energies

MDPI

Editorial

Approaches, Advances, and Applications in the Sustainable Development of Smart Cities: A Commentary from the Guest Editors

Tan Yigitcanlar [1,*], Hoon Han [2] and Md. Kamruzzaman [3]

[1] School of Civil Engineering and Built Environment, Queensland University of Technology, 2 George Street, Brisbane QLD 4000, Australia
[2] City Planning Program, Faculty of the Built Environment, University of New South Wales, Sydney, NSW 2052, Australia; h.han@unsw.edu.au
[3] Faculty of Art, Design and Architecture, Monash University, 900 Dandenong Road, Caulfield East, VIC 3145, Australia; md.kamruzzaman@monash.edu
* Correspondence: tan.yigitcanlar@qut.edu.au; Tel.: +61-7-3138-2428

Received: 13 November 2019; Accepted: 28 November 2019; Published: 29 November 2019

Abstract: Environmental externalities of the Anthropocene—mainly generated from population growth, rapid urbanization, high private motor vehicle dependency, the deregulated market, mass livestock production, and excessive consumerism—have placed serious concerns for the future of natural ecosystems, which we are a part of. For instance, global climate change—the biggest challenge we have ever faced—is directly impacting wellbeing, and even the existence of humankind, in the long run. During the last two decades, the notion of the smart city—particularly the sustainable development of smart cities—has become a popular topic not only for scholars, particularly in the fields of technology, science, urban and environmental planning, development, and management, but also for urban policymakers and professional practitioners. This was due to digital technologies becoming a powerful enabler in stimulating paradigmatic shifts in urban development-related visions, strategies, implementation, and learning. This paper offers a critical review of the key literature on the issues relating to approaches, advances, and applications in the sustainable development of smart cities. It also introduces contributions from the Special Issue, and speculates on the prospective research directions to place necessary mechanisms to secure a smart and sustainable urban future for all.

Keywords: smart city; sustainable smart city; smart infrastructure; smart urban technology; smart governance; sustainable city; sustainable urban development; knowledge-based urban development; climate change; urban informatics; urban policy

1. Background and Literature Review

The 21st century is recognised as the 'century of cities', as more than half of the world's population now live in urban settlements, and the importance of urban environments has become even greater over the recent decades [1]. It is also seen as the 'century of climate change' or 'century of planetary survival', as today, unexceptionally, all parts of the world are confronted with various environmental and/or socioeconomic crises—e.g., climate change, life-threatening natural disasters, loss of biodiversity, destruction of natural ecosystems, regional disparities, social polarization, and digital and knowledge divides [2]. These crises—the climate emergency being the biggest—are mainly caused by rapid population growth and the irreversible commitment of natural resources, combined with industrialization, urbanization, mobilization, globalization, agricultural intensification, and excessive consumption-driven lifestyles [3].

Due to the rising abovementioned concerns—about environmental deterioration such as increasing energy expenditure and climate change aroused from greenhouse gas emissions—the concept of 'sustainable development of cities' or 'sustainable urban development' has gained ever-increasing interest [3,4]. The widely accepted definition of sustainable urban development can be described as meeting the needs of the present without compromising the ability of future generations to meet their own needs, by achieving environmental, economic, and social sustainability [5,6]. As such, the underlying notion of sustainable urban development is closely aligned with the concept of smart cities, which encourages interactions between humans and technologies for a sustainable urban living environment [7–9].

Most smart city practices overlook the well-established notion of sustainable development [10]. For example, in an examination of the European Union's framing of the smart city concept, Haarstad [11] found that the smartness approach is strongly tied to innovation, technology, and economic entrepreneurialism, and sustainability is not a motivating driver. Nevertheless, the importance of the sustainable development of smart cities is gaining importance in the literature [12]. These studies share the view that the two concepts are not entirely separate, rather, they share many commonalities and thus need to be integrated. For example, it is found that the concept of smart cities includes the smart environment, economy, and people, which aim at environmental, economic, and social sustainability, respectively. This is also reflected by several recent definitions of smart cities, which often embrace the underlying notions of sustainable development [13]. Moreover, Bakıcı et al. [14] and Haarstad [11] claim that the important question to answer is how to strategically integrate the two concepts. In fact, Ahvenniemi et al. [15] even suggest that a more accurate term of 'smart sustainable cities' should be used while there are several other studies—e.g., [16–18]—also adopting the same term in their studies.

The general consensus about the importance of becoming smart and sustainable has resulted in an emergence of studies suggesting various technologies, strategies, and initiatives in order to achieve their aims [19]. Of these, Suciu et al. [20] suggest that the integration of a multi-energy network and low carbon resources would help to deal with the issues facing today's cities such as the imbalance between energy supply and demand. To this extent, their study is closely aligned with the concept of zero-energy building, which aims to achieve a higher level of building sustainability by having a balance in building energy consumption and production [21,22]. Additionally, Pour et al. [23] and Olszewski et al. [24] suggest that the utilization of renewable energy and efficient water transport network systems can contribute to more than better energy efficiency or environmental protection.

