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# Sustainable urban transformations towards smarter, healthier cities: Theories, agendas and pathways

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**Sustainable urban transformations towards smarter, healthier cities:**
**Theories, agendas and pathways**

**Abstract**

The ongoing process of global urbanization has shifted the discourse from 'developmental mechanistic' towards 'sustainable and ecological' view. Global cities must also transition toward more dynamic, sustainable, healthier and smarter futures. However, the supportive transition theories, trajectory agendas, methodologies and pathways are currently under-investigated. This introductory paper provides an overview of the twenty-seven papers included in this special volume, with the objective to document the key lessons learned and to catalyze theoretical dialogue about the evolution of smart cities, healthy cities, eco-cities, and regenerative cities. These authors reviewed how these aspects of evolving cities are measured, monitored and implemented across different geographic, time and cultural contexts. After reviewing and mapping the obstacles and enablers in implementing transitions towards smarter, healthier, sustainable, regenerative, post-fossil carbon, urban societies, the authors of this introductory article provide insights into practical pathways and examples of best practices of their implementation in multiple social, cultural and climatic contexts.

## 1. Introduction

This Special Volume (SV) was designed to contribute to the literature on sustainable urban transitions was based upon inputs to two of the workshops held in the First Global Cleaner Production & Sustainable Consumption Conference, held in Sitges, Barcelona, Spain during November 1-4, 2015. It was also built upon articles on Sustainable Urban Transformations, which were recently published in the Journal of Cleaner Production (JCLP), in SVs devoted to similar but distinctively different foci. These include, for example, Li et al.'s (2017) "Urban Ecological Infrastructure for Healthier Cities: Governance, management and engineering", Vergragt et al.'s (2016) "Transitions to Sustainable Consumption and Production in Cities", Zhang et al.'s (2015) "Toward a Regenerative Sustainability Paradigm for the Built Environment: from vision to reality" and Puppim de Oliveira's et al. (2013) "Climate Co-Benefits in Urban Asia."

In this SV, the prospective readers are provided an array of insights contained in the twenty-seven articles, which span the topics of regional eco-efficiency, urban redevelopment, urban regeneration, urban ecological resources and economy, urban usage of renewable energy systems, smart cities, environmental performance of cities, transitioning cities to renewable energy technologies. It also highlights lessons learned from relevant sustainable city districts, Green Start Communities, the environmental profile and lifecycle assessment of building performance, sustainable construction transitions and community involvement with special focus upon, sustainable building materials, methods, and sustainability communication and organization.

### 1.1. Historical background

In their article titled 'Impact of Population Growth,' Ehrlich and Holdren (1971) discussed the disproportionate negative impacts of the population growth and human actions on the planet's ecological integrity with great accuracy. They emphasized that theoretical solutions were seldom operationalized and when they were, they seldom 'solved' the problems (Ehrlich and Holdren, 1971, p.1212). Their early assessments resonate today even more strongly with the environmental, social and economic and ethical concerns than they did in the 1970's. Their assertions about the negative externalities of the most widely

deployed technologies to safeguard the environment's well-being would have unanticipated ecological costs when the residual per capita impacts were weighed proportionally to the population that engaged in those activities (Ehrlich and Holdren, 1971, p.1216).

Currently, the world's population continues to grow by 1.1%/yr. by adding a net increase of approximately 83,000,000 people annually (UNDESA, 2017). If it continues to increase at this rate, it is projected for the human population to be 9.8 billion by 2050 (UNDESA, 2017). Together with the rapid increase in resource consumption and energy flow rates (Huisingh et al., 2015), the current sustainability approaches are becoming less effective, if not obsolete, in terms of building the much-needed momentum towards mitigating anthropogenic climate change (WWF, 2016; UNEP, 2016). There are several factors, which reduce the progress toward broader sustainability transitions such as political and economic ambitions of governments, the linear economic model upon which developmental policies are formulated, resistance to change (Juarez Na'jera, 2010; Lozano, 2009) and the lack of education of societies on the urgent need to make dramatic changes.

In addition to the increasingly evident anthropogenic drivers of climate change (IPCC, 2014), the aging, or poor quality infrastructure of cities, are threatening the wellbeing of urban populations and their eco-systems that already face adversities such as hurricanes, earthquakes, floods, new diseases, refugees, increasing crime rates and other disasters that cause massive traumatic experiences of the societies.

In response to the social and environmental pressures caused by rapid expansion policies and the unprecedented speed at which urban growth occurred in the post-WWII era, '*sustainability*' as a concept emerged in the mid-1900s (Hofstra and Huisingh, 2014); and evolved as an *anti-establishment, self-sufficiency movement with locally available renewable resources designed to limit consumption and development* (du Plessis, 2012, p.9) during 1960s and 70s.

Since the adoption of the WECD, in 1987, there has been a steady evolution of Sustainable Development (SD) as a concept and as a movement. Although promoters of SD sought to encompass the economic, social and environmental dimensions as the mainstream sustainability discourse, it was criticized for being too vague, political, and designed to prioritize economic and commercial interests over ecological concerns (Blühdorn and Welsh, 2007, 189).

One of the relatively better defined and operationalized sustainability approaches was Ecological Modernization (EM) with its theoretical foundations in discussions pertaining to the Risk Society Theory, de-industrialization and de-modernization debates (Mol and Spaargaren, 1993, p.433). These approaches were also addressed by the neo-Marxists and other de-industrialization theorists who challenged modern society's institutions, and centralization of the state/governance and capitalism (Mol and Spaargaren, 2000). However, governmental leader's aspirations for eco-development and the private sector's pursuit of rapid economic growth and usage of resources (du Plessis, 2012) led to its relative success and more effective operationalization as it rapidly eroded the ecological foundation upon which it was and continues to be totally interdependent.

Although, there has been much debate about the extent to which these concepts and theoretical approaches were effective, their reflexive character, in terms of questioning and exploring different aspects of science, technology, and human-nature relationships in the context of environmental integrity, resonates with the emerging problems, which societies are experiencing currently.

Since the early 90s, sustainability researchers sought to address more effective design and development concepts. These included, Industrial Ecology, Industrial Symbiosis, the Circular Economy, Cradle-to-Cradle, Living Machines, Net Zero Building and other developments, all of which were designed to more effectively implement sustainability transitions from reductionist to restorative thinking in planning, design and/or in production and consumption of goods and services.

However, to accelerate the transition to sustainable cities and societies, holistic, systems-based and integrative approaches are needed today and will be even more urgently needed in the future. Among the new types of development, Regenerative Development (RD) was explored by J. T. Lyle (Lyle, 1994; Birkeland, 2012) as early as 1994, among other emerging concepts in ecological design including 'positive development', 'biomimicry', 'permaculture' (Birkeland, 2012, p.168). The RD leaders emphasized the importance of co-

evolution of human and natural systems in mutually beneficial ways (Cole, 2012), which was the defining notion that differentiated it from previous sustainability concepts.

