Green growth e.g.: promoting a greener economy, low-pollution industries and low-carbon lifestyles, urban greening, building constructed wetlands for water cleaning, sponge city/low-impact infrastructural development, green transportation, environmental stewardship, pollution monitoring and control, waste management and recycling, public education, community engagement, symbiotic industrial ecosystems, work-living co-location **New ecology** Central park Green corridors	Ecological restoration e.g.: brownfield utilization, landfill cleanup, recycling materials, low-impact and low-cost development, greening, event organization, relocating or closing factories, environmental cleanup, low-carbon public transportation planning **Restoration** Aforestation Brownfield treatment Water treatment Pollution mitigation **New ecology** Turning landfill into a "Central Park" Constructed garbage hills

	Constructed wetlands Increased biodiversity **Environmental management** Water treatment Air pollution control Floodplain protection **Decarbonization** Public transit Bike-sharing system Discouraging car usage Waste management Energy-saving programs Removing industrial activities	Constructed wetlands Increased biodiversity **Urban regeneration** Slum on-site relocation Low-impact redevelopment Increasing public amenities Removing industrial activities
Elite support	Political support from the top State-owned enterprises as anchoring industries	The participation of intellectual elites Interdisciplinary collaboration and diverse experts' support, including planners, architects, landscape architects, academics, ecologists, environmental scientists
Symbolism and style	Modernist style	Traditional Chinese symbols
Branding rhetoric	A new city, high-tech, smart, retentive (preserving nature in urban growth), expanding into a new frontier and establishing a new identity of prosperity Branded as a pioneer in China's new city movement a widely perceived success An "eco", "multicultural", "symbiotic" city	The rebirth of an old city, low-cost, restorative, low-carbon environmental engineering, confronting the past and rewriting shared memories of trauma Branded as a pioneer in brownfield regeneration China's largest ecological restoration project designed by an interdisciplinary team

Common Features of the Perceived Success

Despite the apparent differences between Zhengdong's and Nanhu's design and development strategies, the two projects share some common features. While their strategies and achievements continue being promoted as successful paradigms emulated elsewhere, what constitutes "success" in China's urban sector today involves chaotic discourses. The ways in which eco-environmental principles are operationalized in each project, as well as how the operationalization shapes the developmental trajectory of each project, are largely contingent on implicit assumptions of major stakeholders and discretionary processes of conception and negotiation. This section examines the accepted criteria for assessing "successes" in Chinese cities and identifies design and development strategies that have been perceived to be effective. Such understandings set the foundation for a deeper diagnosis of China's development norm and for discussions about the potential of more genuine ecological transitions in Chinese cities. The discussion below presents the commonalities between Zhengdong and Nanhu in four aspects: *ecological and psychological benefits, changing political economy of development, emerging social networks, and the projects' roles in spatial politics*.

First and foremost, the ecological and concomitant psychological effects of Zhengdong and Nanhu were the most discussed "success" of these two projects. Through urban greening and beautification, both projects created open parks that brought ecology back to the city, offering popular public amenities to all citizens and establishing a new cultural identity. For both projects, the highlight was a large urban park in the center of the new development, which had become a popular public amenity for all citizens and is increasingly reputed to be a regional attraction. The urban parks also had become the sanctuaries for wildlife where drastically increased quantity and diversity of wild animals had been reported by ecologists and enjoyed by the public. Acknowledging the visible increases in biodiversity and environmental quality, local authorities for both projects adopted urban greening as a key strategy for building new projects in the area. Local officials believed that urban parks and green spaces perform as the natural cleaner of the air, soil, and water and brought an agreeable environment to the city, promoting public health and mental wellbeing. A chief designer of Nanhu argued, "The benefits of living near the Central Park are both eco-environmental and social-psychological." Local officials at Zhengdong suggested that "the beautiful landscape and small animals bring great joy and health to citizens in their everyday life." Residents and visitors in both places had reported that the ecological components of the city created pleasure and comfort for individuals. Designers, planners, and local authorities in both projects believed that their project had demonstrated to citizens, developers, and practitioners how eco-developments could enhance ecosystems health, environmental quality, mental wellbeing, and public health. In the meantime, along with state promotion and city branding, the ecological image and environment in the center of these new urban areas had established a new cultural identity for the city as a whole. Both Zhengdong and Nanhu include large areas of newly constructed ecologies, which are heavily designed for city beautification while representing a new image of a prosperous, modern city with improved quality of life. Both places were generally well-received by residents and visitors and had become very popular destinations for everyday leisure activities, with hundreds of people gathering every evening and hundreds of thousands of visitors every month. Residents and visitors had expressed enjoyment of the environment. They perceived these areas to be "cleaner," "more ecological," and "more enjoyable" than other parts of the city or region. In turn, the public amenities, especially the ecological spaces, have become common destinations that attract people who shared common interests and who engage in similar recreational activities. Citizens formed informal clubs, which nurtured social capital and engendered ecologically friendly sentiments at a collective level.

Second, both projects emerged as land repurposing attempts and both made room for constructing systematic new ecologies. The latter has led to both physical, tangible improvements as well as inadvertent, sociocultural benefits. As a result, urban ecology has increasingly been perceived as a valuable asset of the city. It has been prioritized on the political agendas as a catalyst to spur economic growth, attract productive populations and businesses, and facilitate cultural transformations. While both Zhengdong's and Nanhu's initial achievements have already influenced local decisionmakers' mindsets, their development has gradually changed, and continues to shape the political economy of development at the municipal level towards a path of greener urbanization. The perceived environmental, psychological, and sociocultural benefits of these popular eco-developments continue to attract enterprises to relocate to these jurisdictions, attract developers to invest in subsequent phases with green public amenities, and attract homebuyers and new residents who value improved ecosystems and environmental quality. These trends help to sustain the continuation of the eco-development, which, in turn, has created a favorable environment for the city's economic growth and pro-environmental governance. These places continue receiving

favorable policies for advanced industrial transitions and for the experimentation of innovative development and governance. Their popularity and reputation so far has become the demonstration of, and has educated both the public and decisionmakers of urban development about, the value of urban ecology in promoting the economic and political status of the city. In particular, local officials and planners have become convinced that it was worthy to incorporate, invest in, and maintain the ecological components of a city. While these eco-developments continue disseminating ecological values and pro-environmental norms among the public and urban practitioners, urban greening has become institutionalized in subsequent developments. Although the initial ecological components were largely realized through considerable, direct state investment, the municipal governments in Zhengzhou and Tangshan have increased the requirement of green areas in subsequent developments while incentivizing private developers to build green public spaces in addition to conventional commercial and residential projects. Local state's emphasis on building ecology as a public amenity has maintained and expanded the ecological characteristics of the area. This not only has enhanced the image of the city and social life but also normalized eco-environmental value in developmental mindsets, ethics, and institutions. As the eco-developments continued expanding and evolving, new forms of public and private partnership were created and institutionalized in subsequent developments to increase private contribution to green public amenities and improve environmental stewardship. New companies and state agencies emerged and matured over the initial decade of the eco-developments, which continued to facilitate the construction and expansion of ecosystems and green spaces while improving their long-term strategies for maintenance and financing. In this process, the local state has grown to become an effective coordinator among various experts, developers, and stakeholders. In this way, the huge upfront public investment in these places has not only generated anticipated benefits such as economic growth, human capital gain, improved urban environment, and enhanced quality of social life, it has also brought inadvertent benefits to China's political system and professional networks by enabling institutional learning and illuminating a roadmap for greening urbanization. Therefore, both Zhengdong and Nanhu today remain political symbols that demonstrate the state's capabilities in social and environmental engineering. These eco-developments showcase the state's power to drastically transform the built environment, reorganize resource distribution, reshape societies and cultures, and enhance everyday life for citizens included in the developmental agendas. Nevertheless, both projects were conceived to mainly facilitate, rather than challenge, China's conventional approach to urbanization which was enabled by capitalist exploitation of land and nature. Although authorities of both projects claimed to have respected natural conditions during project conception by conducting scientific site analysis, the siting of both projects was contingent on the developability of land in a top-down quota system rather than scientific studies of natural conditions. The initial development of these places was largely kickstarted by the concentration of public resources and state coordination, especially through direct investment of public funds and capital from "anchoring" state-owned enterprises.

Moreover, both developments have involved iterative processes of trial and error (Figure 2). The implementation is typically carried out and recalibrated through initial master planning, re-planning with new ideas, and further detailed master planning. Phases of re-planning and detailed planning often involve increasing numbers and types of stakeholders and hence require proactive state coordination and expert-facilitated mediation among stakeholders (Figure 3). With the upscaling of an eco-development deeply embedded in local politics, local officials and practitioners must nudge the progress of an eco-development through constant experimentation and active learning. In such dynamic processes, the initially constructed urban ecology, together with the state's continued investment in environmental stewardship, has become the commons that all stakeholders value and

hope to maintain and expand on. As the complexity of inter-stakeholder negotiation was increasing, new developmental agencies were established to mediate among conflicting interests and various expertise. In this way, eco-developments have gradually changed the political economy of development at the local level. New social, professional, and political networks have emerged within these places and have even started to connect with networks elsewhere. Evinced in the development of Zhengdong and Nanhu, three types of networks were absent in typical developments but emerged in the planning and implementation processes of these eco-developments: First, local, domestic, and foreign experts in various disciplinary and professional backgrounds, such as designers, planners, ecologists, and environmental scientists and engineers, came together for the first time to discuss how to work together to realize the ecological (and increasingly smart) components of the new development in a systemic, expandable way. These experts continued working together since their initial collaborations, experimenting with and improving on their approaches to eco-development in other parts of China. Second, local officials had been forming and expanding expert-official networks across administrative divisions and levels. They were proud of the achievements and had become increasingly invested in both promoting and exploring more genuine ecological approaches to further prove their capabilities. On one hand, they were informed about what could be realized through working with various experts. On the other hand, authorities of these places became advocates of building eco-developments in the governmental system by forging collaborations across governmental divisions and by introducing their experiences to officials elsewhere and even at the top. They continued exploring new expertise and new knowledge in best practices internationally to experiment with new eco-approaches in their jurisdictions. Third, inspired by the massive daily usage of the ecological spaces, many grassroots groups had emerged in these places to encourage everyday leisure activities, such as various groups for dancing, running, walking, cycling, skating, singing, and playing instruments. The participants of these groups had also formed online forums and virtual communities to expand their circle and social impact. In this way, these ecological spaces had become lively civic centers fostering social capital in the city. As these eco-developments were rising to become paradigms for domestic and international practices, their experts, local authorities, and residents had utilized the ecological ethos and lively social life to spread—both intentionally and accidentally—a collective reimagination of an urban future that embodies eco-environmental ethics. Local governments have begun working with some of these emerging social networks to mobilize residential communities and improve urban management and environmental stewardship.

Lastly, both projects are a form of place-based developmental policy in China that has been devised to drive larger socioeconomic change and reshape local and even regional distribution of population, wealth, resources, and welfare. Due to the territorial nature of China's place-based policy, the investments in new housing, new ecologies, and new job opportunities in an eco-development have been constrained by jurisdictional boundaries. This approach has inevitably intensified inter-district, inter-city, and inter-region political competition. Although residents (both urban and rural and both new and resettled) within the projects' jurisdictions have benefited greatly from such transformative development through increased wealth, better job opportunities, and improved physical and social infrastructure, these eco-developments remain a form of special development zones that privilege those living and working within their completed and urbanized territories. Those who may have lived there informally beforehand have been displaced and are largely forgotten. Municipal and provincial governments have supported the development of these special zones by deliberately and forcefully concentrating private capital investments and public resources in these areas and by issuing exclusionary, place-based favorable policies. As a result, although with the extension of public transit systems the ecological spaces of the city have brought benefits to broader societies

both within and beyond the project's boundaries, eco-developments remain special zones that could worsen geopolitical and socioeconomic inequalities. Such inequalities have become more apparent with the increasing economic success and rising property value in these places. Successful eco-developments are often viewed and managed as privileged locations with expensive housing and services. Despite that open ecologies can generate broader contributions to the society, during China's growth-oriented, capitalist processes of urbanization, these places are resource-intensive special development zones that concentrate political power and human capital and create privilege within limited administrative boundaries. Although these eco-developments have begun changing the courses of political agendas and practical norms, without systematic continuation and expansion of such approaches to urbanization, piecemeal experimentation would exacerbate spatial and socioeconomic disparities.

Are China's eco-developments successful or failing? Through Zhengdong and Nanhu's achievements so far, we see mixed results. These demonstration projects have achieved piecemeal physical improvements. Their ecological and environmental contributions have been limited in scope. Their eco-environmental performance has yet to be thoroughly measured, monitored, or evaluated in a scientific way.

To summarize lessons learned—through the lens of Zhengdong and Nanhu and against the backdrop of China's enthusiasm for ecological new cities in the past two decades—China's eco-developments exhibit some *common limitations*:

1. The exploitation of ecologies due to a growth-oriented developmental mindset.
2. Their eco-environmental strategies are piecemeal and limited to mitigation.
3. Path Dependency: Working within the growth-oriented regime, local decision-makers are only concerned with green, ecological strategies at limited scales (mainly in designated park areas, although drastically increased compared with a typical city).
4. A consumerist popular culture hinders pro-environmental behavioral shift in individuals;
5. Political Incentives: These projects remain a demonstration of politician's capabilities. Due to the short term of office, these projects lack persistent effort.
6. NIMBYism: Place-based strategies are limited by administrative boundaries, which causes rivalries over resources, personal privilege, and political importance; this hinders regional cooperation on eco-environmental initiatives over resources and privilege; this hinders regional cooperation on eco-environmental initiatives.

Despite these limitations, *accelerant factors* have emerged in these places that can potentially promote environmental sustainability through green transitions in China's next phase of urbanization:

1. These governments' development mindsets are shifting to incorporate social and environmental considerations into their economic agendas.
2. Eco-environmental efforts increasingly receive stronger public support and institutional coordination has improved.
3. New environmental laws have also accelerated such attempts.
4. Local public-private partnership in these places has created new ways and new agencies to finance, construct, and manage ecological projects.
5. There has been institutional learning of both ecological mindsets and green development strategies.
6. Elite-led environmental stewardship, decarbonization products and services have emerged through these projects.

7. There has been rising green governance through public education and civic engagement, which can engender behavioral shifts and foster collective action.
8. The recent deadly floods in Zhengzhou have exposed, and reemphasized, the environmental vulnerability of Chinese cities (including the alleged eco-developments) to the world; this could accelerate urban and environmental policy reform and spur more rigorous measures for disaster prevention and climate change adaptation.

While Zhengdong and Nanhu have demonstrated some genuine intentions to improve urbanization with eco-environmental measures, they are both products of growth-fever during a legendary era of China's contemporary development. As such fever has been decreasing, China policy-makers, public administrators, and practitioners must confront illnesses of rapid urbanization, such as uneven development, overbuilding, resource exploitation, environmental degradation, and socioeconomic disparities, during an era of economic slowdown and increasing social conflicts and civic resistance. China's eco-developments are early attempts that have incubated new, eco-environmental rationality for China's next phase of urbanization. In these places, the conventional growth-oriented administrative thinking—one that prioritizes capital gain and resource consumption—has begun shifting to new developmental rationality that emphasizes resource protection, stakeholder mediation, public management, and environmental governance. To the authorities and practitioners of eco-developments, short-term economic goals (usually within 3-5 years) have become given way to longer-term social and environmental considerations (over a decade long). The evolution of successful eco-developments and the professional growth of their builders are increasingly visible nationally and internationally. The popularity of these places has generated cultural and political shifts at the local level that align with ambitious central agendas of building an "ecological civilization." In this way, eco-developments have become and will continue being an important tool for state-building during China's green urbanization transitions. These eco-developments perform as key state initiatives that transform the built environment in tandem with social engineering and institutional learning. They are special zones in the city that experiment with future-making. In an authoritarian society like China, state-led interventions remain the fundamental tool that is necessary and effective for larger societal change, collective action, and structural reforms.

Popular Assessment: Why are they considered "successful" in China?

Regarding the proclaimed success of Zhengdong and Nanhu, the popular rhetoric must be examined in the context of Chinese society. Media reports in 2015 heaped praises on "the rise of Zhengdong New District" since 2003 as a second- and third-tier Chinese city, refuting a media criticism in 2010 that regarded Zhengdong as China's then-largest "ghost city" (zzloujian, 2017). An article by Sina News highlighted that the false accusation of and controversy about Zhengdong (mainly from 2009 to 2013) as "China's largest ghost city" was debunked by the gradual maturation of this district. Such maturation was supported by the construction of over 100 square kilometers of urban areas, the occupancy of 1.03 million people, and the generation of over 13.58 billion yuan (about 2.1 million USD in 2014) tax revenues (Zhang, 2015). A local urban practitioner and market watcher in Zhengzhou believed that it was only normal for Zhengdong, or any other new city development, to look empty during its initial construction. This view was echoed by Zhengdong's local officials, who argued that Zhengdong looked empty because building a new city took many years of effort. They also pointed out that even though office buildings and housing in Zhengdong were rapidly sold, according to the Chinese convention, residents preferred to take months or even a few years to decorate the interior of their workplaces and new homes. As a result, although the new

area looked empty during most of its first decade of development, local officials and practitioners defied the reputation of a "ghost city" and highlighted the district's popularity to investors, companies, and homebuyers. One stressed, "Zhengdong was never a ghost or empty city." In addition, the market watcher suggested that the wealthier populations in Henan Province have flocked to the capital city of Zhengzhou for better work and living opportunities. These upper- and middle-class citizens chose Zhengdong for its agreeable environment and high-end amenities. As a result, housing price in Zhengdong had become the highest among all districts in Zhengzhou: in 2015, the average housing price in Zhengdong was over 15,000 yuan (2,323 USD in 2015) per square meter, and housing price in general went tenfold from the late 2000s to 2017 (zzloujian, 2017). In addition, Zhengdong was designated as a medium- to long-distance transit harbor that was well-connected to other cities through the expanding high-speed rail network. The convenience of connectivity further attracted residents, workers, and companies.

In popular opinions and media assessments, drastic housing price increase and the ability to attract affluent populations were among the most mentioned indicators of Zhengdong's success. Living and working in this new area had become a fad in Zhengzhou and nearby cities. A local official and chief planner of Zhengdong argued, "We have worked hard to achieve our goals," adding that "Zhengdong New District is the best new city in Henan Province now." He also argued, "The popularity of a district can be reflected by its schools," adding that Zhengdong was home to over 3,000 teachers, over 50,000 enrolled students, and over 70 public schools and kindergartens. Both online media and citizens in Zhengzhou regarded moving into Zhendong as a symbol of social status. They agreed that moving into Zhengdong meant high income, better ecology and environment, better public infrastructure, and better job opportunities. In the popular discourse and self-assessment, Zhengdong symbolizes *progress* and *privilege*. Such an image of this new district has greatly boosted housing sales. Real estate development remained the main driver for Zhengdong's initial economic development and population growth, contributing to over seventy percent of its fiscal revenues by 2015. Local officials were aware of the fact that the growth from housing sales could not be sustained and hence had been fostering the new industries and businesses.

Emphasizing that people have "voted by feet" to come to Zhengdong, local officials believed that Zhengdong had become a successful development because the project was conceived to fulfill Zhengzhou's "actual need" for urban expansion and economic growth, as opposed to broader economic goals that were imposed on the city. China's model eco-cities were planned to enable the transformations of economic geographies at a cross-provincial, regional scale. Such a strategy did not consider local conditions, which has contributed to difficulties in implementation. In contrast, Zhengdong was conceived based on local needs. On one hand, local officials claim that building a new area like Zhengdong was a must and follows the developmental demands of the economy and the society. On the other hand, they have taken a series of favorable measures that intentionally spurred the growth of the new area. For example, in order to facilitate the rapid rise of the new area, Zhengzhou and Henan governments responded to the initial vacancy and stagnant sales in 2007 and rapidly implemented favorable measures, especially by moving provincial and local government centers, dozens of major banks and financial institutions, and high-end services and entertainment industries to Zhengdong (including some of the global top 500 enterprises). This was followed by further agglomeration of universities and major local schools and hospitals. Local officials argued that the public amenities, public services, and urban management were all provided at the highest standards in order to build an advanced new area that outperforms nearby districts economically, socially, and environmentally. In particular, Zhengdong's planners argued that Zhengdong's ecological design and an agreeable environment was a crucial attribute that reflected the exceptional

quality of life in the area, which laid the foundation for its economic success and its attractiveness to investors, companies, and homebuyers. They also believed that the ecological quality of the new area—observable through ample green spaces, increasing wildlife, and increased biodiversity and perceived as cleaner air—continued providing the public with an agreeable environment for living and continued demonstrating sand ensuring the quality of life in the area. Thanks to Zhengdong's reputation as a successful new city, officials of Zhengdong had been quickly promoted to higher-level governments in Henan province and elsewhere.