In addition to the above, several studies also highlight the importance of smart homes and buildings [25–27], smart transportation [28–31], smart energy and resource management [32,33], and smart media displays [34], which may boost the interaction between cities and their residents, and therefore, leads cities to become smarter and more sustainable. Findings of these studies are further supported by numerous other studies [35] suggesting that the implementation of various smart systems would foster the environmental, economic, and social development of smart cities. Indeed, as highlighted by Komeily and Srinivasan [36], having a balance among environmental, economic, and social aspects of sustainable urban development is particularly important for smart cities considering the concept of smart cities lies beyond simply taking advantage of various modern technologies for better convenience. Furthermore, Millar and Choi [37] highlight the importance of the development of knowledge resources to tackle the socioeconomic and environmental challenges of our time.

Meanwhile, there are also several studies discussing the obstacles for the sustainable development of smart cities. Most notably, Höjer and Wangel [8] present five challenges, namely, strategic assessment, mitigating measures, top-down and bottom-up, competence, and governance. It is noted that these challenges are inter-related to each other. For example, the strategic assessment and evaluation of the effects of information and communications technology (ICT) require competent governance models, as well as the adoption of well-balanced top-down and bottom-down approaches. These obstacles are

also discussed by Kudva and Ye [38] where several obstacles including socioeconomic inequalities and the digital divide hinder cities becoming smart and sustainable. The findings of these also tend to agree with several other studies [39–41] showing the country or region-specific obstacles for implementing various smart technologies, strategies, and initiatives to make their cities more sustainable.

In line with the above, many studies also highlight the importance of policy implications to address and possibly overcome such obstacles. For example, Sotto et al. [42] claim that the continuous development of policies is essential for cities vulnerable to climate change. The importance of policy implementation is further highlighted by numerous studies [43–45]. For example, findings of Kim and Lim [46] imply that the development of both mandatory and voluntary regulations is recommended to effectively deal with the contemporary energy consumption and carbon emission issues aroused from our cities. Similarly, Kramers et al. [47] highlight that information and communication technology (ICT) policy implementations can contribute to cities to reduce their energy usage and to meet climate targets. Their studies share the views of Yigitcanlar and Kamruzzaman [48] and Yigitcanlar [49], suggesting that implementing proper smart cities policies and strategies can contribute to not only their environment, but also economic and social aspects of sustainable development.

While the technology dimension is the key identity of smart cities, technology adoption alone is not adequate to make a city smart [50]. Other critical qualities are also required. To be more precise, urban smartness encompasses a mix of human and intellectual capitals (e.g., skilled/talented labour force), infrastructural capital (e.g., high-tech telecommunication facilities), social capital (e.g., intense and open network of social linkages), entrepreneurial capital (e.g., creative and risk-taking business activities), relational capital (e.g., good governance through transparent and democratic institutions), and environmental capital (e.g., protection and enhancement of natural assets within and outside the city) [51]. This holistic view helps in determining policies that can increase the smartness levels of cities, and thus establish a blueprint for a new city model. For example, by diffusing sustainable and smart city discourses and through collaborations between private and public sector actors, Gothenburg represents a successful case of improving the performance of cities [52].

This new city model is widely referred to as 'sustainable smart cities' as numerous studies have indicated that unsustainable cities cannot be considered as smart [53–55]. In recent years, this consolidated sustainable smart cities concept has gained wider acceptance on the global scale. However, most of them focus on measuring the performance of smart cities [56,57]. Few have attempted to conceptualise the sustainable smart cities notion more clearly and comprehensively in a cause–effect model. Such conceptualization could form the basis for developing a thorough understanding, theoretically and practically, of designing smart cities for sustainable and balanced growth [58]. One of the frameworks that represent the abovementioned consolidated view is illustrated in Figure 1.

The conceptual framework (Figure 1) bases itself on an input-process-output-impact model—that also contains a 'system of systems' view—which is a widely used model in urban and regional planning [59]. Assets of a city are the main inputs of that city's smart urbanism endeavours. These assets are put into use through various processes. These processes include key drivers of technology, community, and policy. Given that assets and drivers of a locality (e.g., community, city, and region) are successfully operationalised, various desired outputs are expected to be achieved. The result of the successful execution of these processes is to generate sustainable and knowledge-based development outputs—i.e., in the economic, societal, environmental, and institutional development domains—to achieve desired outcomes. Given that the extent of desired outcomes—i.e., productivity, innovation, liveability, wellbeing, sustainability, accessibility, governance, and planning—are realised, the resulting impacts will transform the city into a smarter one.

This framework emphasises smart 'communities' as the essential ingredient of smart cities, positioning it as the critical driver of smart city development (Figure 1). This approach involves providing access to appropriate technologies, services, and platforms, and modifying the perceptions and behaviours of local communities via awareness campaigns and engagement projects [59]. The framework promotes the customization and development of local and culturally sensitive

solutions by local residents and companies, not only to provide locally tailored/accepted solutions, but also to make contributions to the local knowledge-based economic development, sustainable urban development, and participatory governance practices. The framework emphasises the role of the wider urban community as users and developers of the smart city they live in. It also advocates the importance of providing necessary traditional and technology-enabled methods to engage the community in local smart city projects [59].