In the urban context, Cole (2012) described RD as the 'renewal' and 'rebirth' of a place. According to Mang and Reed (2012), RD focused on forming a mutually beneficial environment for all inhabitants if contextualized within a symbiotic human and nature relationship that was designed not only to restore but also to improve the system of the place (Mang and Reed, 2012, p.36). But, how can the dynamically evolving conditions of a place be measured, assessed or evaluated to guide decision-makers, planners and designers based upon documented evidence of improvements of the 'system of the place' among the eco-system and human inhabitants?

Birkeland (2012) suggested that support systems of nature must be increased significantly in order to mitigate the deterioration of all ecological, social and economic dimensions and that the preindustrial levels must be taken as the ecological baseline (Birkeland, 2012, p.163). She emphasized that all intellectual, biophysical, institutional dimensions need to be addressed to help to restore systemic flaws and to generate positive developments. In order to achieve these combined positive effects, RD as a sustainability paradigm, "aims to adopt localized ecological design solutions and engineering practices to restore and to regenerate the global social-ecological systems," (du Plessis, 2012, p.15).

Additionally, it is essential to emphasize '*resilience*' in the context of urban development and planning while the rapidly increasing number of major disasters and changes in climate are pushing the world's cities and the urban populations into chaos and trauma beyond their known psychological, biological and physical limits. Du Plessis (2012) discussed 'resilience' in conjunction with regenerative development that it could potentially provide a better trajectory, than what is prevalent in current city dynamics. She highlighted the various definitions used to explain resilience, unpredictability, adaptive capacity and variability as the elements to better explain aspects in conjunction with building resilience in the urban context (du Plessis, 2012, p.17). Thus, RD should not only address the institutional, physical and the built-environment or re-development of regions but also reflect upon the psychosocial factors that influence behavioral and cognitive adaptations of societies to the rapidly evolving realities.

Doppelt (2016) extensively discussed, in his book, "*Transformational Resilience: How Building Human Resilience to Climate Disruption Can Safeguard Society and Increase Wellbeing,*" (Doppelt, 2016) how to more effectively build the urban coping mechanisms to deal with adversities and to catalyze transformational changes towards building and enhancing human-habitat resilience.

Similarly, the psychological, biological and ecological aspects were discussed by, Hes and du Plessis (2014) in the context of regenerative developments in which the human-nature symbiotic relationships were rebuilt in ways that all species could thrive mutually (Hes and Plessis, 2014).

In that context, RD is gaining momentum and is becoming a comprehensive theoretical approach, through which many researchers are investigating to develop more systemic insights into understanding and clarifying its philosophy since its emergence in the mid-90s and early 2000s. While it proposed to be evolving into a definitive ecological worldview compared with previous paradigms, it has been found to be somewhat vague in terms of its contextual practicality.

As Cole (2012, p.4) questioned its applicability, it is not yet clear how RD can best provide the guiding principles for its practical use and implementation in complex dense urban systems. This SV was designed to explore the different aspects of the theory and practice of RD to better contextualize and guide implementation of its principles to help to influence professionals/practitioners, policy makers and researchers broadly to develop more sustainable societies which are equitable, sustainable, livable and are based upon post-fossil carbon policies, processes and technologies.

## 2. Overview of the papers included in this SV

This SV of the JCLP was originally designed to address the objectives of:

(1) Documenting and catalyzing the theoretical development of the terms smart cities, healthy cities, eco-

cities, and regenerative cities and their emerging principles and practices;

(2) Explaining how these terms can be measured, monitored and implemented;

(3) Providing encouraging practical pathways and examples of best practice of their implementation in multiple social, cultural and climatic contexts;

(4) Catalyzing and mapping obstacles and enablers that must be understood and addressed so that more rapid progress can be made in implementing the transformation towards smarter, healthier, sustainable, regenerative, post-fossil carbon, urban societies.

Many of the twenty-seven papers of this SV contributed to many of these aspects, as shown in Table 1. The remainder of this section highlights how each author or team of authors contributed to the four themes.

2.1. *Theme 1: Theoretical definitions, future visions or imaginaries, characteristics of catalyzing sustainable urban transformation (including smart cities, healthy cities, eco-cities, regenerative cities and related* concepts)

**Marc Wolfram's "***Cities shaping grassroots niches for sustainability transitions: Conceptual reflections and an exploratory case study***"** discusses the crucial role cities play in the emergence and formation of grassroots socio-technical niches for sustainability transitions. Drawing on research focused upon strategic niche management, grassroots innovations and urban social innovations, it conceptualizes the interdependencies between urban contexts and grassroots niche dynamics, and explores a critical case in point: Current policy efforts in the city of Seoul to create, diversify and network social innovations in urban neighborhoods. The analysis illustrates the specific characteristics of innovative place-making activities in everyday-life urban environs and how empowerment, proximity and institutional thickness enable them to meet basic conditions for niche formation in terms of networking, shared expectations and social learning, while also raising new questions of inclusion, legitimacy and strategy. In conclusion, four issues were highlighted that appear to decisively impact on the formation of urban grassroots niche and related sustainability transition pathways: 1) Urban empowerment capacities, 2) Embedded holistic innovation, 3) Novel community-oriented governance modes, and 4) Urban niche/regime interactions. These issues require attention in future research and policy to guide the coevolution of cities and urban grassroots initiatives towards sustainability.

For many scholars, sustainable urban transformation should be a socially inclusive process in which all urban residents should have a representative voice in its planning and redevelopment.

**Ying Liu, Yanliu Lin, Na Fu, Stan Geertman and Frank van Oort**, in the article, "***Towards inclusive and sustainable transformation in Shenzhen: Urban redevelopment, displacement patterns of migrants and policy implications***"** developed this in the case of China's 'villages in the city' (ViCs) a local urban phenomenon of rural villagers finding themselves isolated in an urban area that has grown around them, yet were unable by law to have urbanized themselves without government. As a result, they were often expropriated, via an exclusionary process in which occupants, many of which were migrants working in the urban areas, were excluded from the decision-making processes. This resulted in inequality and a redistribution of their real income. The migrants' displacement pattern of spatial attachment was explained by their attempts to maintain real income through three modes of integration (redistribution, market exchange and reciprocity). In their research, the authors revealed that the displaced migrants have a strong desire to remain nearby and to maintain their real incomes. The impact of displacement on migrants, it was argued, needs to be considered for urban redevelopment projects, since this social group can become more marginalized in the city due to the redistribution of real incomes resulting from displacement. The authors concluded that the ViCs could be gradually transformed into sustainable neighborhoods with small interventions and incremental upgrading due to their lively and diverse commercial activities. Considering this, the authors suggested economically, spatially and socially inclusive planning strategies should replace the current demolition-development model, thereby providing pathways towards more sustainable transformation of ViCs in the future.