Zhengdong's officials expressed tremendous pride in its high-standard *governance*, which made the consistent and continued implementation of massive ecological projects possible, along with continued efforts in the maintenance and management of the district's environment and in mobilizing other emerging pro-environmental initiatives through civic engagement, such as projects of low-carbon mobility, low-carbon neighborhoods, and waste management at the street level. They believed that such fine-grained, people-oriented governance—embedded in a place created through holistic master planning and systematic ecological design and accompanied by effective industrial strategies and successful financing—had played a crucial role in realizing the innovative concepts in the original design and planning and in sustaining the economic, social, and environmental qualities envisioned in the original scheme. Journalist and critic Hugh Peyman argued that other countries could learn from the remarkable rise of China, highlighting the prosperity demonstrated by the tremendous transformations in Zhengdong New District and Pudong District in Shanghai. Despite Western critiques about the lack of democratic accountability in China's one-party state, Peyman points out that China's political system had lifted 700 million out of poverty and created a middle class 250 million as of 2018 (Peyman, 2018). Zhengdong, an area that has risen from rural villages to an emerging international icon of city-making, exemplifies China's capacity for change along physical, economic, social, and political dimensions. Zhengdong's transformation is first and foremost a miniature of China's legendary rural-to-urban transformation in the last four decades, during which the country has moved away from an impoverished pariah to the global factory and is now rising as the "Global China" with growing international power. More importantly, city-making icons such as Shenzhen (since the late 1980s), Pudong (since the early 1990s), and Zhengdong (since the early 2000s) have become China's message to the world, asserting with the built achievements that it has the economic and political power to create, and continue creating, urban legends (Hawksley, 2018). While earlier generations of these urban legends have mainly focused on economic growth and social engineering, Zhengdong's eco-environmental approaches, along with its increasing focus on smart approaches to urban services and management, signal a more pluralistic, more ambitious vision of future city-making that not only aims at sustaining economic and social growth but also incorporates environmental, technological, and intellectual advancement. The more comprehensive ambitions of city making demonstrated by a district like Zhengdong, despite its largely understated impact on nearby regions which have been disadvantaged in China's internal city-making competition, showcases China's ambition to lead in the world's urban development. Contrasting democratic regimes, China uses projects like Zhengdong to showcase its transformative capacity by concentrating resources and power (Figure X). Such concentration stirs up competition and creates privilege, which in turn grants the nation prestige on the global stage, especially when it exports its model cities to other developing countries. Despite the widely criticized corruption and social suppression, China's capacity to rapidly develop and improve people's quality of life has brought the country allies who are eager to share its success or attracted followers who are eager to catch up with the developed world by recreating "the China Legend."

An important dimension of the impact of the development of Zhengdong, or other successful demonstration projects, has been *ideological*. The process of Zhengdong's eco-development has disseminated and normalized ecological values and eco-environmental approaches to design and planning among the public and among politicians and experts. The decision-makers of the development (mainly officials and experts in design, planning, engineering, and construction, and sometimes investors and developers), agencies that continue monitoring and maintaining the district (including maintenance service and environmental management companies), and governmental supervision agencies (such as the environmental protection bureau) all have adopted the ecological rhetoric while learning to appropriate ecological ideas, set practical goals, and experimenting with ways to improve existing developmental institutions. Together, they demonstrate how the Chinese state can plan ahead, create big visions, mobilize resources, shape ideologies, values, and cultures, and modernize the society while reinventing itself by adopting new concepts, new approaches, and new ideologies—such as those embodied by the concept of sustainable development—which all represent "world-class" betterment. Such networked and targeted self-reinvention towards worldview-guided improvement has been achieved through trial and error in these special eco-development zones with a strong desire to thrive for progress at a collective level and with both strong economic incentives and strict (albeit emerging) environmental restrictions set by a strong state. In this way, Zhengdong as an eco-development and as one of the newest legendary city-making attempts has become the venue and arena for the Chinese state to renew itself at the local level while charting a new course for economic growth, environmental governance, and social reproduction. Its municipal and provincial impact and the professional and political networks formed beyond the provincial boundaries have generated ideological impact at regional and even national and international levels. Although poverty alleviation has been largely limited to the poor original, long-standing citizens within the district, whoever has been included in the development has benefitted economically and psychologically from Zhengdong's development. Deng Xiaoping, the founder of China's economic reform, once remarked that development is a must and that China's development must "letting some people get rich first." Still following Deng's doctrine, Zhengdong's residents have become another batch of beneficiaries of China's legendary growth.

While European and US governments have exported their democratic systems to other parts of the world and generated sociocultural progress in less developed territories, Peyman (2018) has asked whether there are lessons that can be learned by the West from China's way of planning and accomplishing goals despite the shortcomings of its rising authoritarianism. He argues that China's biggest success is its capacity to achieve progress by conceiving ideas and setting goals in a practical way. He points out that, in a failing democratic system, long-term interest can be compromised due to short-term thinking and can be conditioned by the electoral cycle. In China, a strong state lays out a roadmap or playbook for change and has the capacity to engender universal adoption of its central agendas at all its administrative levels, forming collectivity ideologically. This ideological collectivity could be utilized to mobilize societal and behavioral changes. In the case of Zhengdong, although the design and planning ideas seemed utopian and grandiose, its slogans and implementation experiences have been packaged and popularized as a realistic model for emulation, turning Zhengdong into a standard-setter for a greener, more sustainable modern city. Through developments like Zhengdong, China shows the world its wealth, its capacity to make changes happen, and its momentum to bring progress. The image of Zhengdong also presents a rich and confident nation, and its development brings wealth and confidence to its people. Such psychological effect was confirmed by a local villager who had been waiting for Zhengdong's expansion to include their rural land. He stated with excitement, "Seeing the transformations in Zhengdong's exiting area, people in my village, my family, and myself all have more confidence now.

We are looking forward to officially becoming part of the Zhengdong Area and having a better income and an improved quality of life." In turn, all of the progress reinforces and expands the state's legitimacy by fostering a sense of pride among the development beneficiaries and winning their support.

In the case of Nanhu, media articles have focused on its drastic transformation from "an industrial scar in old days" to "the city's green lung" (Liu, 2017). Beautiful photographs of Nanhu area flourished online. Many iconic ones are foregrounded by ample green space, vast lakes, wooden architecture in a traditional Chinese style—all sitting against the backdrop of the city's skyline. The image of Nanhu has allegedly set the character of the city and become "a snazzy name card" of Tangshan.

Nanhu's design team, including experts in landscape architecture, urban design, environmental engineers, geologists, and ecologists, took pride in designing and realizing "the Chinese landscape." They argued that they had respected natural law by incorporating environmental science and engineering into landscape and urban design. According to the strategies for design and construction, the "Chinese landscape" was integrated into the contemporary city as a form of green infrastructure, which not only "enabled nature-based solutions to restore wounded landscapes and clean the environment" but also "created psychological joy and promoted mental wellbeing for citizens." On one hand, Nanhu's chief designers regarded China's ancient philosophies—especially beliefs of the unity of man and nature—as the origin of design principles underlying their "ecology-plus-urbanism" approach. On the other hand, significant elements of Nanhu's design strategies focused on restoring the environment and enhancing human well-being through ecosystem services and comprehensive planning. These elements can be traced to the work of Frederick Law Olmsted (Eisenman, 2013) and subsequent practices in American landscape architecture, ecological urbanism, green infrastructure, and low-impact development, such as projects by SASAKI and James Corner Field Operations. Moreover, Nanhu was conceived in the context of a post-industrial city in need of socioeconomic, environmental, and cultural transitions. Its development context resembled conditions of the post-industrial, declining American cities in the 1960s when "ecological urbanism" emerged with expanding impact. Despite the roughly half-a-century delay in timing, the City of Tangshan seemed to have reached a developmental stage featuring economic decline and population shrinkage, similar to conditions in a post-industrial American city. In turn, selected principles of American urban planning and landscape architecture rooted in post-industrial cities had become relevant for a transitional Chinese city. With the fusion of Chinese and American ideas, values, and experiences in its key designers, Nanhu's conception reflected the appropriation of ecological ideologies derived from both ancient Chinese philosophies and modern American theories of ecological urbanism. More importantly, the implementation and subsequent popularity of Nanhu's transformation had demonstrated an aesthetic image, an agreeable environment, a popular public amenity, a socioeconomic stimulant, and a cultural influencer—all contributing to shifting local politics and growing eco-environmental ethics. In turn, such fusion of ecological ideologies had become a civilizing factor shaping contemporary Chinese urbanism while becoming integral to the evolution of city politics. During the realization of a project like Nanhu, more emphasis had been given to impressive aesthetics, a large and wholistic scale, the agglomeration of urban interactions, a physically and culturally transformative process—all intended for, more importantly, the ideological and everyday influences (mostly at an unconscious level) that such ecological design had on citizens who had experienced the place and viewed the scenery.

Nanhu's designers emphasized that, despite the powerful scenery at Nanhu, its ecosystems service preceded art. Features spotlighted by experts reflected knowledge and expertise from a multidisciplinary team of chief designers and planners, including landscape architects, ecologists, environmental engineers, environmental scientists, geologists (THUPDI, 2015). To these experts, Nanhu's success could be reflected by the following aspects: First, the creation of Nanhu Central Park, with an award-winning design, was the highlight of the entire development and the city. Second, the utilization of a vast brownfield in a mining field was unprecedented in China. Designers took pride in regenerating an abandoned, polluted junkyard of the city and rebuilding its connection with the surroundings of the current city. Third, they claimed that their design had used landscape to realize the transition of the city image from "an industrial city" to "an ecological city," which had effectively revitalized the economy and improved the quality of life in a traumatized city that was still affected by the aftermath of a deadly earthquake. Fourth, the design team suggested that they had integrated design with science to optimize their strategies and respect the existing urban and environmental conditions. In particular, the design schemes were generated based on a series of analysis that was not carried out in typical developments. This included GIS analysis, land use analysis, ecological analysis, geological analysis, soil and water pollution analysis, and development suitability analysis. Moreover, knowledge of ecology and environmental engineering was adopted to construct wetlands and waterways and to nurture forests and other carefully planned ecosystems. The ecological design had taken into account scientific knowledge to connect original and new ecologies into different zones of ecologically performative and restorative systems, in which different species of plants and animals could thrive. Nanhu's designers were confident about their environmental and ecological expertise and regarded the concept of "ecology as the foundation" and the interdisciplinarity in ecosystems planning as an innovation in design practice. They argued that the new ecologies were not only ornamental but also soothing and refreshing to visitors subconsciously. The peacefulness of nature would soothe and restore the spirit. These ecologies would adapt to, grow on, and gradually improve the originally wounded ecosystems and landscapes and continue servicing human psychological needs. Fifth, the design team had overseen and followed through the entire construction process, during which the experts adopted a series of low-impact, low-cost, and low-carbon technologies and techniques. These included recycled construction materials and earthquake-resistant techniques by appropriating traditional Chinese architecture both aesthetically and structurally. The low-rise wooden structures were not only suitable for the site due to the weight-bearing capacity of the ground but also culturally reviving China's unique architectural styles and traditional identity.

The popular media had widely praised the project by listing its ecological achievements, mainly in five aspects: 1) by forestation and creating the Central Park, the development of Nanhu had increased the green coverage area of Tangshan from 41.57% to 44.7%; 2) over 100 bird species had been observed in the park, among which over 30 species stayed in the park in winter; 3) over 100,000 people flocked every day to Nanhu Central Park; 4) surrounding land price increased over 100 billion yuan; 5) Tangshan's figurative story of a phoenix was embodied in the project to symbolize the rebirth of a city, which transformed after disaster and abandonment into a beautiful, agreeable place for living; Nanhu's manmade new ecologies repeated the city's story of recovery and healing, carried hope and dream for a future-oriented city, and demonstrated the potential for a traumatized city to create a new type of success, especially one that would sustain based on advanced commercial and educational quarters like other modernized, economically vibrant cities (THUPDI, 2015).

What is valued in an eco-development according to popular assessment?

Several aspects are frequently praised in the popular discourse as the common "achievements" of both Zhengdong and Nanhu. First and foremost, both projects stand out due to their distinctive approaches to *ecological design*, which encompass ideas for transformations in physical, economic, and cultural dimensions. Famous designers have envisioned the projects' development based on internationally well-recognized conceptions of "urban ecology." In the City of Zhengzhou, rather than letting urban expansion engulf the landscape at the city's hinterlands, Zhengdong's design introduced an unconventional concept of "metabolism" in cities. It views cities as a holistic ecology, the infrastructure of which would integrate manmade and natural elements. In this way, this integrated infrastructure would not only ensure mechanical functions but also provide ecological and social performances. Based on this ecological view of the city, Zhengdong has retained parts of the original greenfield as well as most of the river systems on its site. However, the original ecology has been significantly reconstructed as part of the ecological component of the new city. About fifty percent of its overall area has been preserved for massive afforestation, wetland restoration, park construction, and water systems restoration. All the newly constructed green spaces are interconnected, forming a network that overlaps with transportation networks for vehicles and pedestrians. Together, the ecological, transportation, and public space networks have been interwoven into a connective framework that largely shapes the public realm of the new city. This spatial logic is particularly salient in the layout of Zhengdong's CBD—the pilot zone that is built most true to its original design, which also serves as the core of the connective framework that expands outward into newly urbanizing territories. Local planners and designers highlighted the increased biodiversity and growing numbers of wildlife in the city and argued that by building urban and ecological infrastructures in tandem, the physical outcome of this urban-ecological framework could serve both humans and wildlife in the new city.

The idea of "urban ecology" has also been highly appreciated by Nanhu's planners and designers. Sitting in a coalmine right south of Tangshan's old urban center, Nanhu area has a much more traumatic past when compared with a typical hinterland like the original site of Zhengdong. Nanhu's design focused on the ecological regeneration of an abandoned brownfield, which has brought a drastic turnaround to the environment of this area. The project concentrated its regeneration effort on turning the coalmine into a massive urban park, with constructed ecological zones that mimic natural processes of ecosystems. These zones include aquatic, wetland, mountain, and forest ecosystems. Nanhu's planning team includes expertise in urban design, ecology, and environmental science and engineering. The multi-disciplinary collaboration allows the team to respect processes of Nature while shaping Nanhu's design and construction according to scientific studies of geologic conditions. The successful creation of the park has brought ecology back to the city, generating a massive "natural" amenity in the center of the highly industrialized city. It is also a carefully curated eventful space that welcomes massive assemblies of local and regional residents. Nanhu's approach emphasizes the creation of new ecosystems in the city in order to foster a reciprocal relationship between the city and nature. This notion is captured in the Chinese concept of Shan-Shui City, the principles of which largely overlap with ideas of ecological urbanism that originated in North America. With new projects proposed to be surrounding the new ecological center, the creation of Nanhu Eco-City has greatly changed the geography of Tangshan's future development, heralding the city's growing attempts at deindustrialization.

In addition to the well-received design schemes, popular opinions further praise the two projects by pointing to their successes at *implementation*, especially considering the *speed, scale,* and *consistency* of

development. Both Zhengdong and Nanhu quickly reached a level of completion in their pilot zones within two to three years. In each project, the pilot zone is the most ecological and aesthetic part that has been constructed true to the original design. Ecological design works as a powerful strategy for placemaking, turning the pilot zone into a new landmark while shaping the identity of the entire project. The pilot zones serve as an effective demonstration of key design and planning principles, which generates momentum for developing later phases of the projects. Impressed by award-winning design schemes, images of the pilot zones, and strong political support, investors compete to enter Zhengdong and Nanhu. Both projects have leased all their land to developers, which has reduced municipal governments' fiscal burden. In their continued development, public-private coalitions further fuel the branding of ecological characteristics by proposing "green" sub-projects.

In both Zhengzhou and Tangshan, local officials, practitioners, and the public commonly believe that the eco-developments have raised their cities' profiles through some positive changes. First, thanks to the faithful implementation of their ecological design—even though the most evident parts are the pilot zones—Zhengdong and Nanhu have created *new ecologies* at massive scales that are uncommon in typical developments. Officials in both Zhengzhou and Tangshan suggest that ecological design has contributed to unconventional development outcomes, especially in cities that lacked appealing features in their original landscapes. The new ecologies are essential to place and city branding, enhancing the image of the city as well as its political profile. The new ecological profile of the city further facilitates industrial upgrading, population agglomeration, and the enrichment of social life. One of the most apparent changes is that both projects have transformed the built environment through *beautification*. Both projects began with massive landscape projects that have created agreeable scenery and spectacular views, significantly improving the aesthetics of the public realm. The eco-development has become a brand of the city, manifesting a new ecological identity. The appealing environment in these places also attracts visitors and fosters a sense of place. Another highly observable change can be attributed to the *benefits of ecosystem services*. Zhengdong and Nanhu, especially their green spaces, see a much higher number and diversity of wildlife than other areas. Local officials and practitioners believe that ample green spaces provide shade in hot weather and improve microclimate and air quality in adjacent areas. Residents in both Zhengzhou and Tangshan contend that the construction of ecological zones has provided them with more agreeable, more open, and safer spaces to escape life in concrete, gated, and polluted cities.

The aesthetic and ecological performances of the two projects combined have led to their *high popularity among the public*. Huge crowds can be observed daily in the central ecological zones of both Zhengdong and Nanhu. Among the crowds are various self-organized hobby groups enjoying fitness, artistic, and musical activities, such as walking, running, cycling, skating, painting, photographing, dancing, playing instruments, and singing traditional opera. Most of these recreational activities are spontaneous, grassroots, and open to all. Small vendors can be found in central plazas, near parking lots, and along pedestrian paths to sell water, snacks, tools, and toys. In the most visited areas, local governments frequently propagate optimistic rhetoric that paints a prosperous future through free musical shows and exhibitions that are open to the public. Local governments also organize themed shows and exhibitions to encourage public participation in local action agendas, including new programs for garbage classification, energy saving, and low-carbon travel. In this way, the governments have utilized emerging social capital in these spaces to *shape collective sentiments and new cultural identities*. They have also utilized spontaneous gatherings to promote local eco-agendas by *educating the public, advocating climate-friendly ethics, and mobilizing behavioral shifts*.

What is most important to municipalities is the allegedly facilitating role of eco-development in drive future-oriented *economic restructuring*. Both Zhengdong and Nanhu have aimed at fostering advanced, non-polluting industries amid their ecological settings. Zhengdong's officials reckon that the beautiful image of the district, its ecological environment, plus its lively public spaces are important indicators of an enhanced quality of life. They attract productive businesses and desired labor forces to the city, enhancing the city's human capital and supporting the growth of more advanced industries, such as high-tech, finance, higher education, and modern services. Tangshan's officials also expressed similar expectations. New projects around Nanhu Central Park all aim at growing creative, high-tech, and cultural industries. Real estate developments in both projects, other than the required amounts of resettlement and affordable housing, are designed for affluent populations. Land and housing prices in both projects are among the highest in the cities, which have continued increasing along with the expansion of the projects.

All the above-mentioned aspects are frequently praised by officials, practitioners, and residents of Zhengdong and Nanhu. These two projects have grown to be icons for their cities and even their regions. They are promoted as paradigms of eco-development nationally and even internationally. Officials, practitioners, and investors elsewhere often visit these projects to learn from their experience through business invitations, conferences, or voluntary field trips. Known as successful experimentation of eco-development, these projects have also become hubs or "living labs" for officials and practitioners to exchange ideas and lessons for eco-development. Witnessing the popular rhetoric praising the "successes" of their city, local residents, especially those who frequently visit the districts with eco-development, openly voice their civic pride. To the general public, being "eco" is a "new normal" that is worth celebrating, even though many of them cannot immediately define what that entails. At the local scale, these widely promoted eco-developments have largely popularized ecological rhetoric and, to some extent, *normalized pro-environmental values*, especially in cities that had focused solely on economic growth before carrying out high-profile eco-developments.