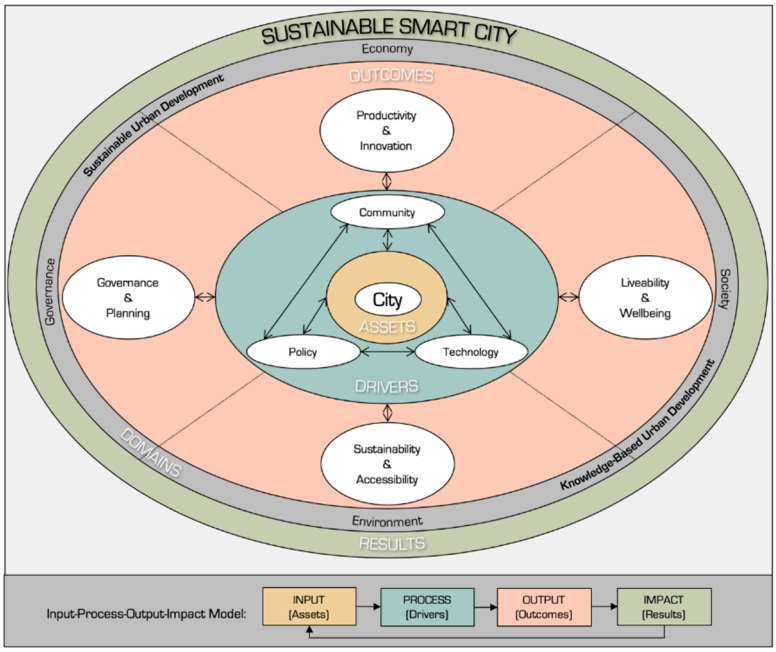

Figure 1. Sustainable smart city conceptual framework (derived from [59]).

In terms of 'technology', this framework, in parallel to the literature, considers a smart city as an organic whole, which is a networked and a linked system (Figure 1). While systems in industrial cities are mostly skeleton and skin, contemporary post-industrial cities, i.e., smart cities, are like organisms that develop an artificial nervous system, which enables them to behave in intelligently coordinated ways. The new intelligence of cities, then, resides in the increasingly effective combination of digital telecommunication networks (the nerves), ubiquitously embedded intelligence (the brains), sensors and tags (the sensory organs), and software (the knowledge and cognitive competences). In this way, the framework perceives urban technology only as a 'means' or an 'enabler' to an end—those ends being to achieve desired urban outcomes. It advocates the importance of a smart city as an organic whole of a network and a linked urban system that benefits from the technological offerings—but not solely dependent on or addicted to them [59].

This framework also highlights that the 'policy' context is vital to the understanding of the use of technology in appropriate ways (Figure 1). Hence, an innovative local government stresses the change in policies, as a government cannot innovate without a normative drive addressed in policy. Although innovation in technology for a smart city can be relatively easily observed and broadly agreed upon, subsequent changes in the policy context are more ambiguous. The policy context characterises institutional and non-technical urban governance issues. This policy, and governance, context creates conditions that can enable, or stymie, smart and sustainable urban development. The framework places urban policy at the heart of smart city development as a process that is critical to get it right. In this way, it frames technology as only one of the integral elements for a good policy and its implementation. It advocates the importance of developing competent strategies for the selection and adoption of technology or relevant solutions in appropriate ways [59].

Besides these drivers, the comprehensive conceptual view of the framework focuses on finding ways to achieve desired outcomes in the economy, society, environment, and governance domains. The desired outcomes or performance areas for smart cities consist of 'Productivity & Innovation', 'Liveability & Wellbeing', 'Sustainability & Accessibility', and 'Governance & Planning'. The integration of these desired smart city outcomes with smart city drivers is critical, and the framework emphasises this integration, or, in other words, intertwining [59].

The presented smart cities conceptual framework establishes a consolidated notion of smart cities, and seeks ways for achieving desired urban outcomes for an effective and efficient smart city transformation. The framework also offers the following consolidated definition of smart cities, which we believe will bring some clarity to what this report envisages a smart city as: "Smart city is an urban locality functioning as a healthy system of systems with sustainable and balanced practices of economic, societal, environmental, and governance activities generating desired outcomes and futures for all humans and non-humans" [59].

A review of the key literature finds that the majority of academic smart city research mainly interpret city smartness as technological solutions to the unsustainable development of cities, while issues such as governance and policymaking or community smartness in the traditional sense seem to be in neglect. As much as technology, the planning and development of sustainable smart cities require a comprehensive capital system—containing a mix of human and intellectual, infrastructural, social, entrepreneurial, relational, and environmental capitals. In other words, city smartness encompasses both modern urban production factors, in common frameworks utilizing advanced ICTs, and social and environmental capitals. It is these aspects together that form the competitive and sustainable cities of the information and knowledge age. Public officials commonly turn to smart urban technologies, for technology's sake, to funnel attention and funds to repair flailing urban systems in the absence of public funding and political action. Yet, urban smartness is not only about the technology adoption and use. Smartness—as a set of technologies, new sources of funding, and a branding strategy—helps local governments articulate pragmatic solutions in the immediate present to structurally thorny urban problems.

2. The Special Issue

Against the above literature background, it is possible to state that there has been growing, but still rather limited, research that systematically investigates cities from the angle of approaches, advances, and applications in the sustainable development of smart cities. Given that there is no silver bullet to unilaterally be applied in all urban environments to achieve sustainability and smartness, this Special Issue aims to gather diverse views and report progress towards the direction of sustainable smart cities. A fundamental objective of this Special Issue is to compile and present the cutting-edge work of researchers who focus on a joined-up thinking of themes—i.e., sustainability, smartness, and city. By doing so, we believe this Special Issue on "Approaches, Advances, and Applications in the Sustainable Development of Smart Cities" contributes to the knowledge pool in this area, particularly with new evidence driven from empirical research.