**Mark Deakin and Alasdair Reid's "***Smart cities: Undergridding the sustainability of city-districts as energy efficient low carbon zones***"** reviewed the literature on smart cities. By offering a critical synthesis of

the material, the authors advanced a Triple Helix inspired account of smart cities as future internet-based developments. As future internet-based developments covering the digital infrastructures, data management systems, renewable energies and cloud computing of a regional innovation in the Internet of Things (IoT). More specifically, as a regional innovation in the IoT that covers the morphology of urban extensions, infill and mass retrofits, which smart cities call for the development of. Focusing on the metrics of mass retrofit proposals, the paper served to demonstrate how the urban morphology of such regional innovations matter in the sense they tell us that being aware of the considerable energy savings and CO2 reductions, which IoTs offer cities to be smart, is not enough. Not enough, because without knowing whether the costs and benefits under-gridding the sustainability of city-districts are shared equally, it is impossible to say if the 65% energy saving and 78% reduction in CO2, attributed to the data collection, information processing and smart (micro) grids of mass retrofits is socially just. The paper suggests that to verify this, it is necessary for smart cities to first baseline the social-demographic structure of retrofit proposals. Then draw upon the environmental profile this evaluation generates to assess whether the regional innovation creates the wealth needed to under-grid the sustainability of city-districts. Under-girding the sustainability of city-districts as the energy efficient-low carbon zones of an inclusive growth strategy is seen to be socially just. Seen to be socially just, because the costs and benefits underlying the ecological footprint that surfaces from this regional innovation are equally appropriated as the proceeds of a wealth creation, which contributes to the resilience of city-districts as energy efficient-low carbon zones, whose inclusive growth strategy also emerges within a post carbon economy designed to be climate neutral.

Although much emphasis has been given to sustainable planning, governance, technologies and innovation in the context of energy and water efficiency, waste reduction and recycling, one of the most neglected aspects of effective operationalization of sustainability goals has been to observe and understand the user behavior and/or willingness to adopt sustainability measures at the household level. Several research teams examined existing waste generation patterns and identified green practices adopted at the household level by documenting and analyzing the possible practices that help in reducing the generation of waste. This includes waste practices associated with generation, reuse and recycling for nine material categories of waste, including paper, plastic, glass, metal, textile, kitchen waste, garden waste, e-waste and appliances.

In their article, **“Exploring linkages between sustainable consumption and prevailing green practices in reuse and recycling of household waste: Case of Bhopal city in India,”, Rama Umesh Pandey, Akhilesh Surjan and Manmohan Kapshe**, expanded upon the field realities from a central Indian city with a population of approximately two million people, which were captured through detailed stakeholder surveys and focus group discussions with experts. Their primary survey was conducted to cover four income groups' categories spanning across 'formal' and 'informal' housing typologies, to understand and to examine the linkages between waste generation and life style, the reuse/recycle practices adopted by the households, and the extent of the usage of such practices. The research revealed innovative, smart and frugal reuse practices adopted at household levels, and documented the extent of how reusability differed among income groups. In their research, the authors highlighted the importance of formally recognizing the potentiality of existing reuse and recycling practices among the Indian households by the planners and urban practitioners to curb waste generation more effectively.

There is no consensus on what is meant by 'smart city" but generally it is an urban development vision to integrate "smart technologies" in city development and governance to achieve a smart life. Big data are being generated during this process and they can be harnessed to help to achieve the 'smart city' vision. However, to date, the idea, actions, and risks of smart cities and big data have not been fully explored in the unique contexts of China's unprecedented urbanization. In this context, **Yuzhe Wu, Weiwen Zhang, Jiahui Shen, Zhibin Mo, Yi Peng's “Smart city with Chinese characteristics against the background of big data: Idea, action and risk,”** sought to demystify the concepts and their relationships through a development framework of smart city with Chinese characteristics analyzed within the support of big data. Key actions, including rational planning of city infrastructures, the establishment and improvement of long-acting mechanisms, the effective performance of city managerial functions, were proposed to help to realize the development visions. The authors also investigated the risks embedded in development of smart cities with Chinese characteristics, e.g., information safety, weak emergency responding capacities and poor independent research and development capacities of

core technologies. Their findings can be used to help facilitate Chinese local governments to develop and implement the blueprint of smart city development.

These bottom-up strategies may help to establish effective solutions in terms of mitigating the rapidly developing urban areas if synergistically and integratively used to accelerate the societies' post-fossil carbon transitions. Like India, other countries with rapid growth rates, such as but not limited to China, experienced exponential increases in their energy demands in the past four decades. Therefore, electricity generation and different models to provide cleaner energy have become one of the most researched areas in the context of climate change mitigation.

In that vein, **Cong Chen, Hualou Long and Xueting Zeng, in their article,** *"Planning a sustainable urban electric power system considering effects of new energy resources and clean production levels under uncertainty: A case study of Tianjin, China,"* focused on electricity generation and developed a risk-aversion optimization model for an urban electrical power system (RAOM-UEPS). By investigating the stochastic uncertainties and capturing the associated risks, the system enabled managers to analyze the tradeoffs between system costs and system risks. The RAOM-UEPS was applied as a case study in the planning of a Tianjin urban electric power system, in which three scenarios were considered, each with different proportions of new energy resources and clean production levels (i.e., energy conversion efficiencies). This enabled the development of an urban electric power system (UEPS) optimization model for supporting the city's transformation from a coal-fired system to a low-carbon electric power mix, as well as the sustainable development of society by facilitating a sophisticated system analysis of energy supply, electric power conversion, capacity expansion and environmental protection over multiple periods. The results underscored the predominance of coal in Tianjin's electrical power generation system, which was the primary source of air-pollutants and $CO_2$ emissions. Therefore, expanding clean energy levels could significantly save energy resources, and mitigate air pollutants and reduce fossil-carbon based $CO_2$ emissions. These findings can provide a scientific basis for the sustainable development of regional electrical power systems, as well as for transitioning from coal-dominated to low-fossil carbon electrical power based cities.

### 2.2. Theme 2 Performance assessment of sustainable urban transformation towards smarter, healthier, more ecologically sound and regenerative cities

This theme is essentially concerned with the measurement of sustainable urban transformation and its application, including the use of a hybrid multi criteria decision-making method (MCDM) and the fuzzy analytic process (FANP), an extended data envelope analysis (DEA) model, the combination of local (territorial) data analysis and use of more global input-output tables, an improved Gaussian processes regression (GPR) method and life cycle assessment using the ISO 14040/44 methodology.

A green building material (GBM) is an ecological, health-promoting, recycled or high-performance building material. The absence of clear instructions for GBMs and the difficulty of precision adjustments of GBM criteria with the three pillars of sustainability make GBM selection a challenge, with the consideration of all sustainability factors involved representing a problem that requires such mathematical techniques as MCDM.

In this context, **Seyed Meysam Khoshnava, Raheleh Rostami, Alireza Valipour and Mohammad Ismail's** *"Rank of green building material criteria based on the three pillars of sustainability using the hybrid multi criteria decision making method"* applied a hybrid MCDM methodology to resolve multiple incompatible and conflicting GBM criteria, with the Decision-Making Trial and Evaluation Laboratory (DEMATEL) a hybrid model using the FANP used to analyze the efficacy of, and interrelationships among the criteria and their aligning and ranking parameters. The criteria identified from a comprehensive literature review were used to modify one of the oldest GBM criteria models in consultation with four groups of professionals involved in GBM selection in Malaysia. The results showed that the relationship between GBMs and sustainability criteria are different for each of the three pillars of sustainability; the evaluations and results provided valuable references for building professionals to enhance sustainable construction with MCDM for green materials decision-making.