More importantly, both Zhengdong and Nanhu have begun *shifting city politics* and *professional norms* by demonstrating positive effects of eco-development. Major decision-makers of local development, including officials, chief planners, and powerful developers, all contend that they have learned something new and established new development mechanisms and new professional networks to carry out similar developments. Zhengzhou's officials suggest that they did not know how to realize a massive ecological project before Zhengdong's construction. Now they have established new state-owned and private agencies and formed new public-private partnerships to design, construct, and maintain various ecological components of the city. In Tangshan, the ecological regeneration of a massive brownfield is unprecedented. In fact, this approach at its scale remains unprecedented in China (as of 2020). The complexity of Nanhu's original site conditions has encouraged designers and planners to create multidisciplinary professional networks and learn to work collaboratively. Both Zhengdong's and Nanhu's construction and management reveal that eco-developments in China require increasing levels of cooperation among different administrations of land and natural resources. Through these projects, Zhengdong and Nanhu have become some of the pioneering projects in China to facilitate cross-professional and inter-governmental collaborations with the intent to explore ecologically responsible and climate-smart approaches to building future cities. Their implementation has become processes of experimentation and institutional learning. Planners and designers of these two projects firmly believe that they have gained knowledge and experience on ecological design and planning, which has informed, and will continue influencing, their practices elsewhere. Thanks to these pioneering experiences, they have also risen to be known as China's

"experts" of eco-development. These practitioners, as well as local officials, are invited to conferences and political meetings to share their development strategies and lessons learned. In this way, major decision-makers of successful eco-developments have been disseminating new ideas and shaping new "ecological norms" in the design, construction, and management of cities. These social and political networks, which emerged from places like Zhengdong and Nanhu, are promising channels to change business as usual in urban development and engender positive influences among broader professional and political communities.

Examining the two projects in parallel, their conception and branding strategies featured some *common rhetoric* that reflected the vision and mission imbued into these eco-developments. The most important objective was to build an area with improved, outstanding economic performance. The eco-development promised to enable the development of advanced industries, bring desirable jobs, attract talent, generate revenues, and facilitate economic and technological upgrading. In Zhengdong, the rhetoric heavily emphasized *prosperity*, accompanied by images of new architecture that symbolized modernity and progress and that would replace an image of backwardness. Such economic and technological advancement was accompanied by an ecological environment that would ensure the quality of life and the happiness of citizens. The tremendous public investment, the forceful demolition and relocation, the urban-rural gap, and the old image of the city were all rendered invisible in the promotional materials exhibited at public-facing governmental offices and distributed by the government to the public. Politically, these eco-developments meant building a future with harmony, the accomplishments of which would prove *the legitimacy of the state*. To the public and to individual citizens, these projects also carry societal and psychological meanings: they represented *a forward-looking image of a livable place, an image of leaping forward, and a new identity for citizens*. They would also create *socioeconomic privilege* and symbolize *cultural superiority*. Moving to these new eco-developments would prove residents' personal accomplishments. To those who could not afford to live in these places, these eco-developments still suggested opportunities, since they would attract the most capable citizens to the new jurisdictions who would need upgraded services; the latter could bring new ways of making a living for lower-end populations. According to such reasoning, a development that was meant to innovate in socioeconomic, environmental, and cultural aspects would benefit all classes of citizens. In Nanhu, the new eco-city carried a story of *rebirth*. The economic performance was to be ensured by a drastic transformation from a past identity with negative connotations into a new identity of the city with an ecological future. This transformation was imbued with *newness, hope, progress, peace, and enjoyment*, all of which would overwrite traumatized memories with beauty, modernity, prosperity, and growth. In both projects, the *stories* underlying project conception carried social, cultural, and political meanings. These developments conveyed optimistic messages about a place for the future to citizens to engender collective sentiments of *hope, confidence, pride, and satisfaction*. In these stories and promotional rhetoric, *ecology* had become the element that was *aesthetic, connective, restorative, and tranquilizing*, which in turn *justified and enabled continued development* while *rendering class struggles and wealth unevenness invisible*.

Through visionary statements that promote eco-environmental *ethics*, the state conveyed a strong belief in *a common cause*—one that constructed a future that did not yet exist. Local leaders communicated the government's commitment to building this vision and a promising future. And this common cause was framed as one that mattered for *everyone*. Therefore, the eco-development was constructed as *a collective vision and a common future*. The eco-development carried the mission to realize such a common cause that held a higher standard than existing urban changes (certainly within and perhaps even beyond China). And this common cause was meant to be *just* since it was envisioned for the wellbeing of all. The conception and branding of an eco-development had indeed

become effective justification for carrying out such a project by *mobilizing and concentrating resources from beyond its territory*.

The just and inclusive rhetoric made stakeholders—especially those waiting to catch up with the more developed world—willing to sacrifice for the development. As one original, long-standing resident stated, "We finally have confidence foreseeing this prosperous future that the city is building and bringing us into." Another citizen of Zhengzhou asserted, "We have all benefited from Zhengdong's development." A migrant worker and taxi driver commented, "Zhengdong's cityscape today is as beautiful as that of a global city in a foreign country," adding that "Zhengdong attracts people and hence gives people like me a job to do." One low-income resident who was receiving social welfare subsidies suggested, "I am not sure how this whole development happened but I like the parks and come here every day," adding that "my government-subsidized housing is good enough for my old mother and myself to have a comfortable life." Similarly in Tangshan, many residents had expressed a positive impression of Nanhu's development. One resident argued, "Nanhu is so popular that it has become the city's pride and most people would visit it every now and then if not every day." Another stated with affirmation, "The city has turned junk into treasure, and Tangshan finally has its own beautiful attraction." A local resident remarked, "Tangshan is finally known to the world for something not traumatic but beautiful and magnificent." When asked about demolition and relocation to make way for a large development, many original, long-standing residents and local citizens felt it was worthwhile to make such transformations happen. These development-supporters believed that such an eco-development would create massive, enduring amenities that would be open to the public and hence benefit everyone. They added that sacrifice would be inevitable and that China's development had always occurred at the cost of replacing the old with something new but better. One villager in Zhengzhou asserted, "This is how things are done in China and we are just waiting for our time to be urbanized and to catch up with those included in China's contemporary development." One villager near Nanhu argued, "We had to move since the government ordered so but Nanhu today is definitely better than what it was." To the relocated residents, governmental compensation was crucial for continuing their livelihoods elsewhere. However, one villager in Zhengzhou suggested that the compensation for the former rural farmers was such a big and sudden fortune that many villagers squandered the money and failed to develop new urban livelihoods. Some even developed gambling and drinking problems. The villager argued, "These poor farmers had never seen so much money that they did not know how to use them wisely and therefore many had developed behavioral and psychological problems." Nevertheless, to development-supporters (including the residents included in these projects' territories), the eco-development had *narrowed the wealth gap* between the top-tier cities and a geographically or socioeconomically disadvantaged city like Zhengzhou or Tangshan. To them, *development* remained the key force of societal progress, especially when achieved through *a promising combination of economic and environmental improvement*.

According to both the conception/branding rhetoric and development supporters' reasoning, these eco-developments were carriers of a common cause that was *resilient/enduring, inclusive/public, and service-oriented*. First, these eco-developments were envisioned, and believed to be able to, engender and withstand cultural, political, or technological change. Second, by announcing a future-oriented vision through initiating an eco-development, the state invited the society to believe what the government believed, and, more importantly, to even contribute to the state-crafted common cause. The whole-society-included rhetoric made everyone feel like they could benefit from the development and thus be willing to sacrifice for it. Third, moved by such inclusive rhetoric, citizens unconsciously became both benefactors and contributors, especially considering that the eco-

development would create massive, lasting spaces that would serve all people in the city or region. In such rhetoric, the public became the primary benefactor and the state was investing in the public. The state-society alignment of belief and ambition in the common cause underlying the new development initiative had facilitated, and provided momentum for, the implementation of an eco-development that was planned to engender tremendous socioeconomic, environmental, and cultural transformations. Despite the forceful, wholesale demolition that had been widely understated, these eco-developments were largely carried out with high-profile propaganda to promote sentiments of *collectivism and progress* in the district and to raise the socioeconomic and political profile of its broader jurisdictional regions, including the municipality and province. With state legitimacy secured in the particular territory of a special development zone, an eco-development had become a *mobilization project* that spurred continued capital investment, physical transformation, economic restructuring, and social engineering. However, the eco-rhetoric, the significant investments in constructing ecosystems and green infrastructure, and the state's input in environmental planning and management had seeded ecological ethics in both urban practice and policy making. *Green politics* and *eco-environmental professional networks* had emerged at the district level, spilling over horizontally to other jurisdictions and other governmental divisions and vertically across administrative levels through *institutional learning and expert networks*. These "successful" eco-developments had become demonstration projects of lessons learned through trial and error in these special eco-development zones. And their key actors had become experienced experts, activists, and influencers who disseminate eco-environmental practice, policy, and ethics.

What is worth noting is that local officials and practitioners, as well as media, have commonly emphasized China's "bottom-up" perspectives. They suggested that people voluntarily chose to visit and move to these eco-development, which reflected that the public valued ecology, even when nature was manmade. By "voting with their feet," people have turned eco-development zones into the places where middle classes and skilled workers live, visit, play, enjoy leisure activities, study, and shop. The ecological public spaces have encouraged civic activities at the local level. People's "voting with their feet" is a key indicator in practice for assessing the success of an eco-development. As a local official in Zhengdong suggested: "Whether people are willing to live and work in the eco-development is our key concern, since only *people* can support businesses, fuel urban growth, and make a city vibrant." Several designers and officials suggested that ecology served this goal by enhancing the quality of life and hence attracting people. The popularity of an eco-development among homebuyers, businesses, and enterprises is also an indicator for political achievements at the local level. The ecological spaces in the eco-developments have been used by a variety of social groups, including middle-class citizens, visitors engaging in leisure activities, musicians, resettled residents, affordable housing residents, service sector workers, employees of new businesses, members of grassroots civic groups, and families with seniors and children. They are widely perceived as civic centers. They are also venues and demonstration sites for public leisure activities, cultural events, and governmental propaganda.

To politicians and practitioners, the gathering of citizens in the ecological spaces and the rapid increase of housing prices and housing sales have become the real branding of an eco-development. Such changes indicate where economic power is agglomerating, along with rising governmental power and increasing human capital. Therefore, greening the built environment is a placemaking strategy and a city branding tool with intertwined social and political impact. This approach reshapes the geography of power and resources. Eco-developments also create new public domains in China where human capital concentration and social capital accumulation occur. In contrast with privatized gated areas that proliferate in Chinese cities today, these ecologically appealing, publicly popular

places have become symbols of social and political harmony, evoking a sense of collectivity and reinforces state legitimacy in today's largely privatized Chinese cities.

China's development policy has a place-based nature. Eco-developments aim to construct a new future and make it visible to the rest of the society. They are place-based demonstration projects. Each place offers a specific social, political, and economic context to test new ideas. The purpose of establishing these testing grounds is to enable institutional and societal learning and foster cultural and ideological transformations. Experimenting with new ideas is an important Chinese approach to improving development and introducing innovative policies. Developmental experiments are learning experiences and the goal is to improve on existing approaches. Therefore, while the processes of eco-development facilitate institutional leaning and cultural shift, these places—once constructed and if attracting people—serve as physical and cultural constructs that reshape economic geographies, social relations, political powers, and norms in space production. These eco-developments indicate where political, economic, and social influences are in China's changing urban landscapes. They represent a typical, and still important, way for the Chinese state to impose social, political, and cultural influences on the society: to control economic and social changes through curating transformations of the built and natural environments.

Progress from the Earliest Model Eco-Cities to Locally Conceived Eco-Developments

China's most well-known, high-profile eco-developments were mostly conceived and constructed during its era of peak urbanization. During those years, the state was actively urbanizing both rural land and rural population to fuel industrialization, real estate development, and infrastructural modernization. It also exercised population control in concomitant with spatial interventions. These conventional strategies for land and population urbanization have led to a higher urbanization rate of land than that of population, exacerbating urban-rural inequalities and spatial unevenness of development. China's conventional approaches to urbanization have remained evident in eco-developments, for the implementation of these projects still heavily relied on land-based local financing. Therefore, path dependency in the political economy of development has greatly constrained innovation in eco-developments. The earliest model eco-cities examined in this study exemplify early pro-environmental explorations. These attempts not only followed the land-centric urbanization strategies uncritically but also sought to impose extra state control over developmental processes by establishing deterministic indicator systems with rigid thresholds. Their reductionist, technocratic approach to being "eco" is utopian in nature and has not generated significant impact on innovating practice in these places. Nevertheless, the earliest model eco-cities—initially designated as national special development zones—heralded continued attempts at greening urbanization across China.

Zhengdong and Nanhu exemplify the promoted successful eco-developments initiated by transitioning Chinese cities. Although limited by China's conventional urbanization approach, these developments are considered outstanding in five aspects: First, these projects each adopted a holistic plan, the components of which were connected by ecological systems. The integration of new ecologies and public infrastructure was unconventional at its time, signaling the emergence of green infrastructure systems in China's urbanization. Second, these developments began with state-invested, resource-intensive urban greening projects—the construction of grand parks and new ecosystems. These new ecologies served as public infrastructure and recreational amenities for all. Local state's willingness to invest tremendous resources and effort into long-term, public benefits

was unconventional, or even unprecedented, during the era of rapid real estate boom. These projects showcase the local state's earliest attempts at integrating environmental engineering into spatial, economic, and social interventions. Third, city beautification through urban greening was carried out at an ecologically significant scale in these places. The ecological components of these developments have reportedly enhanced biodiversity, improved microclimate, and made the benefits of ecosystem services tangible to citizens. The appealing environment and an ecological reputation of the development has enhanced land value and attracted investment. This outcome seems to promise a reciprocal relationship between economic success and environmental wellbeing, evoking the imagination of new possibilities and hopeful directions to improve urbanization. Fourth, the green visions of these places have inspired unconventional economic agendas. The concentration of resource input and public investment on massive, service-oriented green amenities was rare at its time. Their construction has led to new ways of financing these state-led capital projects. Local states also attempted at deindustrializing the economy by promoting cleaner industries as the new economic engine. The green spaces and beautiful landscapes have become signifiers of a good quality of life, helping to attract skilled workers and businesses and ensuring human capital for economic growth. Local governments also established new agencies for urban greening and for maintaining new ecologies. They explored new ways to finance development to expand their green approaches. Fifth, the initial success of the ecological components has led to continued exploration of green urbanization strategies. Local governments continued to experiment with pro-environmental technologies and techniques in construction and public infrastructure, such as green transportation products, energy-saving technologies, and used ecological science for pollution mitigation. The partial implementation of an ecological design and a green economy has led to renewed policies for subsequent phases of development. Green spaces continue being a tool that drives up land value and fuels real estate development, although developers are now asked to support the green vision by building environmental amenities for the public and contributing to social life improvement. Therefore, new ecologies and a perceived enhancement of environmental quality have become new and valuable assets for the city, which the government could leverage to increased private investment in building more green spaces and other decarbonization projects. Nevertheless, these projects have the same oversight as other conventional urbanization projects, where the state discriminates against rural and low-skilled populations at large, despite the inclusion and gentrification of original, long-standing residents.

Limitations of Growth-Oriented Experimentation of Eco-Development

One key feature of China's land politics was to convert low-value, agriculture-based rural use to high-value, industrialized urban use. China's earliest eco-developments were carried out with similar processes of the conventional expansion-focused, rural-to-urban land conversion projects. This had fundamentally set the premier and implicit goal of eco-developments during a phase of continued growth and urban expansion. During this particular pro-growth era, the environment, including rural land and natural resources, was largely exploited for capital-driven economic growth. Nevertheless, the development authorities of Zhengdong and Nanhu argued that in these cases local governments had invested tremendous resources in building a greener infrastructure of the city in a holistic way, which would also provide combined economic, environmental, and social benefits. These development authorities considered such an approach to be highly unconventional at a time when the most common and cost-effective approach to development was to convert rural land directly for real estate development. These development authorities were also proud of the Chinese government's capability to concentrate regional resources and mobilize cross-jurisdictional

cooperation to carry out regional initiatives. Such regional initiatives could potentially lead to eco-environmental improvement at scale. According to such views, evaluating these eco-developments from the bright side, despite the limited environmentalist approach and the partial success, the government had started to claim environmental responsibility to create new ecologies and promote ecological ethics. The state's investment in building healthier ecosystems and commitment to protecting and maintaining the environment in the process of urbanization was regarded as very progressive at a time—and even unnecessary to some officials—when land value increase was of paramount importance in China's urban transitions. After all, China remained at a phase of capitalist urban growth, when the demand for resource appropriation and exploitation was entrenched in the country's land law and development policy. Such a view on nature as an extractable resource had largely limited China's nascent environmentalist approach.

China's earliest eco-developments have also heavily emphasized top-down planning and physical design, at least during their initial conception. The focus on city beautification as a tool for political propaganda has undermined the importance of science and professional expertise in addressing environmental problems. The state's strong intervention in social engineering has also led to the oversight of the importance of civic engagement in scaling up eco-environmental initiatives. As a result, China's earliest eco-developments have largely been static icons that carry eco-utopian ideas. Their impact has been mainly ideological and cultural. Nevertheless, China's transitions towards sustainable development remain an ongoing, open-ended process of experimentation, reflection, learning, and recalibration. The limitations of earlier eco-developments have proven the necessity to carry out more systemic reforms in order to enable more genuine green transitions towards decarbonization, environmental protection, and climate adaptation.

This chapter has revealed that China's eco-developments have inspired local officials and practitioners to change their "business as usual" in facilitating green transitions in urbanization. By adopting various ecological designs and green technologies in these projects, the Chinese state has explored new ways to alter conventional urbanization approaches. While China's typical urbanization greatly focused on territorial expansion and GDP growth, these eco-developments showcase China's emerging attempts at engineering physical, social, and environmental transformations in tandem. China's earliest model eco-cities have shown that in China's place-based developmental regime, if there is no synergy between the economy and the environment, an eco-development will be difficult to sustain. Where political power or political attention is allocated determines where public resources are invested and where natural resources are extracted. Since the state is responsible for urban commons, China's existing types of eco-development must be built in places with strong economy to enhance the synergy between economic growth and environmental protection. In a growth-centered regime, space-bound eco-development is subject to incorporate place-based rationale and typically appropriates the environment to facilitate green economic transitions. And the social development strategies remain competition-centered and migration-based, which is not environmentally sustainable and can jeopardize the economy at a scale broader than the place.

China's eco-development so far have largely prioritized economic goals and mainly privileged affluent citizens and a selected portion of rural landowners. China's eco-environmental initiatives during its era of peak urbanization largely relied on industrial upgrading towards a greener economy as well as the concomitant re-engineering of the built environment. Such initiatives require huge public and private capital investment. They are resource-draining and are greatly constrained by a growth-oriented development regime. Therefore, these privileged eco-developments should be

viewed only as experimental and demonstration projects rather than optimal model developments that were to be replicated elsewhere. The eco-environmental rationality of these projects has reflected the rationale of ecological modernization by trying to find synergies between economic development and environmental protection. As discussed in Chapter Two, such rationales tend to support environmentalist projects that are fundamentally constrained by the capitalist systems and are hence largely ineffective in addressing broader climate and environmental risks. These eco-developments alone, especially with their partial, piecemeal achievements, are far from being sufficient for mitigating environmental degradation or for preparing for environmental risks. Nevertheless, these projects exemplify China's most promoted approaches to greening its development during its course of urbanization so far. Such approaches continue generating impact as these places continue their development and as their builders continue their reflection and experimentation. Depicted by China's slogan "let the bullets fly," more eco-developments have been proposed across China and their formats have begun diversifying. The next chapter further discusses the meaning of China's evolving eco-developments.