Following this guest editorial commentary, the Special Issue includes the following 11 case study, review, and research papers:

- 'The State of Smart Cities in China: The Case of Shenzhen' by Richard Hu [60];
- 'A Multi-Agent Social Gamification Model to Guide Sustainable Urban Photovoltaic Panels Installation Policies' by Robert Olszewski, Piotr Pałka, Agnieszka Wendland, and Jacek Kamiński [24];
- 'Economic Health-Aware LPV-MPC Based on System Reliability Assessment for Water Transport Network' by Fatemeh Karimi Pour, Vicenç Puig, and Gabriela Cembrano [23];
- 'Systematic Integration of Energy-Optimal Buildings with District Networks' by Raluca Suciu, Paul Stadler, Ivan Kantor, Luc Girardin, and François Maréchal [20];

- 'Modelling Interaction Decisions in Smart Cities: Why Do We Interact with Smart Media Displays?' by Hoon Han, Sang Ho Lee, and Yountaik Leem [7];
- 'Digital Commons and Citizen Coproduction in Smart Cities: Assessment of Brazilian Municipal E-Government Platforms' by Maurício José Ribeiro Rotta, Denilson Sell, Roberto Carlos dos Santos Pacheco, and Tan Yigitcanlar [9];
- 'Determining Favourable and Unfavourable Thermal Areas in Seoul Using In-Situ Measurements: A Preliminary Step towards Developing a Smart City' by You Jin Kwon, Dong Kun Lee, and Kiseung Lee [45];
- 'Smart Cities in Turkey: Approaches, Advances and Applications with Greater Consideration for Future Urban Transport Development' by Can Bıyık [35];
- 'City Branding, Sustainable Urban Development and the Rentier State. How Do Qatar, Abu Dhabi and Dubai Present Themselves in the Age of Post Oil and Global Warming?' by Martin De Jong, Thomas Hoppe, and Negar Noori [53];
- 'Aligning Urban Policy with Climate Action in the Global South: Are Brazilian Cities Considering Climate Emergency in Local Planning Practice?' by Debora Sotto, Arlindo Philippi, Jr., Tan Yigitcanlar, and Md Kamruzzaman [42];
- 'Towards Smart Florianópolis: What Does It Take to Transform a Tourist Island into an Innovation Capital?' by Tan Yigitcanlar, Jamile Sabatini-Marques, Cibele Lorenzi, Nathalia Bernardinetti, Tatiana Schreiner, Ana Fachinelli, and Tatiana Wittmann [61].

These articles focused on answering the three broad questions of this Special Issue—namely, what the approaches, advances, and applications in the sustainable development of smart cities are.

Four articles elaborate the approaches used to achieve the sustainable development of smart cities. The objective is to generate transferable knowledge-based diverse case studies. The work by Yigitcanlar et al. [61] entitled 'Towards Smart Florianópolis: What Does It Take to Transform a Tourist Island into an Innovation Capital?' demonstrates the processes used to transform the economic vulnerability of a tourist city, Florianópolis, the capital city of the Brazilian state of Santa Catarina, into a more sustainable economy through knowledge and innovation. Bıyık [35], in his work entitled 'Smart Cities in Turkey: Approaches, Advances and Applications with Greater Consideration for Future Urban Transport Development' describes the processes used to make a radical change in transport policy for the development of a smart transport vision for Turkey. De Jong et al. [53] present the processes used to introduce and operationalise sustainable branding of three middle-eastern cities in their article 'City Branding, Sustainable Urban Development and the Rentier State. How Do Qatar, Abu Dhabi and Dubai Present Themselves in the Age of Post Oil and Global Warming?'. Lastly, Hu [60] in his paper entitled 'The State of Smart Cities in China: The Case of Shenzhen' investigates the state of smart cities in the context of China by particularly focusing on Shenzhen. This paper provides lessons into China's fastest-growing experimental city that has adopted smart urbanization as a model for its development.

The second group of articles examine how the decision-making process can be advanced using technology—i.e., bringing smartness to city governance. Rotta et al. [9] examine how the implementation of the Municipal eGov Platform Assessment Model (MEPA) has enhanced citizen participation in Brazil in their study entitled 'Digital Commons and Citizen Coproduction in Smart Cities: Assessment of Brazilian Municipal E-Government Platforms'. While the results of this study are not promising, other avenues to enhance interaction still exist such as the use of smart media displays. Han et al. [7] present conditions for the effective use of such technologies using Sydney as a case in their article 'Modelling Interaction Decisions in Smart Cities: Why Do We Interact with Smart Media Displays?'