Eco-efficiency is receiving increasing worldwide attention and **Lin Yang and Xian Zhang's** *"Assessing*

*regional eco-efficiency from the perspective of resource, environmental and economic performance in China: A bootstrapping approach in global data envelopment analysis*," investigated the 2003-14 dynamic trends of regional eco-efficiency in China. The authors utilized an extended DEA model involving a combination of global benchmark technology, a directional distance function and bootstrapping, together with a slacks-based measure to decompose performance fluctuations into resource, environmental and economic efficiencies. The key factors responsible for the changes in eco-efficiency were explored using the global Malmquiste Luenberger index to reveal a general upward trend of eco-efficiency in China, which is higher in eastern and northern areas but low in northwestern areas. Some eco-efficient regions, however, consumed a considerable amount of land, water and energy and emitted many environmental pollutants in absolute terms. The whole of China performed well on the economic front, while resource and environmental performances were less good, particularly in environmental efficiency. The eastern and northern regions experienced the greatest advances in resource and environmental efficiency, but made less progress in undeveloped areas, thereby, further widening the gaps between the country's developed areas and undeveloped areas. The decomposition of productivity growth indicates that technical progress was the decisive factor in promoting China's ecoefficiency, while a decreasing management level was, the major obstacle hampering its improvement.

In an era of pressing local and global environmental challenges, it is essential to understand that cities are complex systems dependent on, and linked to, the rest of the world through global supply chains that embody an array of environmental flows. Cities are thus a complex articulation of intertwining local and global challenges, relying on their extended hinterland for their resource use and pollution emissions. To make a comprehensive assessment of the environmental sustainability of an urban area, therefore, it is necessary to both measure its local and direct environmental performance and understand and consider its global and indirect environmental counterparts.

In this context, **Aristide Athanassiadis, Maarten Christis and Philippe Bouillard, An Vercalsteren, Robert H. Crawford and Ahmed Z. Khan's "***Comparing a territorial-based and a consumption-based approach to assess the local and global environmental performance of cities***"** demonstrated this by a comparative analysis of a territorially-based and consumption-based approach to estimate both the direct and embodied resource use and pollution flows of the Brussels Capital Region (Belgium). The territorially-based approach was based on local energy, water and material consumption data as well as data on waste generation and pollution emissions, while the consumption approach estimated indirect resource use and pollution emissions (or consumption-based approach) based on input-output tables of the Brussels city-region and multi-regions, considering global flows of consumption. The comparison of the two approaches was particularly relevant in the case of cities that have limited productive activities and limited or no extraction of materials, as the impact on the hinterland is often underestimated or neglected by local (environmental) policies based solely on territorial figures. The results showed that indirect primary energy use, GHG emissions and material use estimated by the consumption-based approach is more than three times higher than what local measures documented, while embodied water use was over 40 times higher than local water consumption - indicating the unreliability of the territorially-based approach. The authors concluded by discussing the possibility of combining the two approaches to create an improved, hybrid, framework that can provide an accurate and comprehensive assessment of the full environmental performance of cities.

China has been proactively searching for ways to reduce its dependency on both the fossil-fuel based energy production technologies, and the expertise, which was used extensively by foreign investors, as well by the professionals from outside of China. In the article by **Kaijian Li, Guiwen Liu, Asheem Shrestha, Igor Martek and Xiaoling Zhang,** *"The role of local private participation in China's transition to domestically developed renewable energy technologies,"* focused upon China's strategic directions, to achieve energy self-reliance via renewable sources. They analyzed 555 cases and found that foreign companies based outside of Mainland China and those from Hong Kong had played significant roles. They also discovered the increasing influence of the local firms in terms of becoming competitive actors in the development of projects based upon renewable energy technologies. Strong associations were identified between the increase in renewable energy projects and the growth in the participation of local companies in the energy sector.

Sustainable urban development initiatives were found to yield varying outcomes depending on the level of

participation of the potential and/or existing residents, the stakeholders and interest groups in the decision-making processes from the initiation phase through the development phase as well as during their occupancy phases. Thus, it is important to understand the factors that affect the urban development processes, the actors and their potential influence over the planning and development processes, to achieve successful outcomes that involve a wide array of sustainability goals and objectives.

The concepts of Sustainable Development and Quality of Life (QoL) dimensions are pivotal for planning and development of socially and environmentally more liveable cities. These aspects became increasingly popular among scholars, policy-makers and planners in the past two decades with significant efforts directed into understanding and developing methods to measure physical, environmental and societal elements, which are essential to explain individual and societal well-being.

In this SV, **Ji Han, Hanwei Liang, Keishiro Hara, Michinori Uwasu and Liang Dong** explored interconnected facets of QoL dimensions in Shanghai, China in their article titled, ***"Quality of life in China's largest city, Shanghai: A 20-year subjective and objective composite assessment,"*** the authors presented the results from their surveys designed to identify the factors that affect the resident's perceived wellbeing. They found that QoL in Shanghai had steadily improved during the last two decades, with relatively higher QoL scores in the city center and sub-center regions. Additionally, they suggested that the improvements in the social environment and transport accessibility have played dominant roles in contributing to the improvements of QoL perceptions in Shanghai. It was suggested that such composite assessments of QoL perceptions could be used to plan the future layout of city infrastructures, allocation of resources, and the locations of a community's amenities and services, in more effective ways.

The realization that global warming will affect immigration, agriculture and generate human conflicts is becoming a focus in climate change research and forecasting its main source - $CO_2$ emissions - has attracted much attention.

For example, **Debin Fang, Xiaoling Zhang, Qian Yu, Trenton Chen Jin and Luan Tian's "*A novel method for carbon dioxide emission forecasting based on improved Gaussian processes regression*"** contributed to this in developing an improved GPR method based on a modified Particle Swarm Optimization (PSO) algorithm to efficiently optimize the hyper parameters of the GPR covariance function. The improved PSO-GPR method's retrospective application to 1980-2012 United States, China and Japan total carbon dioxide emission data demonstrates that its superior accuracy over the original GPR and BP Neural Network methods. Forward application of the PSO-GPR method to 2013 to 2020 showed that China's total $CO_2$ emissions will still increase initially but finally at a decreasing rate, while the United States and Japan will have a good control over their emission amounts in the near future. The concluding remarks addressed the policy implications for future $CO_2$ emissions reductions.

**Lizhen Huang, Yongping Liu, Guri Krigsvoll and Fred Johansen's "*Life cycle assessment and life cycle cost of university dormitories in the Southeast China: case study of the university town of Fuzhou*"** assessed university dormitories in terms of life cycle environmental impact and cost of the sustainable development of southeast China university campuses. The life cycle assessment was based upon the ISO 14040/44 methodology, considering the construction, operation, maintenance and demolition stages, with the reference unit defined as 'one useful square meter of university dormitories with a 50 year life-time'.