Images:

Figure 1. Key Principles of Eco-Development

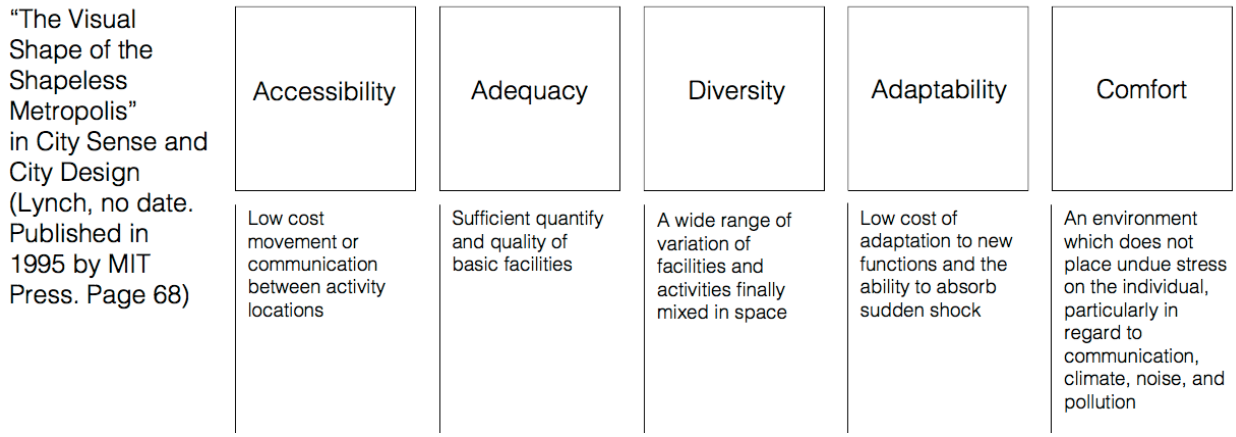

Figure 2. Performance characteristics in "The Visual Shape of the Shapeless Metropolis" in *City Sense and City Design* (Lynch, no date. Published in 1995 by MIT Press. Page 68)

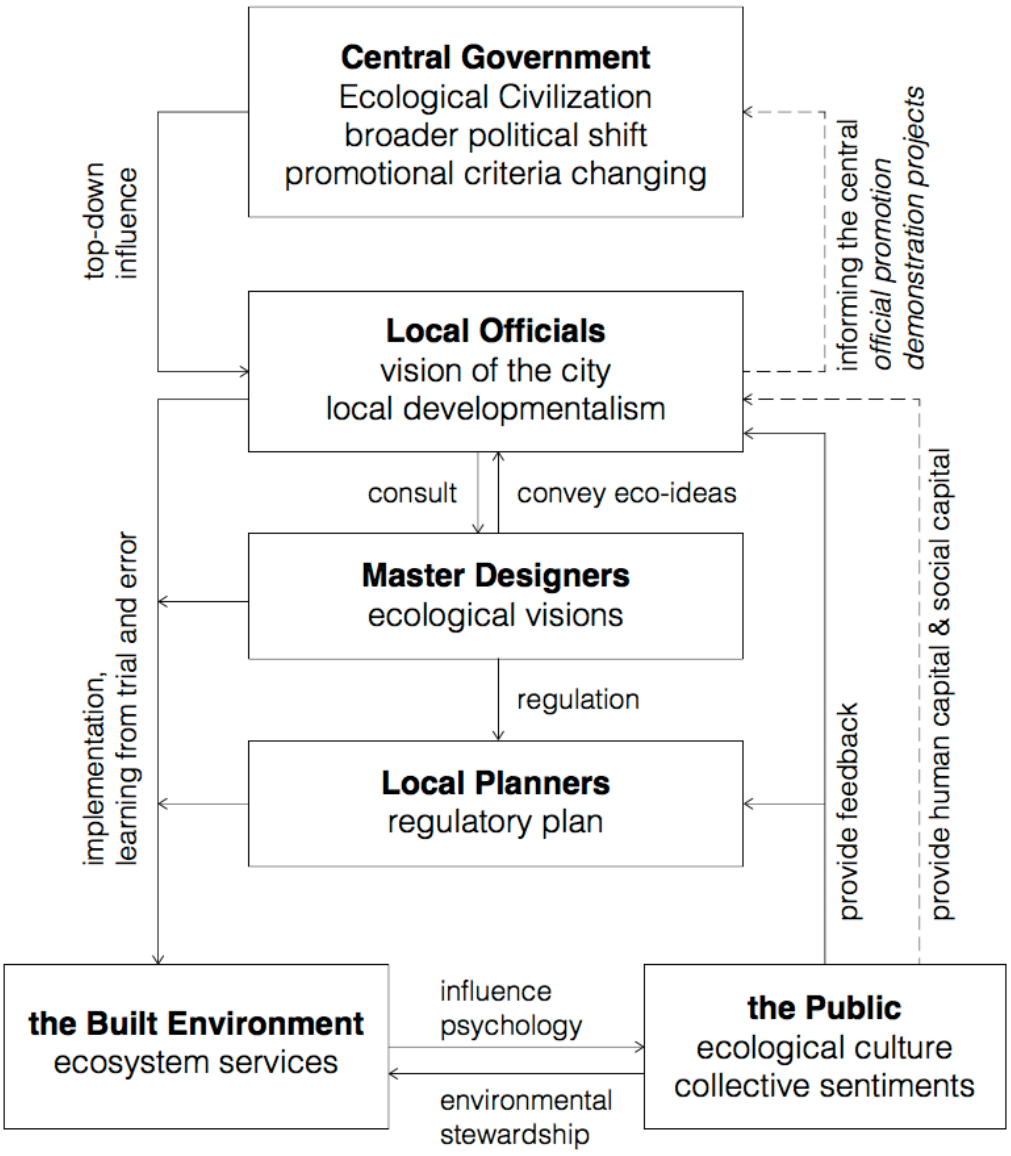

Figure 2. Institutional Learning through an Eco-Development

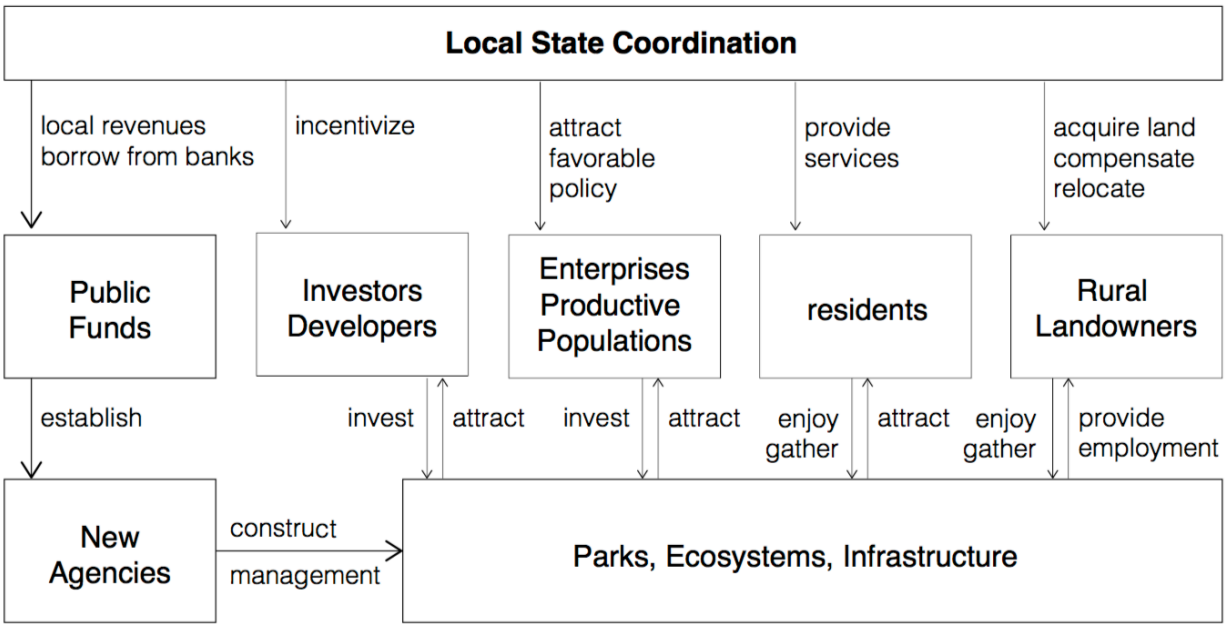

Figure 3. State Coordination in an Eco-Development

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Chapter Seven. Continuing Eco-Experimentation: Seeding Environmentalism in China

While China's experimentation of eco-developments so far has largely been constrained by a phase of growth-oriented urbanization, the continuation and upscaling of attempts at greening urbanization has achieved partial successes. Drawing on experts' reflections and popular discourse, the chapter assesses the achievements of the perceived successes of eco-development in China and discusses what it means to be "eco" in the context of China's urbanization. This chapter argues that China's limited success in its demonstration projects has been enabling by generating momentum for broader, more systemic, and more fundamental changes of developmental rationality. Local trial and error has prepared China's political and professional communities for emerging environmentalism in the next phase of urbanization.

This chapter presents additional evidence that complements development histories and debates presented by the foregoing chapters. The goal of this chapter is to present broader, more nuanced perspectives on what eco-developments mean in China, and more importantly, how existing eco-developments have influenced China's key decision-makers of urbanization and its citizens. As mentioned in Chapter Six, many China's eco-city builders were reluctant to agree with critical perspectives held by Western scholars and media. Many prestigious scholars, experienced practitioners, and powerful officials commonly rejected the highly critical voices as "simplistic" perspectives from "outsiders" who had limited understandings of what was actually happening "on the ground" in China. Some argued that foreign experts might have new, and often innovative, ideas for building ecological and green cities, yet without the capacity to navigate governmental, organizational, and interpersonal politics within China, foreign players would not generate any direct impact on the society and their ideas would remain utopian or even naïve. Acknowledging such sociopolitical barriers to transnational practices and perceiving the contrasting views from beyond and within China, I have become more curious about physical, social, and institutional changes overtime within China's eco-developments, as well as the self-reflections and self-assessments from Chinese experts, politicians, and residents of various socioeconomic backgrounds who have participated in or witnessed the transformations of one or more eco-developments. Accordingly, to understand the perspectives from key stakeholders of China's eco-developments, I carried out semi-structured interviews through a snowball sampling process:

> a) planners and officials who were in charge of the conception of China's earliest eco-cities;
> b) chief planners, designers, engineers, and officials who have experimented with other forms of eco-development in China;
> c) scholars who are knowledgeable about China's political economy, the evolution of China's planning and design practices, and China's urbanization history and policy;
> d) local officials who have been directly involved in realizing ecological, green ideas of urbanization; and
> e) visitors, workers, and residents (both aboriginal villagers and new homeowners) in an eco-development who have personal experiences in these places.

The interviewed elite informants included some of China's very accomplished practitioners and scholars who are still actively participating in China's high-profile eco-developments, including Xiongan New Area. In order to protect the elites' identity so that they could feel comfortable speaking about political issues, the interviewees preferred to stay anonymous in the research. To identify key decision-makers of the selected projects for study, I first visited local archives, reviewed

literature on the development histories of selected cases, interviewed well-known scholars, designers, and planners, and tapped into their knowledge and networks to establish contacts with key informants. These key decision-makers mainly included powerful local officials, governmental rank-and-file employees who directly executed specific policies and plans, as well as developers, state-owned enterprises, and environmental management companies who were commissioned by the government to implement parts of the eco-development. I not only carried out in-depth interviews with these informants, I also joined some of their work meetings with their approval to observe how decisions are negotiated and made in specific multi-stakeholder conversations. In addition, these key contacts introduced other informants whom they considered important to speak to. Through such a snowballing process, I was introduced to not only informants who have played important roles in the selected projects, but also other officials, policymakers, and design and planning practitioners who participated in the selected projects, who continued experimenting with eco-development beyond the selected cases, and who are knowledgeable about the evolution of China's various eco-developments more broadly. The additional perspectives from these experts increase the saturation of information. Collectively, these voices represent a salient sentiment among visionary experts who are forward-looking and hopeful in their practices. They continue pushing for and shaping green, ecological transformations in China, although largely encouraged by the direction of national politics. Their practices and their visions, often embodying both political aspirations of the government and scientific knowledge from their expertise, influence public discourse and specific policy directions. Their influences are further supported by interviews with citizens, most of whom have adopted the ecological discourse. Even when some individuals expressed skepticism about how genuine the studied eco-development has been, they admitted that these developers are at least partially "greener" than a typical development in China.

The saturation of sentiments among various types of informants sheds light on the importance of persuasion in mobilizing reform in the Chinese society. Such persuasion is imbued with optimism and has been largely facilitated by state-dominated propaganda and eco-development builders' aspirations. The saturation of and universal adoption of discourse also reflects why the selected projects, despite their limited eco-environmental achievements, are still highly promoted by the government and some experts. These projects, by making eco-environmental effort more tangible and personable to citizens, serve as a demonstration validating the state's vision of an "ecological civilization." They support state legitimacy and contribute to the formation of a green political ideology. Viewing from this perspective, the question about the eco-environmental achievements in the selected projects has become less relevant to the Chinese society than the question about their cultural influences. A more important meaning of China's experimentation with eco-development so far has become, perhaps unintendedly, to construct cultural artifacts as tools for propagating ecological values that would nurture environmentalist practices, green ideologies, and green politics. Such transformations set the foundation for continued explorations on eco-environmental policy and practice in China's next phase of urbanization when the importance of economic growth is gradually surpassed by the urgency to tackle compounding environmental and social challenges.

The following sections discuss the meaning of partial success in China's eco-experimentation, present lessons learned by eco-development builders, and reflect on what being "eco" means to China and what eco-experimentation means to China's future urbanization.

What are the Benefits of Attempts at or Partial Success of Eco-Development?

China's continued experimentation of eco-developments has gradually seeded and nurtured China's own "environmentalist" approaches to the country's contemporary urban practice. While practitioners who have participated in eco-developments expressed such a perspective, rising environmentalism has become a broader trend evident in both China's popular discourse and in its overarching policy reform. These practitioners argued that the limited progress that China's eco-developments had achieved must be examined against the backdrop of, and be largely attributed to, the fact that the country was still undergoing its era of peak urbanization and concomitant housing boom. Despite the tremendous growth ambition and the top priority of economic development at that time, China's exploration of eco-environmental practices has provided meaningful inspirations that kindled environmentalist practice and ecological ethics. Approaches to eco-environmental practices aiming at environmental sustainability and climate change adaptation continue diversifying and being replicated across China, shaping and reshaping expert networks, city politics, and the political economy of development in local societies. Although the experimental processes have often occurred within the centrally or locally designated ecological development zones, ecological and pro-environmental rhetoric, technologies, and principles have become popularized in local societies and among professional networks. The key actors participating in these eco-developments argued that approaches to ecological design and environmental planning had become well-recognized and even assumed as a default feature in more recent developments. Although building a holistically planned eco-city from scratch has been increasingly frowned upon and is less likely to happen in the future due to China's land policy reform, China's eco-development participants argued that piecemeal explorations at the urban scale within existing built areas continued flourishing. It has been common that new development would incorporate some "green" components, such as constructed ecosystems, green infrastructure, low-carbon transportation, low-carbon neighborhoods, pollution mitigation, environmental treatment, waste management, and renewable energy utilization. In this way, the popularization of eco-developments and pro-environmental norms has reduced local tendencies to sidestep the oversight of environmental damage during urbanization.

Some prestigious planners and officials argued that China's local experimentation of eco-developments had been an important component pushing for a broader pro-environmental political shift. The partial achievements of eco-development at the local scale have collectively engendered a broader normative shift in development practice and policy making, informing researchers, academicians, and policymakers at the top of China's political system. As environmentalist practices, norms, and politics continue spreading across the country, China has exhibited its resolution to formalize sustainable development strategies through a series of state-led initiatives. While the centrally established "first generation" of eco- and low-carbon cities represent the state's short-lived attempts at standardization on a massive scale, locally conceived eco-developments with environmental restoration and decarbonization strategies feature trial and error in implementation. During China's legendary era of urbanization, the central government has promoted formalization, standardization, rationalization, and proceduralization of its development policies. The stagnancy of the earliest generation eco-cities has proven the ineffectiveness and irrationality of such deterministic approaches of superimposing abstract plans onto complex built environment while applying rigid indicator systems to dynamic development processes. Even more recent, more specialized standardization attempts such as the Sponge City initiative have led to inapplicability in many cities since the centralized standards have disregarded local conditions and hence have been impractical. Accounting for all the flaws of China's environmentalist explorations so far, experienced planners, designers, and public administrators believed that making mistakes was inevitable during China's speeded phase of catching up and had greatly enabled learning by doing. As one official asserted, "This is how we learn: we are eager to try and willing to learn." Despite the failed standardization

initiatives during China's environmentalist explorations, successful local practices plus central attempts at the formalization of eco-approaches have provided tangible proofs and an ideological push for mobilizing the public to support eco-environmental initiatives. As local governments have increasingly shifted their attention from building new areas to managing existing areas, the newest environmentalist initiatives greatly emphasize environmental governance and public participation. These examples include regional initiatives such as the Yellow River Ecological Restoration project and local initiatives such as various neighborhood-based waste management projects. Although environmentalist practice and institutional reform remain incipient, experienced experts observed that China's practitioners and officials had become ideologically caught up with the world in terms of ecological and environmental awareness. Some asserted that China had gradually shifted towards being a global leader in pro-environmental urbanization, green technologies, and sustainable development.

Some environmental practitioners who played key roles in several eco-developments including Xiongan's planning and design argued that China's eco-development experimentation exemplified China's unique "bottom-up politics" through which trial and error in local practices had informed high-level researchers and policymakers and hence generated upward influences upon China's macro strategic plans and developmental policies. China's political system features decentralization and fragmented authoritarianism (Lieberthal & Lampton, 2018). Despite its widely known strong central government, the center relies on provinces and cities to utilize their knowledge of local conditions and implement overarching policies. Scholars of Chinese politics and social policy have widely discussed the central-local mismatch or even conflict of priorities of governmental agendas (Huang, 1996; Li, 2010; Wong, 1991; Zheng, 2007). In such decentralized processes of policy implementation, local governments play a significant role in resource mobilization and coordinating efforts among local actors. Therefore, the characteristics of an eco-development have largely been shaped by local governments, together with other key players working closely with the government. The development outcomes, including physical, environmental, social, and economic transformations, often serve as tangible proof of officials' and experts' accomplishments. These key actors would advocate their partial success in eco-development experimentation, share experiences, and educate their peers and superiors through media exposure, conference presentations, and professional promotion. In turn, these key actors and key projects have led to institutional learning and further experimentation of eco-developments in practice. A scholar working as a policy consultant for the central government suggested that China's spatial strategies, or geopolitical plans, were typically proposed by geographers to the central government and then imposed to local levels through top-down processes. However, he argued that urban practitioners could be more influential at the local level, remarking: "Planning practices are more likely to directly influence provincial and municipal leaders and other key decision-makers." Local plans and practices are typically turned into specialized research reports about urban-scale innovation, such as ecological design, planning for disadvantaged populations, and low-carbon transportation systems. Some local officials and practitioners of experimental projects suggested that well-recognized, "successful" projects could provide detailed and practical ideas at the micro scale, which would then influence macro policy decisions when local practitioners and officials managed to inform upper-level experts and officials through upward advocacy and education. Such processes have been crucial for enabling institutional learning within China's political and professional networks.

Nevertheless, it is worth noting that such "bottom-up," practice-to-policy influences have remained largely state-centric and elite-driven and hence been constrained by bureaucracies and ideologies within the authoritarian regime. The latter could confine creative thinking, forbid freedom of

expression, and, therefore, stifle innovative reform (including more genuine eco-environmental practices). This concern was expressed by many of the earliest eco-development explorers, who experienced frustrations due to political, institutional, and ideological resistance when promoting more progressive ideas in their day-to-day practice. Considering eco-development as an attempt at innovating urbanization for sustainable development, they argued that making innovative changes would require a common mindset among development participants that was open to newness and difference, as well as the appreciation of the diversity of thoughts and ideas during the development process. While many argued that China's most educated elites possessed such qualities, explorers of China's eco-developments suggested that local practitioners and officials remained ideologically too "old-fashioned," "uninformed," and largely confined by locally preexisting experiences and know-how. Such limitations had led to ignorance towards the value of new ideas and uncritical perspectives towards China's rapid urbanization, turning a blind eye towards social and environmental costs. As one internationally trained, renowned scholar and planner argued that the confinement of mindsets, ideologies, and cultures, especially within stated-dominated institutions, would prevent China's environmental practitioners from exploring new territories of knowledge and expertise and hinder sustainable development initiatives, or any innovative change at a structurally fundamental level.

Experts' Reflections on Lessons Learned and Ways to Improve Future Eco-Development

In the reflections from China's eco-development experts, or the active practitioners of existing eco-developments, they highlighted some emerging trends of improvement in their day-to-day practices. They believed that these improvements were partially built upon lessons learned from earlier experimentation of eco-developments, and partially encouraged by the broader ecological and pro-environmental turn in China's central urban agendas. New design and planning approaches, new development and management processes, and new professional relations had been emulated in subsequent projects to replicate an ecological quality of the development. Despite the limitations of the existing experimentation, earlier eco-developments, especially those acknowledged as successful practices and paradigms, had expanded their influences and facilitated a broadening discourse about eco-environmental ethics in city making and urbanization.