The remaining five articles both advance knowledge and demonstrate applications of specific technologies to bring smartness and sustainability to cities. Olszewski et al. [24] in their work, 'A Multi-Agent Social Gamification Model to Guide Sustainable Urban Photovoltaic Panels Installation Policies' present a model of social gamification to stimulate the photovoltaic panels installation process, and ultimately, to make cities more environmentally sustainable. A health-aware control

approach for drinking water transport networks is proposed by Pour et al. [23] in their study entitled 'Economic Health-Aware LPV-MPC Based on System Reliability Assessment for Water Transport Network'. Kwon et al. [45] consider that thermal comfort (such as the urban heat island effect) is a public health issue and identify environmental factors that contribute to thermal comfort in cities. This work is entitled as 'Determining Favourable and Unfavourable Thermal Areas in Seoul Using In-Situ Measurements: A Preliminary Step towards Developing a Smart City'. Suciu et al. [20] in their paper entitled 'Systematic Integration of Energy-Optimal Buildings with District Networks' presents a method to combine multi-energy networks in order to reduce household dependency on fossil fuel. The last paper in this group by Sotto et al. [42] focuses on policy evaluation and examines the consistency between strategic policy objectives and policy implementation in terms of the commitment to reduce carbon emissions in Brazil. This work is presented under the title of 'Aligning Urban Policy with Climate Action in the Global South: Are Brazilian Cities Considering Climate Emergency in Local Planning Practice?'.

3. Concluding Remarks and Research Directions

Although the smart cities movement is not new, at present, there is not a single fully-fledged smart city example in the world [62]. Songdo from Korea is widely referred to as the most advanced smart city [63]. Nevertheless, this exemplar urban development project has also received heavy criticism for not being smart in terms of environmental and societal outcomes. Another popular smart city that is planned to be built from scratch is Google Sidewalk Labs' smart city project located at the waterfront area of Toronto. The project has also been criticised for using 'tech for tech's sake'—applying a complex technological solution to a situation that mostly does not need it. As evident in these two cases, while the smart city concept may be good in theory, in practice, there are numerous challenges in building truly smart cities [64–69]. These challenges can be grouped under the following categories:

- Technological and technical issues (e.g., technical barriers due to the size of the city and users, cyber security, privacy concerns, or over irrelevant or unnecessary technology offerings);
- Economic issues (e.g., requiring big-buck financial investments, particularly from the public sector, limited incentives and support to start-ups, incubators, accelerators, and so on);
- Societal issues (e.g., smart cities becoming enclaves for urban elites, gentrification and displacement, negative impacts of disruption, and the digital divide);
- Natural and built environmental issues (e.g., producing insignificant environmental sustainability outcomes or generating negative externalities, and establishing eco-human symbiosis);
- Governance or management issues (e.g., limited transparency, public participation, and bottom-up approach);
- Wider application of the smart city model (e.g., problematic nature of wide-scale development and the cost of retrofitting).

In order to adequately address these challenges, a holistic view on sustainable smart cities is needed [70,71]. We believe the aforementioned conceptual framework (Figure 1) along with other consolidated sustainable smart city research and practices will generate new insights into tackling these issues. In that very moment, it is necessary to place current and emerging approaches, advances, and applications in the sustainable development of smart cities under the microscope. In line with this necessity, the Special Issue generates new insights by investigating the sustainable smart cities from various disciplinary and contextual angles.

Against the literature review reported in this paper and the Special Issue, we compile the following sets of generic research questions focusing on the sustainable development of smart cities. We strongly believe that investigating these issues further in prospective research projects by scholars of this highly interdisciplinary field will shed light on the better conceptualization and practice of sustainable smart cities.

- What is a sustainable smart city supposed to be, and how can benchmarks be determined and set considering smartness is a vague term?
- What is the current status of cities and the inhibitors and threats on the way towards sustainable and smart urban development?
- What are the commonalities amongst cities that are moving towards smart and sustainable futures, and what are the factors of success and failure?
- How can sustainable smart city frameworks be developed and applied, recognizing that every city is unique, to the planning of cities?
- How can institutional and social capacities be developed and further enhanced for the formation of sustainable smart cities?
- How can sustainable smart cities be governed to make sure that existing high sustainability and smartness levels are maintained and improved over time?
- How can sustainable smart cities restore and tap the power of natural systems to enhance and protect urban life?
- How can sustainable smart city agendas contribute to the establishment of global eco-human symbiosis to avoid global ecocide?
- How can sustainable smart cities' climate innovations drive the next urban transformation to address the global climate crisis?
- How can sustainable smart city blueprints be developed for the next global transformation of cities to create carbon-free and adaptive futures for humanity?

Author Contributions: T.Y., H.H., and M.K. jointly prepared this Special Issue editorial that is written in the format of a literature review paper. All three authors read and approved the final manuscript.