Using the Ecoinvent database for background data, the life cycle inventory was estimated for a Fuzhou by the: 1) the tender information of university dormitories built during 2007-11; 2) water and energy bills of the buildings over past five years; and 3) damage and maintenance reports of the Fuzhou University and Fujian University of Traditional Chinese Medicine dormitories during 2004-14. The results showed that 1) the post-occupancy stage, including operation and maintenance, dominated of the life cycle environmental impacts and costs of university dormitories, 2) consumption of electricity has the main environmental impact over the building's life cycle, energy efficient building technologies are more important than other factors, and 3) windows, concrete, steel and cement make the largest contribution to the embodied environmental impacts but with a relatively small contribution to life cycle costs. Therefore, two main opportunities for improved reduction in the environmental impacts in the development of Chinese university dormitories are: 1) improving

existing dormitory buildings by making deep renovations, and by implementing low energy building standards for new built dormitories to maximize energy efficiency and 2) increasing the use of low environmental impact building materials by implementing a carbon tax on the main building materials and the greater use of timber for structural purposes. The need for policies to promote more renewable energy supplies and the implementation of carbon capture and storage technologies were also identified as important issues.

**Hongyang Li, Xiaoling Zhang, S. Thomas Ng and Martin Skitmore, in their article, "*Quantifying stakeholder influence in decision/evaluations relating to sustainable construction in China - A Delphi approach,*"** analyzed the stakeholders of sustainable construction processes in the context of China and sought to quantify their influence over the decision-making by conducting, a. semi-structured interviews, b. a three-round Delphi survey and, c. follow-up interviews. They documented the strong influence of the government in the development process and in safeguarding the interests of various stakeholder groups. More importantly, in their evaluations, the authors underscored the need for meaningful participation of the end-users in the decision-making process in which, inclusiveness and transparency were found to be key elements.

### 2.3. Theme 3: Pathways towards urban models that support sustainable urban transformation

This theme addressed contemporary efforts to identify those most likely to lead to a more sustainable urban future. These included the conditions and mechanisms involved in accelerating urban sustainability, progress in bottom-up participation, mitigating ecological pressures on construction material metabolism and the benefits of off-site construction.

In recent years, multiple transformation initiatives have been made in cities across the world towards sustainable urban systems. To determine how much these initiatives influence systemic changes or accelerate sustainability transitions, **Leen Gorissen, Felix Spira, Erika Meynaerts, Pieter Valkering and Niki Frantzeskaki's "*Moving towards systemic change? Investigating acceleration dynamics of urban sustainability transitions in the Belgian City of Genk*"** applied an analytical framework, conceptualizing five mechanisms of replicating, partnering, upscaling, instrumentalizing and embedding to examine the transition dynamics within the Belgian City of Genk. The focal units of analysis were the innovative activities and related actor-networks from the city region, defined as 'transition initiatives', situated in the context of local governance. Ten local transition initiatives were selected with a clear focus on environmental sustainability in setting out to understand their origins and identify the conditions and mechanisms involved. All five mechanisms of acceleration were shown to be applicable in Genk and the local governance context is favorable for accelerating transition dynamics to sustainability, mostly because it promotes diffusion, partnering and embedding processes. For instance, one important initiative for partnering is the Heempark, a Public-Civic Partnership in which volunteers and the government collaborate in a way that is mutually beneficial. The findings provided early indications of mounting changes, increasing reflexivity and coordination from governance actors and diffusion, embedding and reutilization of more sustainable ways of thinking, doing and organizing in the wider public. These acceleration dynamics were most apparent in the food, nature, resource and education domains in Genk and are mostly fueled by multi-actor collaboration. On the aggregate level, these observations suggested an accumulation of socio-cultural, economic, ecological and institutional changes, prompting the conclusion that early, but fragile, acceleration dynamics are unfolding in Genk. The findings help to deepen understanding of the acceleration dynamics of urban sustainability transitions and may be of interest for practitioners in the field, globally.

The purpose of **Eduardo Aguinaga, Irene Henriques, Carlos Scheel and Andrea Scheel's "*Building resilience: A self-sustainable community approach to the triple bottom line*"** was to assess, theoretically and empirically, the governance approach associated with the formation of the circular value ecosystem (CVES) within Sustainable Wealth creation based on an Innovation and enabling Technologies (SWIT) framework. The SWIT framework is designed to interlink economic models, policies and strategies to introduce and convert residue, waste and byproduct chains into multiple increasing returns cycles. Unlike regional circular economy cases in Germany, Japan and China where governments or industry have taken the lead on such initiatives as top down governance, the SWIT framework was developed for regions where government

support for eco-initiatives was weak and where the bottom up participation of community stakeholders was critical. The ecological, social and economic dimensions of the system were explored to ascertain the key stakeholders critical to the CVES governance in seeking to understand what stakeholders must be incorporated in bottom-up CVES governance for the SWIT framework to be able to restore environmental resilience while creating economic returns and social benefits in rural communities. An action research case was used to document both successes and challenges occurring with this community-driven bottom-up governance approach with a rural community in Mexico, this revealed that, in addition to civic collaboration, a deep understanding was also needed of the social, political, environmental and economic characteristics of the community.

 China's rapid urbanization is characterized by large-scale construction activities that require enormous amounts of construction materials and accompanying resource and environmental problems, while little serious attention has been paid to construction material metabolism within the urban ecosystems involved.

In response to these challenges, **Wei Huang, Yunfeng Huang, Shuzhi Lin, Zhihui Chen, Bing Gao and Shenghui Cui's "*Changing urban cement metabolism under rapid urbanization A flow and stock perspective*"** focused on changes in Xiamen's 2002-12 cement metabolism to elucidate the metabolic characteristics and mechanisms involved. They found that, (1) residential buildings account for 1/3 of total cement use, with increasing amounts accumulating as unused stock; (2) decoration is the second largest cement consumer after construction work and needs to be considered more in metabolism analyses; (3) road transport infrastructure is expected to maintain its growing cement usage; and (4) increasing amounts of construction and demolition waste are not reused or recycled. A multidimensional policy portfolio was proposed to mitigate the ecological pressures resulting from urban cement metabolism to foster sustainable construction, including the development of improved real estate policies, optimization of urban spatial patterns, popularization of decoration-binding residential buildings and premixed mortar usage, establishment of a waste recycling system, industrialization of the construction industry and the promotion of sustainable consumption. The research provided a reference template for future sustainable construction material management studies in rapidly urbanizing areas generally.

A city's economic development is often at the cost of possible ecological resource depletion. Yet, the reported relationships between economic development and the ecological resource costs range significantly from one studied area to another, and are highly dependent on the methods of inquiry.

In this vein, **Hongxiao Liu, Baolong Han, Lan Wang's** *Modeling the spatial relationship between urban ecological resources and the economy*, examined these relationships by using 'Gross Domestic Production (GDP)' and 'vegetation cover (measured by NDVI [Normalized Difference Vegetation Index])' as the proxies of 'economic development' and 'ecological resource', respectively, and focused on Chinese cities along the Beijing to Guangdong high-speed railway. By conducting the spatial matching degree analysis and econometric analysis of 85 cities along the significant railway, their research discovered a negative correlation between economic development and ecological resource conservation.