First of all, from the earliest eco-cities to various local experimentation of eco-developments, the experts saw increasing reliance on scientific approaches to geographic and environmental research to guide design and development decisions so as to reduce environmental impact and protect ecologically sensitive zones. Accordingly, there had been growing trust in and respect for expertise in ecological and environmental science concomitant with rising eco-environmental ethics in development practice. One experienced environmental planner who had participated in a range of key eco-developments across China recalled that in the past environmental analysis was typically used and even manipulated to justify pre-determined design decisions. She explained:

> Typically, design decisions were purely based on spatial and aesthetic considerations of the physical form. So the job of environmental scientists and environmental planners was to come up with a series of environmental analyses to support spatial and formal schemes generated by architects and planners who were in charge of physical design. Therefore, our previous role was less scientifically genuine but more politically ancillary.

Several environmental planners suggested that the conventional professional relations and power dynamics had begun changing within the environmental and urban sectors. One environmental planner in Shenzhen spoke hopefully:

> Based on both lessons learned from local eco-environmental projects and top-down promotion of ecological approaches, we are now using scientific environmental analysis to constrain, and set parameters for, urban development. The protection of ecosystems and the environment is now a precondition for urban development.

These environmental planners expressed optimism for the reason that eco-environmental planning had received much more respect and political acknowledgment. One stated, "We [environmental planners] are very pleased and feel encouraged by the new policy emphasis on the principle of 'ecology first.'"

Other experienced planners and designers also concurred that environmentally responsible research had increasingly become a tool for improving design and development decisions. One prestigious planner who worked with both domestic and international experts and officials on Caofeidian Eco-City recalled:

> When China started building these eco-cities, no one knew how this should be done. We visited best practices of eco-districts in Europe and learned from the West blindly. We scaled up their schemes and directly mapped them onto our massive and vacant land.

He suggested that back then, the rapid speed of project implementation was very important since prolonged construction could lead to extra cost for developers and land policy mandated a quick start of construction after land auction. As a result, the development processes were always highly rushed, greatly compromising the quality of design and planning considerations. In that case, the easiest way to develop would be to follow practical conventions in order to ensure practical feasibility and reduce risks. He reflected on his practice in Caofeidian and argued that despite their initial good intention to learn from best practices and internationally famous ideas, the earliest eco-cities were massive projects of trial and error. Nevertheless, he spoke positively about his experience, stating:

> China's eco-cities have incubated innovation. Thanks to these experiences, we have learned a lot from abroad. China's eco-city experiments educated a whole generation of practitioners and officials about how our practices could be different and better. Such experiences have brought new inspirations to us, expanded our imagination, and enriched our expertise.

These precursors of China's eco-experimentation in urbanization believed that even failed eco-developments had reshaped ecological value in the development-oriented mindsets of professionals and officials. Nature, including constructed nature, had increasingly been regarded as resources. Eco-development had become an important means to reshape environmental and economic geographies. It has also become a means to promote more responsible urbanization while reducing regional variation in development levels. However, while development by areas had been conceived as an incremental strategy to lift most parts of China out of poverty since Deng Xiaoping's promotion of development, such a piecemeal, territorial, and heavily physically focused approach had led to invisible unevenness in social, economic, and political geographies. Such a hidden imbalance of development could be observed from a closer examination of the successful cases, such as Zhengdong and Nanhu. After all, more development does not necessarily lead to more

evenness in development, and the expanding urbanization of the physical realm could be out of sync with human-centered social and environmental improvement.

The nascent environmentalist approach to urbanization demonstrated by these early eco-developments featured master planning and the characteristics of "eco-modernization" (Andersen & Massa, 2000; Hajer, 1997; Lidskog & Elander, 2012; Mol, 2006; Spaargaren, 2000). China's nascent environmentalist approach largely remained subordinate to an authoritarian regime and was constrained by modernistic design and planning strategies and a widespread growth mindset. The latter normalized economic development and urbanization as a universal political and social agenda. Confronting a backward image of the city, these eco-developments were first and foremost *urban beautification* projects. The project conceivers—especially local officials—were eager to construct an image of their city that would match that of globally famous cities in developed countries in the West or Asia. City image-making, accompanied by economic restructuring attempts at industrial modernization, was a key strategy for catching up with the developed world and raising China's profile on the global stage. Although the focus on beautification was an apparent emphasis of these early eco-developments, designers, planners, engineers, and officials who had been involved in the continued development of these places suggested that a shift from mere beautification to centering ecosystems health and environmental restoration and protection has gradually emerged. As one environmental engineer suggested, "In the past, we worked at the surface level, but now we have been practically figuring out how to embed green infrastructure that performs in these projects to clean the environment and sustain the ecosystems." A local development official recalled with frustration, "A more senior official used to tell me that if a place started to look green then our eco-development had been realized," adding that "but we have genuinely been looking for ways to make our new ecosystems perform well to increase biodiversity, clean the environment, and support social life." These key decision-makers and design professionals commonly claimed that they had put hard work into nudging the development towards more genuinely green transformations by advocating for sub-projects that integrated eco-approaches such as afforestation, pollution mitigation, environmental restoration, green infrastructure, low-impact development, nature-based solutions, and low-carbon transportation. Although most of them acknowledge the piecemeal achievements so far and the lack of a systematic, coordinated implementation across different parts of the development, they believed that the relatively complete realization of the core of the eco-development had set a paradigm that allowed them to use such visible effects to continue advocating for continued extension and expansion of nascent improvements in these places.

These former and active eco-development participants and key decision-makers—including designers, planners, engineers, and officials—had become a new generation of China's environmental practitioners who were eco-environmentally more responsible. They displayed a higher sense of responsibility towards the environment and sought to imbue ecological ethics in their practice. Despite the fact that many experience frustration when promoting eco-environmental ideas for and approaches to development, they had been actively promoting ecological value and a sense of responsibility towards the environment among the public sector and urban practitioners. Their practice of and reflection on eco-development had granted them knowledge and experience on both how to carry out ecological design and environmental planning and how to navigate local political economy to realize eco-development agendas. The actualization of the development outcome, especially the completion of an aesthetic built environment, was further branded as a success to attract homebuyers, businesses, and investors. In this way, an appealing built environment became a tool for spurring economic growth, a proof of the local government's accomplishments, and a demonstration of these environmental practitioners' authority in their expertise. Moreover, the

development processes of these projects gradually established and reified power structures in these places, especially empowering their key designers and key officials. The ecosystem services offered by the ecological components of these places, although largely manmade, continued increasing the popularity of eco-development, demonstrating the environmental benefits of ecological design and legitimizing environmentalist approaches. Debates about the genuineness of the eco-environmental approaches to these eco-developments also surged along with the promotion of these high-profile projects, which in turn raised environmental awareness in practice, furthered the dissemination of environmentalist norms, and deepened the understanding of the city-environmental relationship among China's environmental practitioners.

Transborder Appropriation: from "Learning from Abroad" to "Inventing Chinese Approaches"

Some eco-development practitioners suggested that China had gone through a phase of active learning from the West and now been moving towards replicating its own eco-development models both within and beyond China. The early phase of learning from the West, although blindly at the start, saw the rise of a generation of environmental practitioners—including technical experts, officials, and educators—who were eager to explore lessons across the world so that China, as an emerging market largely under development, could catch up with the developed world, especially countries in North America and Europe. To them, foreign paradigms of urban development provide alternatives to their imagination and serve as lenses into different societies, cultures, and politics in other parts of the world. As one internationally trained urban designer argued:

> The difference between practices in China and in the Western developed countries is less significant than what one might imagine. Their different approaches to design and development are due to different development stages, rather than different political regimes. As China has completed its phase of rapid economic growth and urban expansion, Chinese politicians and practitioners have now begun to prioritize environmental and humanistic considerations in more nuanced ways. During this next phase of more fine-grained urban development and renewal, Western approaches to design, planning, and governance have become much for relevant and valuable to China.

In the earliest experimentation of eco-development, global design and engineering firms and experts had used China as the testing ground. The reflections from China's eco-development builders reveal that China's new generation of environmental practitioners have acquainted themselves with foreign ideas and started their own creation of development outcomes, knowledge, and experience through appropriating foreign approaches in project conception while navigating local politics in project implementation. Through jointly designed eco-developments, Western ideas and approaches to environmental design and planning were introduced to China through transnationally trained chief designers who had practiced in different Eastern and Western countries and developed multicultural and multinational perspectives. They had merged Eastern and Western understandings of the city through their education and practice. The conception and implementation of China's eco-development had granted them the opportunity to reinvent foreign concepts and approaches as China's own products reflecting Chinese ideas, values, and cultures. Through working with these prominent foreign-trained designers, China's politicians had also become more and more informed about foreign design fads, best practices abroad, and global policy and practice trends. Such broadened views on the city allowed Chinese environmental practitioners to become increasingly capable of adopting comparative analysis and global perspectives when conceiving a new

development. Practitioners who had worked in both China and the West could effectively facilitate knowledge transfer and facilitate the transnational appropriation of knowledge and experience. They not only helped Chinese practitioners to learn new things but also educated key actors of eco-development. Their influences on China's development sector were technical, cultural, and ethical. When built, these eco-developments also educated the public through their tangible places and engendered socio-cultural influences. Combining the influences among practitioners and the public, the impact of eco-development experimentation had spread to create broader ideological and normative shifts.

Although some builders of China's eco-developments acknowledged the impact of Western ideas and spoke highly of the inspirations that foreign designers brought through their schematic design and practical precedents, they argued that these places were produced largely by China's own political economy of development. The key decision-makers and chief designers commonly stressed that day-to-day communication, especially the negotiation among various governmental bodies, experts, and stakeholders, was key to realizing an eco-development, or any attempts at changing practice norms in China. Their experience of carrying out the eco-development essentially entailed processes of navigating local politics and mobilizing cooperation through effective communication. Most key actors of the eco-developments recalled that being politically savvy was crucial to realizing new ideas or pushing for unconventional, innovative practices. Increasingly, China had been packaging the knowledge and experience of eco-development as China's own innovation in building greener cities. Such "Chinese approaches" were branded by the appealing images of successful eco-developments and gradually exported to other developing contexts, facilitating the "Global China" transborder initiatives.

A planning professor from Peking University argued that China's contemporary urbanization had been propelled by a generation of internationally trained, globally-minded practitioners, or thought leaders, who possessed cross-cultural understandings and hence were capable of "localizing" foreign concepts. While Chinese governmental officials often preferred to involve international designers, these thought leaders were the major players who ensured the employment of foreign ideas to serve China's own development needs. Another planning professor in Shanghai argued, "The internationally trained planners and designers have acquired comprehensive, broadened understandings of histories, geopolitics, and cultures in foreign countries and therefore play a very important role in China's learning from and catching up with the West." Several other educators concurred that Western theory and practice was inspirational to Chinese practitioners and scholars. One stated with optimism: "By learning from abroad, China has expanded what 'Chinese thinking' means and improved the typical 'Chinese approach' to urban practice." China's planners commonly suggested that China no longer focused on expansion-oriented physical planning, but has shifted its attention to the management of its built environment and its people. This is evident in China's ongoing shifts in planning discourse. China increasingly emphasizes urban renewal and governance in existing urban areas. It has also paid increasing attention to social issues by promoting rural regeneration, reducing urban-rural inequalities, and expanding public participation in urban planning and management. Some planner spoke positively about China's ongoing shifts in urban practice, arguing:

> China's new development approaches are not merely growth-oriented. They have less impact on the environment, emphasizes environmental protection and ecological restoration, and are more human-centered and socially responsible. Therefore, China is making progress towards more sustainable development.

Acknowledging the positive shifts, some other planners and urban designers stressed that it was still important and necessary for Chinese practitioners and officials to learn through earlier sustainability-oriented urbanization projects. One stated,

> All learning has a process and China is progressing. Now, China has risen to be a rival of the United States. It will continue improving, especially considering the newer generations of globally-minded, well-rounded practitioners. China will become a global leader in decarbonization and in fighting climate change.

Human Capital Accumulation through Eco-Development: A Key Component of the Chinese Approach

The participants of China's eco-developments pointed out that the realization of ecological visions of a city, even when achieved partially, had empowered local officials and practitioners with growing environmental awareness, more comprehensive expertise, and professional visibility with growing reputation and brand—all of which have granted them more power to facilitate pro-environmental policy change. China's eco-development participants argued that the Chinese practitioners often acknowledged their limitations in expertise and hence aspired to learn from the world. This desire had enormously opened up possibilities for constructive cross-cultural interactions. They believed that the country and its citizens had psychologically positioned themselves as the underdog on the world stage. Such a mindset had led to a nationalistic eagerness to catch up with the developed world, which encouraged often uncritical openness towards foreign ideas and their bold adoption without sensible considerations of their feasibility in practice or the economic, social, and cultural cost of new explorations. Acknowledge this historical mindset during China's initial phase of modern growth, China's pioneer environmental practitioners argued that China's learning had reach sophistication. Processes of trial and error of eco-development had largely brought effects of human capital accumulation to its professional experts and government officials. Increasing professional and official authorities had developed a global perspective, accompanied with comparative analyses between China's and other countries' societies, cultures, and politics. They had also reinvented foreign ideas and improved on preexisting practical and political institutions to facilitate modernization. As one planner and environmental engineer implementing a local Sponge City initiative asserted, "Trial and error is our best approach to learning." Another urban designer and researcher participating in the development of Xiong'an New Area stated, "China has always carried out experimental development projects like running political campaigns," adding that "if we 'let the bullets fly' by building a lot to allow for trial and error, then some experiment will certainly hit the target." Another planner and educator argued that "China remains behind foreign countries, such as the United States and therefore China has been building new knowledge during its urbanization and industrialization," adding that "China has definitely improved its development strategies and technical know-how." Several officials and practitioners argued that few other countries in the world would have the capacity to concentrate resources and effort to mobilize such widespread, campaign-like explorations. However, some socially-minded practitioners cautioned that China's innovation would always be restrained by its political system. In particular, local explorations had been greatly constrained by top-down politics and processes. In such an authoritarian regime, practical problem-solving must first and foremost fulfill overarching principles and rules set up by top-level policy-makers on a level of abstraction. These overarching policies could be irrelevant to local practice and hence lead to a vertical mismatch of interest and structural barriers to innovative practice in specific places. Moreover, China remained a highly hierarchical society, where authority was established

through age, prominent past experiences, job title, and political networking. Political and professional authorities—two often interlinked and overlapping social networks—had tremendous power to construct knowledge and define norms. Such power could be misused, especially when superior politics overruled local societies, when pre-established expertise rejected new ideas, and when politics overrode science.

Reflections of China's environmental practitioners reveal an important component of China's strategy to rapidly catch up with the West and thrive through globalization: human capital accumulation through capability building among experts and officials. In recent years, such capability building has shifted from being an accidental benefit from rapid modernization to purposeful investments in people. Programs have been set up to send elites abroad and train them with global knowledge, especially elites identified as authorities and leaders in China's professional, educational, and political communities. These elites are expected to contribute to a strategic advantage for China's rise as a global power. Even when they have built a competency in an area, they are expected to rich a new horizon of learning in a higher-level government or in a newer project. Changes in Chinese cities are directly tied to political elites' performance reviews, whereas urban transformations reflect practitioners' capabilities and determine their chances of subsequent projects. In this way, the continued practice has allowed these key actors to stay current given the rapid speed at which cities have been changing in China. They directly and tangibly saw their own performance improve in the formation of urban places, and many were rewarded with promotions and better work opportunities. In turn, key actors of a successful eco-development had commonly expressed a sense of fulfillment and personal growth, as well as increased confidence in their skills and capabilities of innovating development. This suggests that China's accidental and purposeful investments in human capital accumulation among its eco-development actors—whether through hands-on training in local practices or through international training of its political and professional authorities—have enabled a generation of key actors who can adopt new ideas and new skills for the future needs of the nation's growth ambition on the world stage.

Broader Trends of China's Eco-Environmental Attempts

Reflecting on their participation in eco-developments, the environmental practitioners suggested that China's eco-approaches to urban development had evolved over the years and reached a stage of diversification by involving more types of expertise. For example, being eco had become less about urban greening during territorial expansion and more about protecting the environment and maintaining ecosystems health. The central and local governments had increasingly stressed regional eco-environmental initiatives to promote collaborations in areas of environmental restoration, pollution mitigation, and ecosystem protection. Moreover, green approaches had increasingly become an integral component of governance strategies, especially in aspects such as energy saving, waste management, and decarbonization in daily lifestyles. While local practices continued diversifying eco-approaches starting with designated eco-development zones and then scaling these approaches up to other areas, the central government had officially begun China's overarching pro-environmental policy reforms. Since 2014, the national Environmental Protection Bureau has introduced new laws for protecting the quality of soil, water, and air. Polluting companies would hold legal responsibility to clean up the environment. In order to protect the environment in future development, the central government launched an important reform in 2017—called "Multiple Compliance" or *duoguiheyi*—integrating China's planning and design systems with its land and resource management systems. In this way, the formerly fragmented governmental bodies playing

parallel and often conflicting roles in a range of areas—including economic planning, physical planning, land use planning, environmental protection, heritage preservation, natural resources protection, transportation planning, ecosystems management, and industrial planning—would be carried out in tandem and managed through a shared geographic information platform. The goal was to enhance the coordination among different governmental functions, ensure the consistency of the multiple types of planning, optimize spatial layout and resource efficiency, and improve the state's governance capability. One planner contributing to the new platform building argued, "In this way, China's goals, strategies, and realities of various planning would be fully aligned." By promoting "a single blueprint and a single strategic plan" for each municipality, this reform also marked the centralized integration of various planning-related fields within China's political and professional systems. At the same time, the central government also stressed the importance of continued, faithful implementation of the new comprehensive plans at the local level, as well as the necessity to shape such plans through public participation. In order to avoid frequent modification of plans at the local level due to short terms of office, these comprehensive plans would be granted legal validity—an approach evident in Zhengdong's plan implementation.

China's environmental practitioners believed that the ongoing reforms of planning policy and law would ensure further explorations of China's environmentalist approaches to urban development. They believed that China had reached a phase of growth that required a more reciprocal relationship between urban development and environmental protection to sustain its prosperity. Some argued that Western developed countries had gone through a similar path—from industrialization to post-industrial development. The United States—especially the vicissitudes of American cities over the twentieth century and the concomitant theoretical evolution in planning-related fields—was frequently mentioned as an example. An eco-development practitioner and educator observed, "the broader trend of China's urban explorations follows the path of how urbanism evolved in American cities during the twentieth century." This view was echoed by a few other planning and design experts who were educated in the United States. They believed that in recent years, China had been undergoing the expansion and diversification of its views on the urban, which was what happened during the 1950s in the United States. During the second half of the twentieth century, American urban practitioners and scholars had expanded the field of planning from one that focused on modernistic physical planning to diverse subfields such as urban design, landscape urbanism, environmentalism, and participatory planning. The role of planners and designers also shifted from facilitating postwar growth through rational design to promoting the integration of humanistic, social, and environmental considerations into physical and spatial agendas. Such diversification of urbanism-related fields also occurred with the shift from making big plans to working with communities. Although China's environmental practitioners had been learning from the West, many argued that foreign ideas, especially concepts and development approaches that emerged in the United States, were great sources of innovative ideas but not directly applicable to China. Therefore, the adoption of foreign eco-ideas in China would require appropriation and reinvention according to China's own political system and urban agendas. In such processes, the Chinese environmental practitioners had sought to generate their own theories of eco-environmental planning and design, as well as China's own approaches to actualizing eco-development. Through working together on China's eco-developments, including the earliest failures, the Chinese environmental practitioners believed that they had formed a growing intellectual community that involved government officials at the local and regional levels and experts in design, planning, engineering, and environmental science—who were actively participating in the implementation of eco-developments. Despite the aforementioned limitations in China's environmentalist practices, through active participation in processes of trial and error, these environmental practitioners had been spreading internationally

famous ideas and lessons from best practices across their peers and among key policymakers. Hence, such processes ensured that China's environmental practitioners could forge communities that were at least ideologically caught up with the West, which would more likely promote pro-environmental ethics in practice and propel the evolution of more genuine eco-development.