Funding: This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

Acknowledgments: We wish to thank the authors of the Special Issue papers for accepting our invitation and submitting and revising their manuscripts within a short time frame, and thank the referees for their thorough, constructive, and timely reviews. We also thank the journal management, for inviting us to serve as the Guest Editors of this Special Issue.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Yigitcanlar, T.; Inkinen, T. *Geographies of Disruption: Place Making for Innovation in the Age of Knowledge Economy*; Springer: Cham, Switzerland, 2019.
2. Arbolino, R.; Carlucci, F.; Cirà, A.; Ioppolo, G.; Yigitcanlar, T. Efficiency of the EU regulation on greenhouse gas emissions in Italy: The hierarchical cluster analysis approach. *Ecol. Indic.* **2017**, *81*, 115–123. [CrossRef]
3. Mahbub, P.; Goonetilleke, A.; Ayoko, G.A.; Egodawatta, P.; Yigitcanlar, T. Analysis of build-up of heavy metals and volatile organics on urban roads in Gold Coast, Australia. *Water Sci. Technol.* **2011**, *63*, 2077–2085. [CrossRef] [PubMed]
4. Yigitcanlar, T.; Kamruzzaman, M.; Foth, M.; Sabatini-Marques, J.; Costa, E.; Ioppolo, G. Can cities become smart without being sustainable? A systematic review of the literature. *Sustain. Cities Soc.* **2019**, *45*, 348–365. [CrossRef]
5. UN. World Commission on Environment and Development. Our Common Future. 1987. Available online: https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf (accessed on 5 November 2019).
6. Dur, F.; Yigitcanlar, T. Assessing land-use and transport integration via a spatial composite indexing model. *Int. J. Environ. Sci. Technol.* **2015**, *12*, 803–816. [CrossRef]
7. Han, H.; Lee, S.; Leem, Y. Modelling interaction decisions in smart cities: Why do we interact with smart media displays? *Energies* **2019**, *12*, 2840. [CrossRef]
8. Höjer, M.; Wangel, J. Smart Sustainable Cities: Definition and Challenges. In *ICT Innovations for Sustainability*; Hilty, L.M., Aebischer, B., Eds.; Springer: Cham, Switzerland, 2014; pp. 333–349.

9. Rotta, M.J.; Sell, D.; Pacheco, R.C.; Yigitcanlar, T. Digital commons and citizen coproduction in smart cities: Assessment of Brazilian municipal e-government platforms. *Energies* **2019**, *12*, 2813. [CrossRef]
10. Joss, S.; Sengers, F.; Schraven, D.; Caprotti, F.; Dayot, Y. The smart city as global discourse: Storylines and critical junctures across 27 cities. *J. Urban Technol.* **2019**, *26*, 3–34. [CrossRef]
11. Haarstad, H. Constructing the sustainable city: Examining the role of sustainability in the 'smart city' discourse. *J. Environ. Policy Plan.* **2017**, *19*, 423–437. [CrossRef]
12. Yigitcanlar, T.; Han, H.; Kamruzzaman, M.; Ioppolo, G.; Sabatini-Marques, J. The making of smart cities: Are Songdo, Masdar, Amsterdam, San Francisco and Brisbane the best we could build? *Land Use Policy* **2019**, *88*, 104187. [CrossRef]
13. Angelidou, M.; Psaltoglou, A.; Komninos, N.; Kakderi, C.; Tsarchopoulos, P.; Panori, A. Enhancing sustainable urban development through smart city applications. *J. Sci. Technol. Policy Manag.* **2018**, *9*, 146–169. [CrossRef]
14. Bakıcı, T.; Almirall, E.; Wareham, J. A smart city initiative: The case of Barcelona. *J. Knowl. Econ.* **2013**, *4*, 135–148. [CrossRef]
15. Ahvenniemi, H.; Huovila, A.; Pinto-Seppä, I.; Airaksinen, M. What are the differences between sustainable and smart cities? *Cities* **2017**, *60*, 234–245. [CrossRef]
16. Aina, Y.A. Achieving smart sustainable cities with GeoICT support: The Saudi evolving smart cities. *Cities* **2017**, *71*, 49–58. [CrossRef]
17. Bibri, S.E.; Krogstie, J. Smart sustainable cities of the future: An extensive interdisciplinary literature review. *Sustain. Cities Soc.* **2017**, *31*, 183–212. [CrossRef]
18. Yigitcanlar, T.; Kamruzzaman, M. Smart cities and mobility: Does the smartness of Australian cities lead to sustainable commuting patterns? *J. Urban Technol.* **2019**, *26*, 21–46. [CrossRef]
19. Yigitcanlar, T. Planning for smart urban ecosystems: Information technology applications for capacity building in environmental decision making. *Theor. Empir. Res. Urban Manag.* **2009**, *4*, 5–21.
20. Suciu, R.; Stadler, P.; Kantor, I.; Girardin, L.; Maréchal, F. Systematic integration of energy-optimal buildings with district networks. *Energies* **2019**, *12*, 2945. [CrossRef]
21. Han, J.H.; Kim, S.; Kim, J.H.; Lee, S.Y. A review of zero energy housing regulations for low-income households. *Int. J. Knowl.-Based Dev.* **2018**, *9*, 343. [CrossRef]
22. KiKylili, A.; Fokaides, P.A. European smart cities: The role of zero energy buildings. *Sustain. Cities Soc.* **2015**, *15*, 86–95. [CrossRef]
23. Pour, F.K.; Puig, V.; Cembrano, G. Economic health-aware LPV-MPC based on system reliability assessment for water transport network. *Energies* **2019**, *12*, 3015. [CrossRef]
24. Olszewski, R.; Pałka, P.; Wendland, A.; Kamiński, J. A multi-agent social gamification model to guide sustainable urban photovoltaic panels installation policies. *Energies* **2019**, *12*, 3019. [CrossRef]
25. Su, K.; Li, J.; Fu, H. Smart city and the applications. In Proceedings of the 2011 International Conference on Electronics, Communications and Control (ICECC), Ningbo, China, 9–11 September 2011; pp. 1028–1031.
26. Klein, C.; Kaefer, G. From smart homes to smart cities: Opportunities and challenges from an industrial perspective. In *NEW2AN 2008, Next Generation Teletraffic and Wired/Wireless Advanced Networking*; Balandin, S., Moltchanov, D., Koucheryavy, Y., Klein, C., Kaefer, G., Eds.; Springer: Berlin/Heidelberg, Germany, 2008; p. 260.
27. Plageras, A.P.; Psannis, K.E.; Stergiou, C.; Wang, H.; Gupta, B.B. Efficient IoT-based sensor big data collection–processing and analysis in smart buildings. *Future Gener. Comput. Syst.* **2018**, *82*, 349–357. [CrossRef]
28. Yigitcanlar, T.; Fabian, L.; Coiacetto, E. Challenges to urban transport sustainability and smart transport in a tourist city: The Gold Coast, Australia. *Open Transp. J.* **2008**, *2*, 29–46. [CrossRef]
29. Kyriazis, D.; Varvarigou, T.; Rossi, A.; White, D.; Cooper, J. Sustainable smart city IoT applications: Heat and electricity management & eco-conscious cruise control for public transportation. In Proceedings of the 2013 IEEE 14th International Symposium and Workshops, Madrid, Spain, 4–7 June 2013.
30. Menouar, H.; Guvenc, I.; Akkaya, K.; Uluagac, A.S.; Kadri, A.; Tuncer, A. UAV-enabled intelligent transportation systems for the smart city: Applications and challenges. *IEEE Commun. Mag.* **2017**, *55*, 22–28. [CrossRef]
31. Zawieska, J.; Pieriegud, J. Smart city as a tool for sustainable mobility and transport decarbonisation. *Transp. Policy* **2018**, *63*, 39–50. [CrossRef]