Precast in-situ construction is becoming more popular in China for its efficiency and ability to reduce construction waste. Few studies, however, assess the greenhouse gas (GHG) emissions involved. Therefore, **Yingbo Ji, Kaijian Li, Guiwen Liu, Asheem Shrestha, Jinxi Jing's "*Comparing greenhouse gas emissions of precast in-situ and conventional construction methods*"** established a systems boundary for the measurement of GHG emissions to assess if precast in-situ construction produces less GHG emissions than the conventional method. They found that while embodied GHG in building materials is the main GHG emitter in both precast in-situ and conventional construction methods, there are four factors that positively contribute towards reduced emissions: (i) embodied GHG emissions of building materials, (ii) transportation of building materials, (iii) resource consumption by equipment and techniques and (iv) transportation of waste and soil. Conversely, the transportation of on-site manufacturing equipment was identified as a negative factor.

Off-site construction generally refers to a building process conventionally carried on site that is instead carried out in a controlled factory environment away from site and its widespread use potentially provides numerous and significant benefits. In China, however, several transferable driving factors are lacking, such as strategic roadmaps, appropriate policies and sufficient workable guidelines. To investigate China's off-site

construction *status quo* against its backdrop of new urbanization, **Rui Jiang, Chao Mao, Lei Hou, Chengke Wu, Jiajuan Tan's** *"A SWOT analysis for promoting off-site construction under the backdrop of China's new urbanization"* study conducted an exhaustive review of the recent literature and governmental documents, along with semi-structured interviews with several experienced stakeholders. A strengths, weaknesses, opportunities and threats (SWOT) analysis was used to determine the advantages and barriers of implementing off-site construction in China. Key aspects were identified that the state-of-the-art research work has seldom addressed namely, top-to-bottom implementation roadmaps and strategies that could significantly contextualize China's 2014-20 National New Urbanization Plan and help the improve the competency of the Chinese construction sector.

### 2.4. Theme 4: Obstacles, benefits and enablers for the implementation of sustainable urban transformation

The obstacles to the transformation to an improved environment comprise a wide variety of interrelated institutional, regulatory, and individual and group behavioral issues. Obstacles and enablers often go hand in hand, with enablers seen as helpers in removing or ameliorating obstacles. To date, many tools and guidelines to reduce environmental impacts were available as enablers in the construction sector. However, basically all were modelled according to a backward-looking blame-type of attributional approach and there was a lack of studies that developed forward-looking strategies for improvement based on a consequential life cycle assessment.

In this context, **Matthias Buyle, Johan Braet, Amaryllis Audenaert and Wim Debacker's** *"Strategies for optimizing the environmental profile of dwellings in a Belgian context: A consequential versus an attributional approach"* analyzed the differences in results from applying both approaches to a representative dwelling in Niel, Belgium, with the addition of a conceptual optimization scenario for insulated exterior cladding to examine the effects on the ranking of improvement strategies. The entire life cycle results revealed differences between the approaches that are directly related to their underlying assumptions, and those which become more pronounced when examining the separate materials especially the three most contributing materials of steel, concrete and brick because not being damped by the aggregation in life cycle phases. From this, the authors concluded the need to include the consequential model as complementary to the attributional model as a useful addition to provide the right information for all types of decision-making.

Improving regional eco-efficiency provides a significant means of achieving the coordinated economic development and environmental protection earnestly needed in China, and effective environmental regulation systems are crucial to enable this to be fulfilled. Based on the 2000-13 panel data of China's 30 provinces, **Shenggang Ren, Xiaolei Li, Baolong Yuan, Dayuan Li and Xiaohong Chen's** *"The effects of three types of environmental regulation on eco-efficiency: A cross-region analysis in China"* pursued this by employing the STIRPAT model to test the effects of environmental regulation into command-and-control regulation, market based regulation and voluntary regulation on eco-efficiency in China's eastern, central and western regions. The research results indicated that the effects of different types of environmental regulation on eco-efficiency differ between regions, showing that: (1), market-based and voluntary environmental regulation in the eastern region have a positive impact on eco-efficiency improvement while command-and-control environmental regulation has no significant impact; (2) command-and-control and market-based environmental regulation can promote eco-efficiency more significantly in the central region, compared with voluntary environmental regulation; and (3) command-and-control environmental regulation plays a positive role in eco-efficiency improvement in the western region where market-based and voluntary environmental regulations have no significant impact. They concluded with policy recommendations to optimize and adjust the regional environmental regulation tools.

Economic growth and rapid mass migration into cities and has created many sustainability problems. Environmental pollution and land occupation because of increasing household solid waste are current major concerns, and separating different types of waste for collection is recognized as a sound way of disposal. However, waste separation is not common in China, and research into the dynamics of urban residents' behavioral intentions is scarce.

In this context, **Zhaohua Wang, Xiaoyang Dong and Jianhua Yin's "*Antecedents of urban residents' separate collection intentions for household solid waste and their willingness to pay: Evidence from China*"** used the theory of planned behavior as a framework to explore the antecedents of separate collection intentions for household solid waste and identify their effects on residents' willingness to pay for separate collection by other organizations. The results showed that separate collection intentions towards household solid waste are significantly influenced by the behaviors of others, facility conditions and moral obligations, while their willingness to pay for separate collection was also affected by age, perceptions of results and government policies. They concluded that the urban residents' willingness to pay is more sensitive to perceptions of results and policy implications than separate collection intentions in China and that the government should accordingly provide a pro-environmental climate, convenient facilities, detailed cases, cultivate environmental moral obligations and proposed appropriate promotional and incentive policies for different recycling modes.

Industrialized construction technology (ICT) is now widely used and becoming the new green construction method, and stakeholders are endeavoring to use inter-organizational collaboration develop more innovative methods. Despite its extensive use by the manufacturing industries, for example, little is known of how to apply this to ICT. **Xiaolong Xue, Xiaoling Zhang, Liang Wang, Martin Skitmore and Qi Wang's "*Analyzing collaborative relationships among industrialized construction technology innovation organizations: a combined SNA and SEM approach*"** to investigate this by developing a method for studying the effects of a variety of aspects of existing ICT collaborative innovation relationships using a combination of social network analysis (SNA) and structural equation modeling (SEM). A set of hypotheses was proposed concerning the expected influence of the SNA factors of interaction frequency, emotional intensity, reciprocal exchange, network size, network density, centrality, relationship strength, network position, promotion, enterprise scale, nature and experience on collaborative innovation. This was followed by the results of an Internet questionnaire survey of experienced staff or senior managers of large Chinese enterprises with an early exposure to industrialized construction, including Vanke, LongFor, Broad Homes, Shanghai Urban Construction, Shanghai Construction Engineering, Beijing Construction Engineering, Greentown Decoration, China State Construction Engineering System and Libby, in which SEM is used to identify the key indicators involved and how much they affect innovation. From this, a collaborative ICT innovation relationship model was used to determine the strengths of the interaction paths between stakeholders, which generally support the hypotheses indicating the suitability of SNA for developing collaborative ICT innovation and providing a suitable conceptual basis for modeling and analyzing of ICT innovation relationships.