China's environmental practitioners observed that the country's eco-environmental approaches to development had grown tremendously since the early 2000s, building some of the world's largest, most ambitious developments with green infrastructure and decarbonization technologies. Therefore, they argued that China had become a world leader in the experimentation of eco-development. However, these experts also expressed concerns about the confusing state and an uncertain future of China's design and planning field. They commonly pointed out that China was undergoing unclear and messy processes of power redistribution, building new decision-making mechanisms in order to advance ecology-first, pro-environmental urban development agendas. The proposed integration of city development, environmental planning, and resource management systems would engender shifting relationships among different governmental bodies and among various urban and environmental expertise. With less land available for development, local governments' responsibility had gradually shifted from building new urban areas to urban renewal in existing areas. Similarly, policy priorities have shifted from urban growth to urban governance and environmental management. Assessment criteria for development and politicians' performance have begun to deemphasize the quantity of space and capital production and instead give prominence to the quality of the environment and social life. Planners have commonly highlighted that the management and renewal of existing cities involve more and more stakeholders, which makes the next phase of development more complex than the initial phase of rapid urbanization. Instead of erasing rural landscapes and communities, local governments now must negotiate with different classes of citizens, different communities, and different corporations and consider their benefits in a more equitable way. Some internationally trained planners have anticipated that Western concepts of equity planning and approaches to civic engagement would become more and more relevant to China's future development initiatives. They have also cautioned that China could only sustain its economic prosperity, social development, and political stability by promoting environmental and social wellbeing in tandem and by understanding and balancing the benefits of various stakeholders.

As systemic reforms of environmental and social governance remained emerging, some planners have observed that China's central policy on development has expanded to emphasized three themes: 1) "green:" eco-development, environmental protection, and climate change adaptation; 2) "intelligent:" smart cities and the digitalization of urban and environmental governance; and 3) "equitable:" the emphasis on regional coordination, urban-rural integration, and multi-stakeholder engagement in development conception, as well as the encouragement of public participation in urban governance. They believed that these new trends had increasingly aligned China's development approaches with the tripartite principles of sustainability which promote the wellbeing of the economy, society, and the environment in tandem. Nevertheless, although many practitioners concurred that China's new policy fads were ideologically progressive, the ongoing reforms within the government remained confusing to many practitioners and scholars. Many urban and environmental experts raised a series of questions that, the answers to which remained unclear, would shape China's planning-related fields and its urban sustainability in the future. For example: What should be the core elements of planning practice in China? How to define the responsibility of different professions when expertise diversity under a broadening field of planning had been surging in China and when disciplinary boundaries of urban and environmental fields are increasingly

blurred? What is planning in contemporary China and, more importantly, how should future environmental practitioners plan?

Several urban scholars and practitioners pointed out that answers to these questions had already begun shifting as China continued heightening its experimentation with pro-environmental development. Despite the confusing state that China's development-related fields had entered, the environmental practitioners felt hopeful that emerging eco-environmental initiatives would collectively pave a path towards a more environmentally sustainable way of developing cities. Building on lessons from the legendary urban growth over the last four decades, they believed that concepts of ecology and ecological ethics would inspire further exploration, reform, and innovation through active learning from both international and domestic experiences. This would provide momentum for China's continued experimentation with environmentally sensitive city development by mobilizing resources for ecological restoration, ecosystem protection, environmental governance, and decarbonization. Many also cautioned that China's current eco-environmental transitions remained hyped in political rhetoric and were ideologically driven. Therefore, ideological progressiveness and technical professionalism must be connected to advance pro-environmental innovation in reality and the evolution of the planning field. This would require new institutions of planning and new processes of multidisciplinary collaboration that would involve comprehensive expertise, sophisticated practical skills, scientific knowledge, and technical analysis for both projective planning and outcome assessment.

What does it mean to be "eco" in China?

Examining China's urban practice in the twenty-first century, eco-development has been both an outcome of its continued search for sustainable development and a product of its particular development phase of peak urbanization. Being "eco" in urban development has included four salient types of action that have occurred during overlapping periods and have been carried out by different key actors at different levels of China's political system:

First, the "first-generation" eco-cities: These projects were designated by the central government as national demonstration projects. Their planning involved global design firms and foreign urban, environmental, and engineering experts. The conception of these projects focused on standardization and sought to generate universalistic indicator systems for guiding and controlling urban sustainability. These projects were too utopian, deterministic, and unfeasible. Their development remains largely incomplete or stagnant after almost two decades.

Second, local explorations of eco-development: There have been many locally conceived urbanization projects featuring strategies of urban greening, green infrastructure, environmental restoration, and low-carbon transportation. These projects were mostly initiated by local governments to facilitate growth and to improve urbanization at the same time. Local governments incorporated internationally renowned designers and appropriated foreign concepts according to local socioeconomic conditions and developmental agendas. When development outcome involves successful placemaking and image building, these projects have been widely promoted as paradigms of eco-development. Conceived during China's era of peak urbanization (like the "first-generation" eco-cities), these projects also featured utopian design concepts and largely served urban expansion.

Third, central policy reforms: Since 2012, at the eighteenth National People's Congress, President Xi Jinping officially advocated "ecological civilization." Since then, a series of legal reforms have been carried out to mandate pollution mitigation, environmental cleanup, and environmental protection. Regionalism has emerged in centrally designated geopolitical zones (defined according to natural systems) to ensure cross-jurisdictional collaborations on environmental protection and ecological restoration. The ongoing reforms of "Multiple Compliance" further spurs systemic reforms of urban and environmental planning and governance. While central policy reforms remain underway, environmental laws have been effective locally and local explorations have been further stimulated. The central policy shift increasingly promotes the integration of multidisciplinary expertise and emphasizes the scientific evaluation of environmental capacity and ecosystems health. Overall, the approach to planning has stressed the principle of "ecology first" and views on the city and its relationship with nature have also evolved to reflect ecological ethics.

Fourth, diversifying approaches to promoting joint urban and environmental sustainability: The abovementioned explorations of eco-development and formalization of pro-environmental policy have led to a widespread ethical shift in practices of development and urban management. The current eco-environmental practices have grown tremendously to include both state-led and developer-led projects. These changes have been occurring at scales that vary from a neighborhood to a regional ecosystem. They also involve governments ranging from the lowest to the highest levels. The newest eco-environmental approaches also integrate physical interventions with people-centered governance strategies and involve comprehensive disciplines to combine future-oriented design and planning with scientific studies of existing conditions. Therefore, China's new eco-environmental initiatives have become more inclusive by considering the needs of more diverse social groups, such as the elderly, women, children, and sometimes even migrant workers. Smart technologies are increasingly employed to enhance urban services, encourage civic engagement, increase information transparency, and enhance procedural fairness. China has also seen growing collaborations among universities, enterprises, practitioners, and governmental officials who join forces to create urban innovation.

Overall, China has come to realize the limitations of its conventional approach to promoting sustainable development. Cases examined in Chapters Three, Four, and Five all feature a *tabula rasa* "blueprint" approach to urban and environmental planning, at least in their initial conception. Their initial proposal all emphasized a utopian vision and presented a compositional approach to infrastructural and environmental design. The visual representations of these projects, especially the renderings of iconic buildings, the animations, and the grand physical models exhibited at the planning bureaus, were all stylized in a similar and unrealistic way. Their promotional rhetoric was consistently formulaic, lavishing promises on the prosperity and enjoyment that the eco-development would bring. Yet all these projects have followed China's then-conventional approaches to urbanization and hence were largely constrained by China's growth-oriented political economy of development. As a result, these projects—despite the limited successes in Zhengdong and Nanhu—have inevitably deviated from their pro-environmental premise and instead appropriated land and exploited natural resources for capital gain. Being "eco" encompassed aspirations to innovate urbanization at the time but was largely constrained by attempts to be visually appealing, to modernize physical infrastructure, to gentrify rural areas, and to establish national or even global visibility.

Nevertheless, most practitioners saw early eco-developments as enlightening and catalytic. They link the emerging restructuring of China's political economy to the early eco-experimentation and spoke

hopefully about the rise of more fundamental, more effective pro-environmental reforms in China's next phase of development. They suggested that China's central reforms of land and natural resources administration and environmental law would alter how a development would be financed, how different governmental bodies would cooperate, how conflicts of stakeholders would be mediated, and how civic participation would be handled. Many practitioners believed that, after technical learning through building past eco-developments, China's policymakers and practitioners had shifted their mindsets about what constitutes effective strategies for sustainable development. Such mindset shifts—from prioritizing economic growth and physical planning to more nuanced mediation of social relations and the governance of the environment and local societies—can be considered as an inadvertent outcome of China's early waves of eco-experimentation. This inadvertent achievement has contributed to meaningful cultural transformations that have naturalized genuine environmental and social considerations as important components of societal, political, and professional values.

Eco-Development as a Learning Experience and a Process of Building Confidence

China's eco-development experimentation so far has been opportunities for domestic practitioners to explore how to innovate development and promote environmental wellbeing and social development during China's rapid economic growth. To the participants of China's high-profile eco-developments, these projects have played catalytic roles in normalizing sustainability goals in China, institutionalizing pro-environmental approaches to urban development and governance. These eco-development builders believed that China had been continuously learning from and improving on past eco-developments and hence developing more genuine and more effective eco-approaches. They defied foreign media's critical views which considered China's eco-city projects as mere greenwash to brand new developments. Few questioned the constraints of a resource-intensive capitalist economy, a prevalent pro-growth mindset, and a pro-consumption popular culture underlying China's pro-environmental initiatives. Rather, most officials argued that China's strong economic growth provided the impetus for drastic physical, social, and economic transformations, which also enabled rapid modernization and technological innovation. Being uncritical of the conventional Chinese approach—especially foreign ideas-inspired schematic design, rapid implementation, and top-down state intervention—these officials and practitioners had reinforced the path dependency that had constrained China's eco-experimentation. Yet one planner and scholar has found a positive impact of the conventional features of the Chinese approach. He stressed:

> Efficiency has always been a top priority in China's development. Although one could argue that rapid building can sacrifice the quality of development, an efficient implementation can exhibit tangible transformations quickly, which promotes a sense of fulfillment and ensures the development's continuation.

This view was echoed by Zhengdong's development authority. One official of Zhengdong believed that China was one of the few countries in the world that was able to engender massive transformations efficiently and hence lead future sustainability initiatives with transnational impact. She argued:

> Over the last two decades, efficient urbanization, the beautification of the built environment, drastic improvement of the quality of life for more and more citizens, and legendary upgrading of infrastructural networks have proven the strong executive power and the capability of the Chinese government. Which other country can mobilize drastic

> transformations as massively and as quickly as how China did so? With China's current focus on environmental quality and climate change adaptation, we are all trying our best in our day-to-day work to improve our development and management decisions according to sustainable development principles.

A few planners and scholars suggested that China was genuinely searching for more sophisticated approaches to green urbanization and sustainable development by prioritizing environmental protection, pushing for decarbonization, and making urban management and public services more inclusive. One spoke hopefully:

> A big country like China has the power and resources to make fundamental changes. We have started shifting from importing ideas to exporting our own knowledge and experience. China has made its mistakes in past eco-experimentation. Its experts and officials are well-informed today—many are internationally outstanding elites. Therefore, things will be different in the future. China's sustainability initiatives and pro-environmental practices over the next ten to twenty years will be worth anticipating. More genuine, sophisticated sustainable development will likely emerge in China and spread outwards.

A few scholars stressed that, although many officials were technocrats themselves, politics would always override professional expertise to drive China's transformation. Therefore, China's transformation had largely been driven by ideology rather than technocracy. While some Chinese technocrats had been arguing for the importance to respect science and natural law, most environmental practitioners suggested that they continued researching trendy foreign ideas and best practices in the world's famous cities, especially global cities, as design inspirations. Precedents studies of foreign approaches had become a typical initial step for project and policy conception in China. Designers, planners, and officials would typically appropriate foreign ideas and emulate foreign spatial strategies. One U.S.-trained planner and practicing urban designer stated:

> Foreign ideas remain a great source of inspiration for Chinese planning and design. This is because the imagination of foreign designers tends to be less constrained by China's practical systems, technical details, and political agendas. Rather than mainly serving political interests and growth demands, foreign designers and planners can diagnose urban illnesses, value the quality of the built environment, and consider specific environmental and social needs in a specific place. In turn, they generate more flexible and more creative visions and more environmentally friendly designs. Therefore, Chinese practitioners and officials still trust foreign designers to bring innovative ideas and new knowledge to project conception.

Many planners and designers believed that the fundamental aspirations of Chinese, American, and European design and development—especially the combined economic, social, and environmental wellbeing—were similar and intimately connected, rather than being divided by territorial boundaries. The intimate relationships between Chinese and Western worldviews of design and development were evident in two ways: First, through active learning from well-known and trendy foreign practices, Chinese practitioners had become more informed about global ideologies and values. Most planners and designers suggested that they had always studied Western practices of ecological design, landscape urbanism, and sustainable neighborhoods for inspiration. Therefore, these approaches and their underlying principles and values had been rapidly assimilated into China's mainstream development trends. Second, a growing number of Chinese designers and planners (as well as politicians in recent years) had received training in the U.S. As a prestigious American scholar

asserted, "America has trained a whole generation of Chinese architects, urban designers, landscape architects, and planners who are shaping Chinese cities and development trajectories today."

Nevertheless, the consensus among practitioners was that project implementation in China must respect domestic technical details and hence must be led by practitioners experienced with local practice. One planner explained:

> The Chinese government has always wanted to involve foreign designers at the initial stage for the newness of ideas. However, foreign designers lack knowledge of China's technical specificities and China's unique sociopolitical conditions. Hence, the appropriation and implementation of foreign designs remain the responsibility of Chinese experts, who possess technical knowledge of how planning works in China. Local practitioners also have sophisticated understandings of China's political economy and can get down to the nitty-gritty of practical problems.

A few scholars and planners concurred that it had been, and will continue to be, important to be informed about design and policy fads across the globe, especially those serving sustainability goals. They believed that a global perspective on sustainable development initiatives had become the strength of China's internationally trained technocrats and academics. One high-level think tank researcher remarked:

> By involving foreign designers, foreign and Chinese experts have increased mutual learning. In such international collaboration, China has risen in its global impact on policy and practice related to sustainable development and climate change. Transnational influences and joint ventures also allow Chinese officials and practitioners to continue learning from, and concomitantly shape, the most advanced worldviews.

One U.S. trained urban designer and landscape architect highlighted the positive impact of transnational learning on China's eco-environmental turn in development strategies:

> Urban thinking in the West stresses the relationship between the city and the environment. This is very different from the conventional Chinese approach. China used to only focus on exploiting rural land for constructing buildings, especially market housing, for profit, which has completely ignored the environmental impact of urbanization. Its conventional planning and architecture design largely followed a modernistic tradition that prioritized efficiency and standardization of production. However, in emerging eco-developments, the Chinese government has started to invest in constructing a good environment and in curating everyday living experiences for citizens. Such a combination of environmental and social considerations was introduced to China by foreign designers and was considered very innovative in China during its era of peak urbanization.

A local official and civil engineer in Zhengdong also acknowledged the positive impact of transnational learning and praised China's pro-environmental progress by comparing conventional approaches with eco-developments. He suggested that when Chinese cities were still rapidly urbanizing and expanding, foreign designers and engineers often proposed "eco" or "green" approaches to building more sustainable cities in China. These eco-approaches at least partially followed principles of ecological design and environmental planning. He recalled that progressive-minded, often young, officials and practitioners had been working hard to persuade key decision-

makers and mobilize the private sector and other public administrations to experiment with foreign eco-approaches. However, many local practitioners considered foreign eco-approaches irrational and unfeasible and refused to adopt them. On one hand, many did not understand the value of ecological design. To them, reserving developable land to construct massive ecologies was certainly a waste of public resources, let alone the high opportunity cost of potential revenues from real estate development. On the other, urban practitioners did not consider environmental planning—such as ecosystem conservation, pollution mitigation, and natural resources protection—their responsibility. Typical planning practices would focus on building public infrastructure, such as roads and utilities, and lease the rest of the available land to developers to generate revenues. However, this official observed learning from his colleagues through Zhengdong's development. He stated:

> China's practitioners are no longer ignorant about foreign eco-approaches. We now always incorporate ecological design and environmental planning has been increasingly incorporated into urban planning. By trying these principles and strategies out in our own eco-developments, we are building prenominal ones that are bigger, greener, and more attractive than foreign practices.

Despite the generally recognized progress through transnational learning, some scholars and practitioners have cautioned against China's limitations. One planner and scholar stated:

> The earliest eco-cities have failed largely due to the technocratic nature of their initial strategies. We blindly adopted engineering solutions and adopted green technologies, especially foreign products with decarbonization features and foreign low-impact materials, without critically assessing whether they were suitable for China. Such technocratic believes remain evident among many Chinese practitioners. To them, all problems could be solved through engineering and technology.

Another designer and scholar highlighted the ideological limitation of China's urban practice and argued:

> China's approaches to eco-development remained greatly limited by a Modern planning tradition. This could be contributed to its developmental stage—one that prioritized rapid economic growth and urban expansion, which resembled the postwar boom in the U.S. Examining China's eco-development so far, the eco approaches have put great emphasis on master planning, making big plans, city beautification, and compositional form making.

A U.S.-trained urban designer and educator pointed out that China's urban thinking and development practice had "lagged over half a century behind Western theory and praxis." He added that China had reached a new developmental stage that would prioritize urban renewal and humanistic concerns. He argued that in the meantime Chinese urban fields had broadened to investigate linkages between cities and social and environmental transformations. While such transformations had begun in China, some urban designers suggested that the agreeable environment from existing eco-developments could provide tangible evidence of the value of environmental and social engineering.

Nevertheless, a planning policy researcher cautioned about the limitation of China's political regime and supported the importance of experimental projects. He stated:

> China's political leaders overpower authoritative experts. Therefore, professionals can only engender political impact and influence policy decisions through actual achievements in practice, and these actual achievements must gain a good reputation to generate impact.

> Experimenting with foreign ideas is a process of absorbing foreign concepts, values, and practical approaches. Therefore, the branding of such experimentation is important for establishing the authority of pioneering practitioners and for generating social and ideological impact.

Another academic and geographer argued that eco-approaches in China still largely lack scientific rigor due to the relationship between politics and science in China. He suggested:

> Being 'eco' in China is not genuinely scientific enough. One must know that the Chinese government strongly emphasizes science in policymaking. However, science is typically used to justify political leaders' ideas, and academic research is often used to provide evidence for the correctness of policy agendas or to prove the rationality and feasibility of policy decisions. As for planners, many of them have a technical and engineering background. They believe that any environmental problems can be solved by civil engineering and environmental technology. As a result, unreasonable plans will still be approved by some planning experts. Overall, as long as the government wants to promote a development, science is merely a tool to facilitate such political decisions.

Reflections from the builders of and citizens in China's eco-developments reveal that the trial and error through China's experimentation has enabled learning on multiple levels.

First, planners and designers are learning initially through expanding their ecological imagination, creating new, utopian, and foreign ideas inspired and/or directly drawn from Western eco-concepts and green development practices. These practitioners have learned—and innovated their practices and globalized and renewed their values and visions—through the appropriation of foreign ideas in the Chinese context. New ideas inspire new explorations in practice, through which developmental actors learn to innovate by greening the built environment as well as improving urban and environmental governance. These practitioners learn through trial and error in the implementation process.

As one local official, also a public administrator and planner, and a key coordinator of Zhengdong's development stated:

> China has caught up with the most advanced parts of the world in terms of knowledge and technology. Our leaders and experts are well-informed about the world's most recognized paradigms of urban practice. Yet ideas alone are insufficient for change-making in our country. True innovation lies in the *process of realization*. The explorations and adjustments in the processes of realizing innovative ideas are the most challenging aspect of China's transformation. Therefore, overcoming socioeconomic and political obstacles during developmental reforms brings actual innovation and progress.

A prestigious urban designer and planning educator argued:

> The sustainability of China's prosperity is challenged by the slowdown, and even stagnancy, of economic development in many cities, compounded by rising social and environmental problems. Today, China has reached a phase of recalibration and reform, led by the central

state. Such recalibration is inevitable and the outcomes of reform will shape the trajectories of China's continued economic development and social transformation.