32. Bulkeley, H.; McGuirk, P.M.; Dowling, R. Making a smart city for the smart grid? The urban material politics of actualising smart electricity networks. *Environ. Plan A* **2016**, *48*, 1709–1726. [CrossRef]
33. Masera, M.; Bompard, E.F.; Profumo, F.; Hadjsaid, N. Smart (electricity) grids for smart cities: Assessing roles and societal impacts. *Proc. IEEE* **2018**, *106*, 613–625. [CrossRef]
34. Struppek, M. The social potential of urban screens. *Vis. Commun.* **2006**, *5*, 173–188. [CrossRef]
35. Bıyık, C. Smart Cities in Turkey: Approaches, Advances and Applications with Greater Consideration for Future Urban Transport Development. *Energies* **2019**, *12*, 2308. [CrossRef]
36. Komeily, A.; Srinivasan, R. Sustainability in smart cities: Balancing social, economic, environmental, and institutional aspects of urban life. In *Smart Cities: Foundations, Principles, and Applications*; Song, H., Srinivasan, R., Sookoor, T., Jeschke, S., Eds.; John Wiley & Sons: Hoboken, NJ, USA, 2017; pp. 503–534.
37. Millar, C.C.; Choi, C.J. Development and knowledge resources: A conceptual analysis. *J. Knowl. Manag.* **2010**, *14*, 759–776. [CrossRef]
38. Kudva, S.; Ye, X. Smart cities, big data, and sustainability union. *Big Data Cogn. Comput.* **2017**, *1*, 4. [CrossRef]
39. Mohammed, F.; Idries, A.; Mohamed, N.; Al-Jaroodi, J.; Jawhar, I. Opportunities and challenges of using UAVs for Dubai smart city. In Proceedings of the 6th International Conference on New Technologies, Mobility and Security, Dubai, UAE, 30 March–2 April 2014; pp. 1–4.
40. Maysoun, I.; Al-Nasrawi, S.; Adams, C.; El-Zaart, A. Challenges facing e-government and smart sustainable city: An Arab region perspective. In Proceedings of the 15th European Conference on e-government, University of Portsmouth, Portsmouth, UK, 18–19 June 2015; pp. 396–402.
41. Granier, B.; Kudo, H. How are citizens involved in smart cities? Analysing citizen participation in Japanese "smart communities". *Inf. Polity* **2016**, *21*, 61–76. [CrossRef]
42. Sotto, D.; Philippi, A.; Yigitcanlar, T.; Kamruzzaman, M. Aligning urban policy with climate action in the global south: Are Brazilian cities considering climate emergency in local planning practice? *Energies* **2019**, *12*, 3418. [CrossRef]
43. Visvizi, A.; Lytras, M.D.; Damiani, E.; Mathkour, H. Policy making for smart cities: Innovation and social inclusive economic growth for sustainability. *J. Sci. Technol. Policy Manag.* **2018**, *9*, 126–133. [CrossRef]
44. De Jong, M.; Joss, S.; Schraven, D.; Zhan, C.; Weijnen, M. Sustainable–smart–resilient–low carbon–eco–knowledge cities: Making sense of a multitude of concepts promoting sustainable urbanization. *J. Clean. Prod.* **2015**, *109*, 25–38. [CrossRef]
45. Kwon, Y.J.; Lee, D.K.; Lee, K. Determining favourable and unfavourable thermal areas in Seoul using in-situ measurements: A preliminary step towards developing a smart city. *Energies* **2019**, *12*, 2320. [CrossRef]
46. Kim, S.; Lim, B.T. How effective is mandatory building energy disclosure program in Australia? In Proceedings of the IOP Conference Series: Earth and Environmental Science, Banda Aceh, Indonesia, 26–27 September 2018; Volume 140, p. 12106. [CrossRef]
47. Kramers, A.; Höjer, M.; Lövehagen, N.; Wangel, J. Smart sustainable cities: Exploring ICT solutions for reduced energy use in cities. *Environ. Model. Softw.* **2014**, *56*, 52–62. [CrossRef]
48. Yigitcanlar, T.; Kamruzzaman, M. Does smart city policy lead to sustainability of cities? *Land Use Policy* **2018**, *73*, 49–58. [CrossRef]
49. Yigitcanlar, T. Technology and the city. In *Systems, Applications and Implications*; Routledge: New York, NY, USA, 2016.
50. Yigitcanlar, T.; Kamruzzaman, M.; Buys, L.; Ioppolo, G.; Sabatini-Marques, J.; Costa, E.; Yun, J. Understanding 'smart cities': Intertwining development drivers with desired outcomes in a multidimensional framework. *Cities* **2018**, *81*, 145–160. [CrossRef]
51. Yigitcanlar, T. Position paper: Benchmarking the performance of global and emerging knowledge cities. *Expert Syst. Appl.* **2014**, *41*, 5549–5559. [CrossRef]
52. Brorström, S.; Argento, D.; Grossi, G.; Thomasson, A.; Almqvist, R. Translating sustainable and smart city strategies into performance measurement systems. *Public Money Manag.* **2018**, *38*, 193–202. [CrossRef]
53. De Jong, M.; Hoppe, T.; Noori, N. City branding, sustainable urban development and the rentier state: How do Qatar, Abu Dhabi and Dubai present themselves in the age of post oil and global warming? *Energies* **2019**, *12*, 1657. [CrossRef]
54. Martin, C.J.; Evans, J.; Karvonen, A. Smart and sustainable? Five tensions in the visions and practices of the smart-sustainable city in Europe and North America. *Technol. Forecast. Soc. Chang.* **2018**, *133*, 269–278. [CrossRef]