The results led to suggestions for collaborative ICT innovation capacity to be advanced to promote interactions between stakeholders and the occupation of strategic positions, and recommendations to guide operating companies, designers and contractors in improving their collaborative innovation activities. Although restricted in this study to prefabricated housing construction in China, the authors claim that the methods used can be adopted in the broader global community.

**Filip M. Alexandrescu, Lisa Pizzol, Alex Zabeo, Erika Rizzo, Elisa Giubilato and Andrea Critto's "*Identifying sustainability communicators in urban regeneration: Integrating individual and relational attributes*"** continued the collaborative strand in advancing a conceptualization of sustainability in urban regeneration as communicative practice within networks of social actors, proposing an interdisciplinary methodology integrating SNA from sociology, and multi-criteria decision analysis (fuzzy logic) from operations research, to calculate an actor's sustainability communicator score. The score was based on three dimensions: a sustainability vision (relying on the three-pillar model of sustainability), a formal network influence dimension (based on organizational practice and decision-making position) and an informal network influence dimension (drawing on degree, betweenness, eigenvector and closeness centrality measures from SNA).

This approach allows the identification and ranking of sustainability communicators based on the preferences of specific users, while allowing for variable degrees of vagueness, and was illustrated by a case study of a social network of 28 actors involved in the sustainable regeneration of a brownfield site in Porto Marghera, Venice, Italy. The methodology was claimed to be expandable beyond the actor level to allow for the ranking of more complex network configurations for promoting sustainability.

It has been generally acknowledged that mitigating climate change is an individual responsibility. However,

energy planning is also pivotal in mitigating GHG emissions and adopting climate resilient strategies, but has been overlooked at the community level in the urban development planning and approval process. Many energy and emission reduction approaches are still voluntary for developers and have been pursued on an ad-hoc basis. The objective of **Hirushie Karunathilake, Piyaruwan Perera, Rajeev Ruparathna, Kasun Hewage and Rehan Sadiq's "*Renewable energy integration into community energy systems: A case study of new urban residential development study*"** was to propose a systematic framework for renewable energy integration in community development. This involved a scenario-based study conducted for an upcoming neighborhood in Okanagan, British Columbia (BC), Canada. Scenarios are assessed based on life cycle cost (LCC) and GHG emission reduction and compared in terms of the costs and benefits to key stakeholders. The surprising result was that a higher share of renewable sources in the energy mix does not necessarily reduce LCC or GHG emissions. The benefits that can be achieved via incorporating renewables to the regional energy mix vary, depending on the existing energy sources in the mix. Therefore, the regional power grid mix influences the feasibility and acceptability of RE integration at a given location. Developers need to be aware of the optimal investment level that could be recovered by research premium home prices, while it would be helpful for the government to promote this practice via various incentives such as tax credits and grants. The findings mainly inform urban developers in their renewable energy planning and the local government in formulating climate action policies.

Due to its recent introduction, there has been a lack of research and critical analysis of the Green Building Council of Australia's (GBCA) Green Star-Communities rating tool's anticipated influence within the local industry. The aim of the final paper in this theme, **Anthony Morris, Jian Zuo, Yutao Wang and Jiayuan Wang's "*Readiness for sustainable community: A case study of Green Star-Communities*",** was to gain a greater understanding of the concept of sustainable communities in the specific context of the tool and its potential impact on the future of urban development through a questionnaire survey and semi-structured interviews. The survey results indicated only 35% of the respondents to be aware of Green Star-Communities' pilot release; and with a negative likelihood of using the tool in the future. The largest perceived barriers to adopting the rating tool were the additional costs, time and complexity of the process, while the strongest perceived benefits include the tool's marketing potential, as well as the respondents' concern for the environment. The interviews, on the other hand, revealed that Government initiation and funding was a key success factor for the implementation of their Green Star-Communities projects, which provided a basis for the perception that it may still be some time before the private sector will initiate the use of the tool. The authors also highlighted that future improvements are needed in the flexibility of the rating tool and its subsequent suitability for all types of developments. Similarly, improved marketing of the tool and a fundamental behavioral change for industry members were identified as the two main factors that would improve the application of Green Star-Communities and to increase the number of registered developments as, without this shift in attitude, it is anticipated that the Government will remain the principal user of the Green Star-Communities rating tool for the foreseeable future.

3. Conclusions

The papers contained in this SV provided a unique opportunity to explore, in one volume, the breadth and depth of catalyzing sustainable urban transformations towards smarter, healthier cities through urban ecological infrastructure, regenerative development, eco-towns and regional prosperity sustainability. This SV was designed to focus upon the various dimensions of sustainable urban transformations applied to cities across different scales, which range from buildings, neighborhoods, cities and regions within the urgently needed transformation of cities to being more sustainable and to make rapid progress to the post-fossil carbon status. This is based upon understanding and using the process of unlocking or disembodying its energy and resource underpinnings, rapidly reducing resource and energy consumption and switching to renewable sources. It is also dependent upon how these approaches and developments are evolving; how they can help us to prevent or adapt to climate changes; and how they are likely to evolve in the next two to three decades.

The imaginative perspectives articulated in the twenty-seven papers in this SV provided a sound basis for

exploring the theoretical definitions, future visions or imaginaries and characteristics of catalyzing sustainable urban transformation. The authors articulated methods for performance assessment of sustainable urban transformation towards smarter, healthier, more ecological and regenerative cites; and highlighted pathways towards urban models that support sustainable urban transformation. The authors also investigated the obstacles, benefits and enablers for the implementation of sustainable urban transformations. The editorial team of this SV solicits reader's feedback and recommendations for future action-based research on this crucial series of topics.

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**References**

Birkeland, J., 2012. Design blindness in sustainable development: from closed to open systems design thinking. J. Urban Des. 17 (2), 163-187.

Blühdorn, I., Welsh, I., 2007. Eco-politics beyond the paradigm of sustainability: a conceptual framework and research agenda. Environ. Polit. 16 (2), 185-205.

Cole, R.J., 2012. Regenerative design and development: current theory and practice. Build. Res. Inf. 40 (1), 1-6.

de Oliveira, J.A.P., Doll, C.N.H., Kurniawan, T.A., Geng, Y., Kapshe, M., Huisingh, D., 2013. Climate Co-Benefits in urban Asia. J. Clean. Prod. 58.

Doppelt, B., 2016. Transformational Resilience: How Building Human Resilience to Climate Disruption Can Safeguard Society and Increase Wellbeing. Greenleaf Publishing Limited, Sheffield, UK.

du Plessis, C., 2012. Towards a regenerative paradigm for the built environment. Build. Res. Inf. 40 (1), 7-22. 171, 1212e1217.

Ehrlich, P.R., Holdren, J.P. 1971. Impact of population growth. Am. Assoc. Adv. Sci. 171, 1212-1217.

Hes, D., du Plessis, C., 2014. Designing for Hope: Pathways to Regenerative Sustainability, first ed.