Second, both local and central politicians are learning through the eco-development process. In China, it is very important for *politicians* to learn and appreciate the value of greening development, especially through *witnessing* the physical impact of an eco-development as well as citizens' favor for ecological spaces. After all, it is *politics* leading physical practice and socioeconomic transformation in China. Accordingly, political leaders' learning, as well as transforming their ideologies and values, are the most important propeller for change. They can interfere with experts' practices, mandate the directions of urban visioning and construction, and either disregard or utilize expertise to change "business as usual" in development practice. Therefore, an important, and perhaps originally unintended, impact of eco-developments is influencing key policy decisions in tandem with reshaping landscapes of resource allocation, which stimulates key stakeholders' learning and institutional reform. The processes of institutional learning and reform did not occur only to advance the development of technology and science in urban construction. They also fostered an ecological norm in economic and social policies, seeding a degrowth mindset when economic and environmental benefits are in conflict. With the popularization of various eco-developments and the proliferation of local explorations, eco-developments in China have evolved from imaginary, piecemeal local experiments that focused on replicable models for economic restructuring and physical transformation to more regulatory, systematic, proactive, and scientific approaches that can engender regionally connected, scalable, and structural changes in physical and sociopolitical domains.

Third, other stakeholders in the society, especially citizens, developers, and businesses, are also learning. By choosing to engage in the formation and growth of the new ecological zones, citizens, developers, and businesses are adopting new narratives of themselves, the city, and the culture. The constructed new ecology, although largely artificial, serves as cultural artifacts and plays the role of nurturing new mindsets. The processes of building ecological elements of the city forged new institutions, shifted practical paradigms in real estate, planning, urban management, and environmental governance. The new developmental norms increasingly emphasize pollution mitigation, decarbonization, climate adaptation, ecological restoration, and environmental conservation.

Overall, in a top-down society like China, creative practitioners and visionary politicians can encourage new ideas, lead paradigm shifts, and stimulate developmental reform. Such experimentation further engenders cultural, normative, and institutional transformations. The processes of transformation and influences are both *vertical* in the political system—simultaneously from central to local and from local to central—and *horizontal* at the local level—with political and professional elites leading ideological shifts while citizens and market players adopting new discourse and disseminating new norms. Citizens' and markets' favor for eco-developments and eco-discourse further validates state-led green policy reform and facilitates practitioners' continued exploration of ecological approaches to urbanization. In particular, when politicians learn the benefits of greening the built environment in tandem with the economy and culture, they change policy directions and intervene in the allocation of public resources to facilitate green transformations. Practitioners, especially designers and planners, generate impact when they introduce new, foreign ideas and achieve observable changes in the built environment and in public life. When these changes are well-received by the middle classes and politically branded as successes, designers' and planners' practices contribute to the institutionalization of new approaches that embody new values and new norms

and foster new cultures. Once their effort has been recognized as innovative or successful in the country and/or internationally, visionary designers, planners, and local leaders often have opportunities to introduce their experiences and adopt their approaches in different places across China. Through these opportunities, these visionary players become change-makers who contribute to the upscaling and diversification of eco-developments. In turn, eco-experimentation in urban development expands in a form of localized, actionable political and cultural movement, which collectively leads to policy and institutional reforms. As several experienced practitioners have observed, the evolving eco-developments have stimulated ongoing institutional reform at the central level of administration, which could potentially lead to systemic changes that would prioritize environment over economy.

Although structural reforms remain underway, practitioners and local leaders believe that they have perceived normative shifts which are rapidly expanding influences on a geographic scale. Accordingly, many practitioners, especially the builders of China's existing eco-developments feel empowered by rising political support, cultural recognition, and public appreciation. Many practitioners contrasted the earliest discourses about growth-oriented eco-cities and the latest discourses on green urbanization, arguing that China's green initiatives had gone beyond greenwashing. They believed that this was evident in the gradual greening of public discourse, developmental norms, practical paradigms, citizens' values, and the integration of environmental protection in local and central developmental policies. One prestigious planner argued:

> Viewing China's green transformations from a historically continuous perspective, the limited progress along the way in a developing country like China should not be concluded as total failure or reduced to mere greenwashing; experimentation *per se* necessitates some trial and error, but we genuinely hope to advance our eco-environmental effort through continued adjustments and improvements.

Several local officials, planners, and designers suggest that they had been increasingly engaged in more genuinely green practices that aimed to decarbonize both the built environment and urban lifestyles, starting in the existing eco-development zones. Attempts have risen in these places to conserve and restore ecosystems along regional water systems, as well as to cleanup pollutants in industrial sites and in air, soil, and water bodies. They believed that these attempts had started to disseminate eco-environmental values in formerly growth-focused cities.

What does the experimentation of eco-development mean to China's green transitions in urbanization?

Experimentation with eco-development has been a form of ideology-driven institutional transformations in China's urban development, which has created economic value of the city, delivered pro-environmental ethics, and engendered cognitive and normative shifts. Eco-development builders have differentiated themselves from other practitioners and policymakers in their efforts to advocate principles of sustainable development, disseminate ecological value, adopt green technologies, promote green economy, and integrate ecological design and environmental planning with urbanization and governance. They suggested that a typical eco-development would inevitably take the form of the dominant approach to development at its time. Therefore, during China's era of rapid urbanization, eco-developments had adopted a place-bound, form-driven approach and heavily stressed aesthetic modernization of the built environment. As China's urbanization was slowing down, strategies for eco-development had shifted to the improvement of

the existing built areas, emphasizing pollution mitigation, environmental management, and green governance. The latter typically includes people-centered management strategies that utilize civic engagement and public participation to encourage behavioral shifts in individuals. The goal of green governance is to reduce the environmental impact of urban living, enhance environmental stewardship, reduce energy consumption, and improve waste management at the neighborhood scale. Several progressive innovators among the eco-development practitioners pointed out that China had begun exploring more scientific approaches to environmental planning and urban management by adopting smart technologies. Acknowledging the limitations of China's current limitations in smart city technologies, they believed that the convergence of eco and smart approaches to sustainable development had increasingly become a trend. To them, eco-environmentally focused pre-development research and data-enabled civic engagement would reinforce each other and lead to more fundamental changes towards integrated pro-environmental development and governance at broader scales.

To China's eco-development builders, the progress towards sustainable development through eco-development experimentation was less limited by leading experts' capacity to learn from best practices but more constrained by local officials' and practitioners' cognitive capabilities to accept new values and associated new approaches and by policy priorities at the particular development stage. Nevertheless, they believed that experimental projects had demonstrated the physical and economic impact of ecological design and environmental planning. The popularity of these places among homebuyers, companies, and visitors had become tangible proof of the value of eco-environmental investment, which had led to the willingness among key decision-makers at the local level to continue exploring pro-environmental approaches to development as well as the political support from the top. Pro-environmental approaches in diversifying forms are increasingly institutionalized across administrative levels. Many Chinese practitioners and policymakers today have remarked positively about China's pro-environmental turn in urban practice and policymaking. They commonly recognize the growing eco-environmental emphasis on ideology, policy, professional practice, scientific expertise, and technological transformations as one of the most salient characteristics of China's next phase of development. China's urban scholars believe that such pro-environmental norms will reshape urban research and practice, redefine the focus of China's planning and design practice, and reconstruct inter-governmental, inter-professional, and interdisciplinary relationships. Although the economic growth during the first three decades of urbanization since 1978 had occurred with tremendous environmental and social costs, many Chinese practitioners who had been participating in and promoting eco-development argued that experimentation of eco-developments during the first decade of the twentieth-first century had brought more and more Chinese experts and politicians to a new level of environmental awareness. Eco-development approaches that had led to visible improvements of the built environment and quality of life had been increasingly incorporated into broader economic and environmental transformation agendas. Hence, the next phase of China's transformations would aim at striking balances between economic growth, environmental protection, and social development. Some scholars and practitioners remarked that when the Chinese government had fully committed to, and mobilized its resources for, pro-environmental agendas such as ecological restoration, environmental protection, green growth, and decarbonization, systemic changes could be possible.

Experimental Projects as Catalysts of Innovations in Development Policy and Practice

Processes of planning and design should not be linear or constrained by top-down determination, even when operated within an authoritarian regime like China. Design and planning practices should be reflective by nature. Therefore, environmental practitioners should constantly incorporate new knowledge learned from partial implementation, monitor the multifaceted impacts of their interventions, and adjust their interventions according to emerging changes. As an urban designer experimenting with eco-development in rural areas stated, "We are learning by doing, and we do a little more after we learn a little more about the impact of our action from what has been done." He called such iterative, reflective processes "appraisalism." Such processes would involve implementing new ideas, evaluating outcomes, and then reinventing new ideas and refining new approaches. He argued that all innovative reforms were subject to "appraisalism" and fundamentally "bottom-up."

Development innovation in China has evolved in forms of movements catalyzed by waves of policy fads. The state-promoted rhetoric of sustainable development, ecological civilization, public participation, decarbonization, and other progressive concepts alike are ideological fads signaling which geographic territories and what sectors would receive favorable policy and governmental subsidies. The universal adoption of the central rhetoric among local Chinese societies largely guides local development explorations, drives public and private capital investment, fuels practitioners' imagination, and stimulates their active learning from abroad and thinking outside the box. In the case of eco-development, such practices have collectively lit a path to sustainable development during China's era of peak urbanization. The successful pilot projects, especially their continuation of development after partial successes and their promotion as demonstration projects, have become both the validation of the "China approach" and the lighthouses indicating the direction of China's development policy reforms. These experimental development zones are ideological symbols and they demarcate privileged territories that can receive a concentrated allocation of state resources, private capital, and human capital.

Catalyzing policy reform and development innovation through special development zones is an approach that can be traced back to China's first special development zone—Shenzhen, which has been a pioneer of China's socioeconomic transformations after its economic liberalization began in 1978. Experienced planners and policymakers have observed that Shenzhen's transformations are often a few steps ahead of China's overarching policy shifts. Shenzhen's developmental experiments in areas such as industrialization, housing privatization, land reform, low-carbon growth, and urban renewal have occurred with spontaneity, and sometimes informally, thanks to the concentration of capital and population, the openness to foreign investment, and the often absence of deliberative state intervention. Shenzhen represents land within China with relatively more freedom to test new ideas and more financial and social capabilities to achieve breakthroughs at the local level. Therefore, Shenzhen's transformations have set precedents for other Chinese cities and hence often heralded China's post-1988 policy reforms. Since then, China's physical, social, and concomitant cultural transformations have continued being catalyzed by specialized experimental development zones. Lessons from these zones would be incorporated into centralized policy guidelines. At the same time, these special development zones would generate spillover effects in their surrounding districts and regions. The proliferation of development zones across China has led to piecemeal, and largely uneven, urbanization, closing urban-rural wealth gaps within limited local territories while unintendedly widening socioeconomic disparities on regional scales. The proliferation of resource-intensive special zones also inevitably intensifies inter-district, inter-city, and inter-region competitions. Driven by central policy fads and in the name of creating replicable, scalable innovations in development, local governments vie for favorable policies, public subsidies, private

capital, skilled workers, natural resources, visibility, and reputation. Therefore, China's development reforms have largely been driven by new visions from the top, catalyzed by numerous local experimental projects, and intensified (and in many cases hampered) by local competitions. Projects in China's "special" or "pilot" zones of development innovation are touted as the path to China's newest reform objectives. They carry the mission to engender ideological, technological, and cultural shifts at a collective level and reshape values, behaviors, and beliefs at the individual level.

China's eco-developments during its rapid urbanization have played similar roles as special development zones with the goal to naturalize principles of sustainability while exploring effective ways to achieve sustainable development. Despite their apparent failures and the tremendous limitations of their progress, China's eco-developments have effectively catalyzed eco-environmental transformations in practice and policy norms. Acknowledging that exploring sustainability involves continual and adaptive processes, China's urban practitioners today anticipate with optimism that China's pro-environmental initiatives will continue evolving to include more comprehensive, specialized, and effective strategies. Many caution that decision-making in China has typically relied on past experiences of technocrats and authorities. They believe that the sophistication of future strategies must have thorough groundings in science, technological innovation, and humanistic considerations. Some believe that new ways of collecting and analyzing data combined with scientific studies of existing conditions could enhance the effectiveness of future pro-environmental initiatives. Meanwhile, designers and planners have become increasingly aware of their shifting professional roles and the blurring of boundaries between fields of planning and design and other natural and social sciences. Planners and urban designers argue that the core of their professions has shifted from physical and aesthetic considerations to mediating among various stakeholders and resolving conflicts of interest between state, market, and society.

China's officials and practitioners today still regard eco-developments like the earliest eco- and low-carbon cities and relatively more successful local practices such as Zhengdong and Nanhu as meaningful experimentation and necessary paths to innovative development reform. Eco-Utopian ideas have been used as a mobilization device in eco-development. They have the capacity to transform dominant discourses and create new objectives of development, especially those that concern ecosystem wellbeing and environmental sustainability. Eco-development explorers have become the movers and shakers that facilitate China's pro-sustainability transformations in political and professional norms and cultural shifts. In a top-down regime like China, local experimentation of urban practice provides central policymakers with important feedback. First, local practices serve as a way to test new policies. Even partial development outcomes allow policymakers to examine the actual impact of a policy reform on the environment and on people. The implementation process also grants practitioners the opportunity to witness how their spatial and physical interventions can affect the benefits of various stakeholders. Through experimentation grounded in local societies, policymakers and practitioners can evaluate whether the implementation of a new idea within China's political economy would deviate from the policy's initial intent. They would also learn lessons from any unintended consequences. Viewing eco-developments from this perspective, many practitioners and officials have spoken positively about the tangible impact and educational value of China's eco-developments. They believe eco-developments represent the "Chinese approach" to urban innovation, which will continue and further advance initiatives of sustainable development in China.

The Chinese Path of Pro-Sustainability Development Reform

Planners and designers who have participated in eco-development experimentation or promoted other approaches to sustainable development have commonly experienced three phases of pushing for innovation in development practice and policy making. These movers and shakers describe the three phases of pushing for innovation as: 1) *initial persuasion and enlightenment*, 2) *catalytic experimentation and institutionalization,* and 3) *continuation through local breakthroughs*.

The first phase, *initial persuasion and enlightenment*, is about battling ignorance. Innovative concepts such as sustainable development and related design and development strategies were once completely alien to local officials, practitioners, and investors in China. At that time, most local actors of development in China embraced opportunities to fuel rapid urbanization. They were uninformed about the concept of sustainability and hence could not understand the need to incorporate eco-environmental considerations into project conception. Therefore, educating and persuading local decision-makers—or "brainwashing" them (borrowing the phrase of a progressive planner)—is typically a crucial, inevitable first step for development and policy innovators (including early eco-development builders) to promote eco-environmental (or any other innovative) approaches to sustainable development. Effective "brainwashing" is needed to onboard key decision-makers so that they would establish pilot projects where innovative practitioners can experiment with new ideas. Through the successful implementation of new ideas, positive outcomes would become concrete and visible, even when they are limited in scale. These pilot projects then prove that the adoption of new, and often foreign, approaches in China is beneficial. These places would become demonstration sites that widen the acceptance of new approaches inspired by unconventional, foreign ideas.

The second phase, *catalytic experimentation and institutionalization*, involves figuring out specific strategies in actual implementation in more places and setting standards for wider adoption of the new approaches. Once the initial demonstration projects have generated partial output, their builders would research the outcomes, assess the impact in reality, and improve on their initial experimentation while adjusting subsequent strategies. At the same time, officials and practitioners in cities seeking an improvement of development would emulate demonstration projects that have achieved partial successes. This leads to the multiplicity of experimental projects in various places across the country, which enriches experiences and broadens lessons learned at a collective level. In response, municipal and provincial authorities would work with pioneering practitioners and experts who have participated in initial experimentation to develop policy guidelines and set regulatory standards. The governments would then launch new policies and new regulations through newly established political systems. The latter would also supervise the implementation of the new agendas. When a new agenda gains a reputation of success—typically reflected by economic competitiveness, the quality of the environment, and the popularity of the place in the case of an eco-development—it would be recognized by the central government, which would further promote the new approach as a paradigm and institutionalize it across the country.

The third phase, *continuation through local breakthroughs*, involves the further dissemination of the new agendas across the country as well as the normalization of the new approaches, together with their underlying ways of thinking and values. This phase also involves the refinement of the new approaches through more locally embedded considerations. The continued dissemination and

improvement of the new approaches necessitates creative solutions to local problems and effective means to include various stakeholders and balance their benefits in the process. Locally embedded breakthroughs that create more inclusive, more environmentally and socially responsible practice and policy, along with broader cultural and mindset shifts, are key to the long-term advancement of pro-sustainability initiatives.

The societal progress towards eco-environmental approaches has been regarded as an example of such innovation in China's urban practice and policymaking. Experts argue that today no one in China would frown upon eco-environmental approaches. Instead, officials and practitioners are all focusing on how to create developments that are true to the original intend of such approaches and how to carry out developments that are more socially responsible and more inclusive. They have put more emphasis on closing the gap between utopian ideals and reality and between lofty rhetoric and actual societal struggles. Some practitioners have spoken hopefully:

> China is full of problems as it is still developing and changing. It gives practitioners abundant opportunities to engage in experimental practice so that they can learn and grow quickly. China has been, and will continue, catching up with the First World and aims to surpass it someday. In such processes of experimentation and transformation, China is a vast testing ground for policy and practice innovations.

Nevertheless, some practitioners caution that progressive approaches can be hampered or completely blocked by China's political and economic systems. The current political economy of development in China greatly facilitates gentrification through hybrid processes of socio-spatial upscaling. Eco-environmental initiatives such as ecological restoration and environmental protection still play a subordinate role in support of gentrifying processes of socio-spatial upscaling. The focus on gentrification can derail eco-environmental attempts from their initial good intentions. Therefore, progressive-minded practitioners anticipate that they still have a long way to go in their search for technical and ideological breakthroughs in order to advance pro-environmental and pro-equity agendas.

The progressive environmental practitioners commonly spoke about six institutional factors that can enable partially successful experimentation of eco-developments, which they argued could nudge further transitions towards sustainable development in China:

1) central and/or local policy guidance and incentives
2) a transitional urbanization stage with favorable physical and social conditions
3) key local decision-makers' openness to new ideas and new approaches
4) chief designers' inherent values and patterns of practice
5) diversity of expertise and multidisciplinary collaboration
6) vertical and horizontal cooperation of governmental authorities

Through the experimentation of eco-developments, China's environmental practitioners have observed that the government has begun taking increasing responsibility for environmental governance by integrating it into physical upscaling and social reproduction agendas. The trial and error in these places allows China to build a decision infrastructure that increases the diversity of pro-sustainability innovation. The evolution of decision infrastructure occurs both vertically and horizontally within the governmental systems and nurtures comprehensive expert networks that are grounded in both practical experience and scientific research. Local governments have gradually shifted their role from being merely a facilitator of GDP growth to being the mobilizer and

coordinator of integrated reforms for social and environmental reproduction. Local mobilization and coordination involves interpreting centrally designated directions of innovation and mediating among public, private, and individual stakeholders during the implementation of pilot projects. The local state has also shifted from being the authority determining the blueprint of future growth to being the manager responsible for public service provision and environmental protection. Concomitantly, the experimentation of unconventional approaches beyond facilitating growth reshapes relations between state, society, and market and between different professional communities. In eco-developments particularly, views of city-nature relationship have also begun shifting to reflect eco-environmental ethics. Their participants believe that in a strong state like China movers and shakers must use small progress to demonstrate the benefits of change and then leverage partial successes to engender bigger changes. Hence, eco-developments—despite their limited, piecemeal successes—represent how Chinese government mobilizes development reform and how the Chinese environmental practitioners nudge the country's continual development towards a pro-sustainability direction. While China's capitalist, growth-oriented institutions have been at times obstructing pro-environmental and pro-equity transitions, the spread of institutional learning within governmental systems, the maturation of multidisciplinary expert networks, and the emergence of better-informed local societies have all fueled optimism for progress. The unwavering belief among many Chinese officials and practitioners that the country's development has been and will be better could become the main driver enabling transitions towards more genuine attempts at sustainable development. Proponents of eco-developments argue that the path towards sustainability in China entails not only forward-looking visions of urbanization but also a consensus view on socio-environmental reproduction in the society. To them, the experimentation of eco-developments, representing China's transformative efforts, must continue so that such projects can be carriers of pro-environmental values and engender cultural and institutional shifts at a collective level. The proliferation, diversification, and sophistication of eco-developments would transform dominant discourses, reshape more territories, and involve more actors of the society, which would, in turn, facilitate continued explorations of sustainable development.

China's eco-developments reflect the tradition of an experimental approach in China's developmental reform. Such an approach has different emphasis at different levels of the society:

1) At the top level: Ecological development reform is about state legitimacy. This is the ultimate goal.
2) At the local level: Greening a development was still about political achievements and economic growth. Ecological ideas for urbanization emerged out of pressure from the top and were interpreted by individual leaders due to their desire to use demonstration projects to secure chances of promotion.
3) At the bottom level, or in local societies: Eco-developments are where markets and citizens choose to go. They are places where new management strategies are explored by the state and where new social groups and social networks are voluntarily forming. Therefore, ecology has become a symbol of civic choices, public resources, and political preferences.