Hofstra, N., Huisingh, D., 2014. Eco-innovations characterized: a taxonomic classification of relationships between humans and nature. J. Clean. Prod. 66 (C), 459-468.

Huisingh, D., et al., 2015. Recent advances in carbon emissions reduction: policies, technologies, monitoring, assessment and modeling. J. Clean. Prod. 103, 1-13.

IPCC, 2014. Climate change 2014: synthesis report. In: Writing Team, Core, Pachauri, R.K., Meyer, L.A. (Eds.), Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC, Geneva, Switzerland, p. 151.

Juarez Na'jera, M., 2010. Sustainability in Higher Education. An Explorative Approach on Sustainable Behavior in Two Universities. Erasmus University Rotterdam.

Li, F., Wang, Y., Chen, B., Wang, R., 2017. Urban ecological infrastructure for healthier cities: governance, management and engineering. J. Clean. Prod. 63 (Suppl.).

Lozano, R., 2009. Orchestrating Organisational Change for Corporate Sustainability: Strategies to Overcome Resistance to Change and to Facilitate Institutionalization. Cardiff University Business School & the ESRC Centre for Business, Responsibility, Accountability, Sustainability and Society. Cardiff University (B.R.A.S.S.).

Lyle, J.T., 1994. Regenerative Design for Sustainable Development. John Wiley & Sons.

Mang, P., Reed, B., 2012. Designing from place: a regenerative framework and methodology. Build. Res. Inf. 40 (1), 23-38.

Mol, A.P.J., Spaargaren, G., 1993. Environment, modernity and the risk-society: the apocalyptic horizon of

environmental reform. Int. Sociol. 8 (4), 431-459.

Mol, A.P.J., Spaargaren, G., 2000. Ecological Modernisation theory in debate: a review. Environ. Polit. 17-49, 17-49, 9:1.

UNDESA, 2017. World Population Prospects: the 2017 Revision, Key Findings and Advance Tables. Working Paper No. ESA/P/WP/248.

UNEP, 2016. The Emissions Gap Report 2016. United Nations Environment Programme (UNEP), Nairobi.

Vergragt, P., Dendler, L., de Jong, M., Matus, K., 2016. Transitions to sustainable consumption and production in cities. J. Clean. Prod. 34 (Part A).

WWF, 2016. Living Planet Report 2016. Risk and Resilience in a New Era. WWF International, Gland, Switzerland, pp. 1-74.

Zhang, X., Waldron, D., de Jong, M., Suzuki, M., Huisingh, D., 2015. Toward a regenerative sustainability paradigm for the built environment: from vision to reality. J. Clean. Prod. 109.

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Table 1
The overview of author and paper list in sustainable urban transformation (included in this special issue).

| Author(s) | Title | Theme 1 | Theme 2 | Theme 3 | Theme 4 |
|---|---|---|---|---|---|
| Wolfram | Cities shaping grassroots niches for sustainability transitions: Conceptual reflections and an exploratory case study | X | | | |
| Buyle, Braet, Audenaert and Debacker | Strategies for optimizing the environmental profile of dwellings in a Belgian context: A consequential versus an attributional approach | | | | X |
| Khoshnava, Rostami, Valipour, Ismail and Rahmat | Rank of green building material criteria based on the three pillars of sustainability using the hybrid multi criteria decision making method | | X | | |
| Yang and Zhang | Assessing regional eco-efficiency from the perspective of resource, environmental and economic performance in China: A bootstrapping approach in global data envelopment analysis | | X | | |
| Athanassiadis, Christis, Bouillard, Vercalsteren, Crawford and Khan | Comparing a territorial-based and a consumption-based approach to assess the local and global environmental performance of cities | | X | | |
| Ren, Li, Yuan, Li and Chen | The effects of three types of environmental regulation on eco-efficiency: A cross-region analysis in China | | | | X |
| Gorissen, Spira, Meynaerts, Valkering and Frantzeskaki | Moving towards systemic change? Investigating acceleration dynamics of urban sustainability transitions in the Belgian City of Genk | | | X | |
| Aguinaga, Henriques, Scheel and Scheel | Building resilience: A self-sustainable community approach to the triple bottom line | | | X | |
| Huang, Huang, Lin, Chen, Gao and Cui | Changing urban cement metabolism under rapid urbanization - A flow and stock perspective | | | X | |
| Li, Liu, Shrestha, Martek and Zhang | The role of local private participation in China's transition to domestically developed renewable energy technologies | | X | | |
| Liu, Han and Wang | Modeling the spatial relationship between urban ecological resources and the economy | | | X | |
| Wang, Dong and Yin | Antecedents of urban residents' separate collection intentions for household solid waste and their willingness to pay: Evidence from China | | | | X |
| Han, Liang, Hara, Uwasu and Dong | Quality of life in China's largest city, Shanghai: A 20-year subjective and objective composite assessment | | X | | |
| Alexandrescu, Pizzol, Zabeo, Rizzo, Giubilato and Critto | Identifying sustainability communicators in urban regeneration: Integrating individual and relational attributes | | | | X |
| Ji, Li, Liu, Shrestha and Jing | Comparing greenhouse gas emissions of precast in-situ and conventional construction methods | | | X | |
| Liu, Lin, Fu, Geertman and Van Oort | Towards inclusive and sustainable transformation in Shenzhen: Urban redevelopment, displacement patterns of migrants and policy implications | X | | | |
| Deakin and Reid | Smart cities: Under-gridding the sustainability of city-districts as energy efficient-low carbon zones | X | | | |
| Xue, Zhang, Wang, Skitmore and Wang | Analyzing collaborative relationships among industrialized construction technology innovation organizations: a combined SNA and SEM approach | | | | X |
| Fang, Zhang, Yu, Jin and Tian | A novel method for carbon dioxide emission forecasting based on improved Gaussian processes regression | | X | | |
| Huang, Liu, Krigsvoll and Johansen | Life cycle assessment and life cycle cost of university dormitories in the Southeast China: case study of the university town of Fuzhou | | X | | |
| Karunathilake, Perera, Ruparathna, Hewage and Sadiq | Renewable energy integration into community energy systems: A case study of new urban residential development | | | | X |
| Pandey, Surjan and Kapshe | Exploring linkages between sustainable consumption and prevailing green practices in reuse and recycling of household waste: Case of Bhopal city in India | X | | | |
| Li, Zhang, Ng and Skitmore | Quantifying Stakeholder Influence in Decision/Evaluations relating to Sustainable Construction in China - A Delphi Approach | | X | | |
| Wu, Zhang, Shen, Mo and Peng | Smart City with Chinese Characteristics against the Background of Big Data: Idea, Action and Risk | X | | | |
| Morris, Zuo, Wang and Wang | Readiness for sustainable community: A case study of Green Star Communities | | | | X |
| Chen, Long and Zeng | Planning a sustainable urban electric power system with considering effects of new energy resources and clean production levels under uncertainty: A case study of Tianjin, China | X | | | |
| Jiang, Mao, Hou, Wu and Tan | A SWOT Analysis for Promoting Off-site Construction under the Backdrop of China's New Urbanization | | | X | |