With the branding and political promotion of these projects across all levels of the society, eco-developments have shaped public discourse and value. They have enabled the trans-sectoral, universal adoption of an ecological discourse and cultural norm in China, supporting policy guidance to stimulate cultural and institutional shifts. The accompanying learning and transformations have expanded beyond practical improvements and physical change. More importantly, such transformations are political and ideological, which further ensure social stability, facilitate

technological and scientific explorations, and ultimately promote the power and importance of the Chinese state on a global stage.

In sum, China's eco-developments exemplify how China mobilizes development reforms. These unique projects suggest a common path for the state to scale up new policies and practices during urbanization:

1) Offering the testing grounds for innovative, and often transnational, practices of design and development
2) Appropriating foreign ideas through trial and error during implementation
3) Establishing successful demonstration projects, building national confidence, and enhancing state legitimacy
4) Disseminate new knowledge, new values, and new principles through the promotion of demonstration projects
5) Inventing China's own approaches and export elsewhere both domestically and internationally

Such a process reflects the tradition of an experimental approach in China's developmental reform, ever since Deng Xiaoping introduced the approach of "Crossing the River by Feeling the Stones" in making the Modern China. China's political system features decentralization and fragmented authoritarianism. Under this regime, processes of trial and error at the local level were crucial to scale up practical, cultural, and political changes. Nevertheless, it is worth noting that such "bottom-up," practice-to-policy influences have remained largely state-centric and elite-driven and hence been constrained by bureaucracies and ideologies within the authoritarian regime. The latter could confine creative thinking, forbid freedom of expression, and, therefore, stifle innovative, systemic reform.

Reinventing the Chinese Rationality in the Context of Global Environmental Politics

In China's continuous experimentation of eco-development, the greening of both urban landscapes and developmental rhetoric has greatly expanded. Eco-development has become a practical means to reinvent China's governmental rationality and cultural norms in favor of continuing urbanization and renewing social and environmental governance. With the growing importance of environmental initiatives in international political spheres, China's global ambition is evinced in, and increasingly intertwined with, its eco-development. China's approaches to eco-development have evolved along with the progress of urbanization and changes in resource management. The term "ecology"—other than describing a discipline of environmental science—has become a popular naming prefix. Despite the lack of a unanimous definition of its meaning in the context of development, the term's chaotic but universal adoption in urban practice and policy making—which has been officially validated by the central political agenda to build "ecological civilization"—suggests that Chinese practitioners and local officials have been appropriating pro-environmental worldviews and reinventing eco-concepts and eco-principles as China's own approaches to sustainable development. Many practitioners consider the recent green political reforms a momentous shift in China's political agendas, professional ethics, and public attitudes towards urbanization and environmental governance.

As China continues exploring more sophisticated, more effective approaches to eco-development as a next-generation urbanization model, China has grown to prominence as the largest emerging market in the world that has committed to sustainable development, environmental protection, climate adaptation, and decarbonization. China's expanding and diversifying pro-environmental initiatives have won the country more weight in international spheres of environmental politics. At the same time, eco-developmental rhetoric frames continued urbanization as socioenvironmental improvement, justifies the Chinese state's interventionist approach to resource management, and facilitates social reproduction and environmental engineering in China's increasingly contested development sector today. In turn, eco-development legitimizes the state's power over both the society and the environment and refashions China's development from sweeping, unsustainable urbanization that prioritizes short-term gains at tremendous socioenvironmental costs to green, comprehensive initiatives that build a common future for all by advancing social, technological, and environmental agendas in tandem. With the recalibration of its course of urbanization, China's eco-development builders have reshaped physical spaces and political systems through which eco-rhetoric takes on meaning and hence have gained growing agency in producing knowledge about how to operationalize sustainability in developing contexts. The ongoing trial and error in eco-development and policy-making has naturalized eco-environmental ethics among China's intellectual and political elites. Eco-environmental ideas—despite the open-ended interpretation of their meanings and associated principles—have become integral to China's urbanization plans, governance strategies, and officials' performance evaluation. Future rationales for China's state-led social and environmental interventions will be intertwined with diverse discourses about ecological sciences, environmental engineering, and political ecology.

Conclusory Reflections

Overall, are China's eco-developments mere greenwashing? Are they purely a political tool for promoting state legitimacy and facilitating national building? Or, has there been any genuine intention to establish and institutionalize ecologically and environmentally performative practices? The results are mixed; the processes are experimental; and the achievements are changing with China's broader socioeconomic and political transformations.

China's eco-developments over the last two decades have largely adopted a place-bound, growth-oriented, and aesthetically focused approach. A core feature of the Chinese approach remains to create a territorialized special zone with a built environment featuring highly designed, physical spectacles. These places, whether imaginary or constructed, have been ideological and physical spaces for communicating ecological discourse to the public. Such spaces facilitate the universal adoption of the state-led and state-centered construction of ideology and culture. In turn, eco-developments serve as the state's tool for educating the society and as a means for the society to learn from more developed nations in the world. Therefore, although eco-developments seem to have been a facilitator of the Chinese state's sloganeering, they have effectively communicated eco-environmental ideas to the society and engendered rhetorical, and subsequent ideological and cultural, shifts. Such shifts point to the potential to bring about broader political, behavioral, and mindset shifts at different levels of the society. The society's wide adoption of the state-centered rhetoric is indeed an accelerant factor for a large country like China to mobilize and scale up

transformations. Collectively ideological and cultural shifts are a crucial step that prepares the society and key decision-makers for contributing to a pro-environmental path of development.

China's contemporary eco-development is a phenomenon that has inherited the legacy of intertwined physical and cultural transformations in modern China and has been shaped by an era of peak urbanization and globalization. China's eco-developments exemplify how the nation builds an ecological modernity, which can be considered a continuation of the preexisting "hybrid modernity" (Padua, 2020). Therefore, the characteristics of the Chinese approach to eco-development so far reflect a hybrid of China's historical strategies for modernization and nation building and its new strategies for securing domestic stability while gaining global power.

Acknowledging the open-mindedness of the phenomenon of eco-development, the goal of this study is not to lock down the definitions or to conclude with deterministic discourse. Rather, the dissertation embraces the open-mindedness and curiosity towards change. Such an attitude is inherent in scholarship that centers on progress in space and society. This dissertation acknowledges the limitations of China's green transitions so far, but highlights a hopeful note: The evolution of China's eco-developments illuminates how ecological city design and planning—especially when under transnational influences—has contributed to the expansion of urban ecology in Chinese cities while nurturing change makers and public agencies who continue to carry out eco-developments and disseminate an eco-environmental mindset; concomitantly, such physical and social transformations have fostered institutional learning and engendered cultural shifts through the expansion and maturation of social, political, and professional networks across cities and regions within the country. Such positive effects on social and political networks and cultural shifts are inadvertent achievements of China's eco-developments. After all, social and ideological influences are often the byproducts of physical transformations. And physical transformations remained a key tool for the Chinese state to leverage social and environmental engineering during the rapid growth. In contemporary China, while the built environment remains highly emphasized on the political agenda in support of state legitimacy and nation building, the state has realized how vital the built environment is for societal wellbeing. Through China's eco-developments, the state has realized, and increasingly stressed, the influences of an ecological environment on citizen's quality of life, economic geography, technological advancement, cultural and environmental conservation, and ideological innovation.

While China's fever for eco-development remains unflagging, cautions against existing practices must be raised. Despite the promising accelerant factors, the validity of the popular, most promoted approaches to ecological design and environmental planning has yet to be scientifically proven or systematically attested in China. This brings to light the need to establish a circular mechanism with a feedback loop that consists of imagination, experimentation, monitoring, evaluation, reflection, and adjustment. Such a mechanism entails interdisciplinary, scientific, and cross-cultural studies that could inform eco-environmental policy and action along spatial, temporal, and sociopolitical dimensions. As China continues to build an "ecological civilization" during an era of economic

slowdown, its past and ongoing eco-experimentation, such as the eco-developments presented in this dissertation, should serve as both valuable precedents and cautionary tales. The limitations of China's eco-developments discussed in the foregoing chapters provide some salutary warnings that could inform China's policy-makers, design and planning practitioners, and key decision-makers of development. Drawing lessons from the global debates about environmentalism and ecologism in urban policy and practice, China's ongoing ecological turns in its physical, sociocultural, and political development have displayed shortcomings that more developed nations have experienced during their processes of industrialization and modernization. Without structural reforms of the economy and governance strategies, the fundamental limitations of China's growth regime will perpetuate the root causes of the environmental crisis and lead to the ultimate failure of growth-oriented eco-development. This points to the need to reconsider China's future green, eco-environmental endeavors from a degrowth perspective. China's ongoing socioeconomic transitions, accompanied by rising civic power, suggest that China should foster civic engagement and collective action to tackle climate and environmental risks. Such a human-centered approach could encourage behavioral shifts in individuals, foster cooperation and collaboration, scale up innovative changes, and complement the conventional top-down, prescriptive approaches to physical planning and environmental governance. Accordingly, Chinese politicians and practitioners must consider how to forge and leverage civic networks to engender broader social movements and cultural shifts to accelerate institutional reforms and step up the nation's eco-environmental initiatives.

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Appendix:
Methodology for Conducting Research on China's Design, Planning, and Development

The methodology for this dissertation is explained mainly in Chapter One, as well as in Chapters Four, Five, and Seven. This note includes my additional reflections on conducting research in China. In particular, I reflect on what strategies were relatively easy and possible to carry out in China and what was challenging or almost impossible to do. I hope to build on my research experiences so far and invite further discussions about ways to improve on the methodology for researching China's design, planning, and development, as well as its built environment, society, and politics more broadly.

The main methodology for my dissertation has mixed several methods, including ethnography, ground theories, case studies, and critical discourse analysis. The nature of this research is qualitative and reflective based on "thick" data rather than "big" data. Big data-based research adopts quantitative logic to reveal statistical significance on an aggregated scale. It can effectively illuminate broader trends. Complementing such approaches, thick data-based research pays attention to the uniqueness of individual cases, reveals nuanced commonalities and differences across various cases within a broad phenomenon, and contributes to idea building and meaning making in a society. While both attesting a theory and building a theory are valuable in research, a reflective approach is often necessary for interpreting thick data and for theory building. Questions for reflective research are usually open-ended. The collected data are thick and messy. Processes of data analysis are not formulaic, And the conceptualization is cognitively demanding.

I have found qualitative and reflective approaches to be very rewarding in the research of the Chinese society. China is an enormous shifting and mutation entity. It serves as a rich ground for testing theories, constructing theories, and propelling the evolution of theories. I chose the method of case studies to collect "thick" data for the phenomenon of eco-development. I adopted a "within case" strategy by focusing on China's eco-development as the overarching unit of study while embedding several sub-units of analysis—four background cases plus two focused cases—in the overarching phenomenon. To reach the "thickness" of information, in-depth interviews have been very helpful. An interview reveals the informant's cognitive process in a social context. Through interviews, the researcher can collect personal perspectives of individuals with various backgrounds. Patterns of thinking often emerge from the saturation of informants' discourses. They reflect what is valued in the society as well as the rationale underlying certain behavioral choices or policy decisions. Interviews allow researchers to experience processes of social learning and be aware of implicit politics at play. For data interpretation, theories and debates from a broad range of fields can provide a rich foundation that enhances a researcher's intuitive reasoning. Combining extensive literature review with "thick" data analysis, it is useful to analyze and critique what has been approved in existing theories and then compare theory and praxis to find what new perspectives are becoming more important to an evolving world.

As mentioned in the dissertation, when investigating a length eco-development in China, data accuracy and transparency—especially the accessibility, comprehensiveness, and authenticity of quantitative data—is largely compromised. China has significantly tightened secrecy rules for geographic information over the last decade. Available data are often piecemeal or fragmented, since China is still building its digital database and environmental monitoring remains largely insufficient. Even if the researcher has connections with the government and can have access to formal data, official statistics are largely subject to governmental manipulation. Acknowledging that data on

urban development might not exist, or they might not be reliable or accessible, generating original, primary data can be a significant contribution to research on China.

With highly limited GIS information and environmental data to assess the performance of the places, this research views an eco-development as an open-ended, dynamic process of combined physical and social changes and investigates its sociopolitical meaning in the society during a certain period of time. After all, the premise of my dissertation is to make the perplexing phenomenon of eco-development more understandable. In order to reach information saturation and triangulate the sources and perspectives of information, my data collection has relied heavily on literature review, local archival research, direct observation during site visits, in-depth and semi-structured elite interviews, randomized citizen interviews, questionnaire-based surveys, and ethnographic fieldwork. Below, I provide some reflections on each component.

Case selection:
I identified "unique," "exceptional" cases based on discourse saturation in media and literature. I also assessed the stated uniqueness of the developments through preliminary literature review and brief interviews with Chinese experts. In addition, I assessed research feasibility based on the availability of key decision-makers of each project. In the Chinese context, support from key decision-makers is crucial for gaining a thorough understanding of a development. For my research, the key decision-makers mainly included powerful local officials, governmental rank-and-file employees who directly executed specific policies and plans, as well as developers, state-owned enterprises, and environmental management companies who were commissioned by the government to implement parts of the eco-development. Together, these people provided comprehensive rationales from the supply side of the development.

Establishing contacts:
To identify key decision-makers of the selected projects for study, I first visited local archives, reviewed literature on the development histories of selected cases, interviewed well-known scholars, designers, and planners, and tapped into their knowledge and networks to establish contacts with key informants. Establishing contacts can be a multi-step, snowballing, and time-consuming process. It typically takes several meetings with various people to get connected with one key informant. The process of establishing contacts is a process of sharing ideas and building trust. In addition, I visited local universities, established connections with Chinese professors, and recruited local students who were interested in learning about research to assist with data gathering. I have benefitted tremendously from the support that I have received within the academic community.

Literature review:
It is important to compare non-Chinese and Chinese perspectives. In order to do so, I reviewed English literature extensively and purchase dozens of Chinese books on the subject. It was also helpful to compare media articles from both within and beyond China.

Local archival research:
Local archives are useful for understanding the history of a Chinese city, as well as what has been emphasized on the local political agendas. It is worth noting that local archives and libraries are often controlled by the state and, hence, information can be biased. Archival materials largely include what is deemed non-classified by the government. Such officially approved public information often promotes governmental propaganda and communicates state-constructed perspectives.

Site visits:
Direct observation is always useful and relatively simple to do. In addition to documenting the spatial and morphological characteristics in my field notes, I visited key areas of an eco-development at different times of the day to observe how different people use the spaces in various ways. I have found walking, biking, and commuting by public transit to be the most rewarding ways for seeing the city and observing people. Occasionally, I would take a taxi or hire a driver. In those cases, I would learn more about the places and people's lifestyles through conversations with the driver.

Structured and semi-structured interviews:
In parallel with assessing the characteristics of the built environment and observing people's behavior, my investigations focused on collecting opinions, emotions, and stories of various kinds of people to identify patterns of thinking, behaviors, and experiences. The reflection and conceptualization brings insights into why people have certain preferences, the rationales behind people's behaviors and choices, and why certain trends stick.

I approached my informants in different ways. When I spoke to elites—mainly officials, key decision-makers, powerful stakeholders, and well-informed experts and scholars—I conducted semi-structured interviews. In addition, I followed up with many of them to have more open-ended conversations. With these knowledgeable individuals, letting the conversations be open-ended and only probing when necessary could be very rewarding. The conversations often bring additional important issues and valuable insights to my attention. I recorded all the conversations (unless asked otherwise), transcribed the recordings, and wrote down my immediate reflections from the conversations. I listened to what was not explicitly said but implicitly suggested. I looked for patterns in responses and was open to change in responses, even if the responses seemed messy and occasionally tangential. My reflections and interpretations then inspired new, more important questions, which became the basis of subsequent conversations with the same informants. They would also recommend other informants to help with answering my questions. Overall, open-ended conversations with various elite informants have been very important for me to develop meaningful insights.

In addition, I carried out structured and semi-structured interviews with individual citizens through a randomized process in key locations within an eco-development. These locations were often recommended by local officials and planners. Sometimes they helped me get connected with community managers so that I could visit an enclosed area, such as a gated community, a company, or a school. In this way, I could speak to citizens who were in the area of study for a range of different purposes. These citizens included, but not limited to, park visitors, civic activity organizers, street cleaning and environmental maintenance staff, restaurant workers, small business owners, employees who worked in the area, public housing residents, gated community residents, resettled former villagers, college students, teachers, and school administrators.

During all the interviews, open-mindedness toward various perspectives was key to inviting more genuine reflections. I considered people's rationales based on their backgrounds, political positions, and personal agendas. My personal understandings of the culture, language, and society thanks to growing up in China have enhanced my social sensitivity when doing research in China. This social sensitivity has been largely enabling in a human-centered research process. My personal background has complemented my scholarly research to help with interpretation and expanding connections for research. In addition, experienced experts and scholars helped me learn about the politics in a place,

which further enhances my social sensitivity. They provided valuable advice that allowed me to identify whom to speak to, what to ask, and how to talk to the key informants while being considerate towards their positions.

Questionnaire-based surveys: I recruited local college students to assist with questionnaire distribution on site. I also received support from the government and local companies who facilitated the distribution. Such help was important since local citizens were not always interested in filling out a three-page-long survey. The responses also vary in quality, which likely hinged on the participants' interest in the research and their personalities. When the response was collected in person, I could observe individual's reactions and comments as they were filling out the survey. Such social cues and accidental conversations sometimes revealed the participants' opinions about the survey itself and about the development under investigation. This helped me to know how the questionnaire could be improved. I also managed to ask clarifying questions in person with the participants.

Ethnographic fieldwork: My fieldwork and data collection process was ethnographic in nature. I not only carried out in-depth interviews with various informants, but I also joined some of their work meetings with their approval to observe how decisions are negotiated and made in specific multi-stakeholder conversations. In addition, these key contacts introduced other informants whom they considered important to speak to. Through such a snowballing process of networking, I was introduced to not only informants who have played important roles in the selected projects, but also other officials, policymakers, and design and planning practitioners who participated in the selected projects, who continued experimenting with eco-development beyond the selected cases, and who are knowledgeable about the evolution of China's various eco-developments more broadly. The additional perspectives from these experts increased the saturation of information and enhanced my understanding of the broader impact of the eco-developments. Collectively, these voices represented a salient sentiment among visionary experts who were forward-looking and hopeful in their practices. Their discourses cross-verified various perspectives. Their practices and their visions, often embodying both political aspirations of the government and scientific knowledge from their expertise, exemplified important public discourse and specific policy directions.

Critical discourse analysis:
The analysis and conceptualization of collected information remain some of the most challenging parts of the research. The conflicted and conflicting views from various sources can lead to cognitive dissonance in the researcher. To avoid such conceptual chaos, discussing the matter with knowledgeable experts and scholars is always fruitful. Generating meaningful critiques and insights necessitates deep knowledge about China's politics, history, culture, traditions, and language, which can only come from years of experience in related fields of study and practice.

While conducting interviews and critical discourse analysis, I considered the power dynamics at play and acknowledged the implicit biases underlying each individual's opinions. In order to improve internal validity—the ability to interpret causality—and external validity—the ability to generalize findings, I triangulated data sources to add depth and richness to the narrative and to put individuals' opinions in perspective. I also triangulate and cross-verify the perspectives by comparing opinions from both the supply and the demand sides, from both the privileged and the disadvantaged populations, and from the more neutral individuals (such as scholars and experts who were not directly involved in the development). While it is fortunate for me to have access to the increasingly multidisciplinary perspectives in the world of scholarship, I have realized that it is also

important for a researcher to establish their own belief system based on what is learned both from extensive global discourse and from perceived and observable "truths" on the ground. It is important to be inquisitive about others' theories, reflect on their premises, and identify what is overrepresented and what is underrepresented. The critical analysis and interpretation of data would require value-aligned reflection and conceptualization.

Potential studies:
During my fieldwork, local officials and builders of the selected projects have expressed their curiosity towards the actual ecological, environmental, and social performance of an eco-development. Such performance-based investigations are indeed worthwhile to carry out. Yet they require governmental and institutional support in China and would necessitate interdisciplinary studies that involve designers, planners, and natural and social scientists who can collaborate to generate effective data for verifying the validity of claimed achievements in China's eco-developments.