55. Silva, B.N.; Khan, M.; Han, K. Towards sustainable smart cities: A review of trends, architectures, components, and open challenges in smart cities. *Sustain. Cities Soc.* **2018**, *38*, 697–713. [CrossRef]
56. Liu, Y.; Wang, H.; Tzeng, G.H. From measure to guidance: Galactic model and sustainable development planning toward the best smart city. *J. Urban Plan. Dev.* **2018**, *144*, 04018035. [CrossRef]
57. Bhattacharya, T.R.; Bhattacharya, A.; McLellan, B.; Tezuka, T. Sustainable smart city development framework for developing countries. *Urban Res. Pract.* **2018**, 1–13. [CrossRef]
58. Metaxiotis, K.; Carrillo, J.; Yigitcanlar, T. *Knowledge-Based Development for Cities and Societies: Integrated Multi-Level Approaches: Integrated Multi-Level Approaches*; IGI Global: Hersey, PA, USA, 2010.
59. Yigitcanlar, T. Smart city policies revisited: Considerations for a truly smart and sustainable urbanism practice. *World Technopolis Rev.* **2018**, *7*, 97–112.
60. Hu, R. The state of smart cities in China: The case of Shenzhen. *Energies* **2019**, *12*, 4375. [CrossRef]
61. Yigitcanlar, T.; Sabatini-Marques, J.; Lorenzi, C.; Bernardinetti, N.; Schreiner, T.; Fachinelli, A.; Wittmann, T. Towards smart Florianópolis: What does it take to transform a tourist island into an innovation capital? *Energies* **2018**, *23*, 3265. [CrossRef]
62. Alizadeh, T.; Irajifar, L. Gold Coast smart city strategy: Informed by local planning priorities and international smart city best practices. *Int. J. Knowl.-Based Dev.* **2018**, *9*, 153–173. [CrossRef]
63. Townsend, A.M. *Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia*; WW Norton & Company: New York, NY, USA, 2013.
64. Han, H.; Hawken, S. Introduction: Innovation and identity in next-generation smart cities. *City Cult. Soc.* **2018**, *12*, 1–4. [CrossRef]
65. Alvarez, M.D. Creative cities and cultural spaces: New perspectives for city tourism. *Int. J. Cult. Tour. Hosp. Res.* **2010**, *10*, 171–175. [CrossRef]
66. McLaren, D.; Agyeman, J. *Sharing Cities: A Case for Truly Smart and Sustainable Cities*; MIT Press: Boston, MA, USA, 2015.
67. Plastrik, P.; Cleveland, J. *Life after Carbon: The Next Global Transformation of Cities*; Island Press: New York, NY, USA, 2018.
68. Heitlinger, S.; Foth, M.; Clarke, R.; DiSalvo, C.; Light, A.; Forlano, L. Avoiding ecocidal smart cities: Participatory design for more-than-human futures. In Proceedings of the 15th Participatory Design Conference: Short Papers, Situated Actions, Workshops and Tutorial-Volume 2, Hesselt/Genk, Belgium, 20–24 August 2018; ACM: New York, NY, USA, 2018; p. 51.
69. Clarke, R.; Heitlinger, S.; Foth, M.; DiSalvo, C.; Light, A.; Forlano, L. More-than-human urban futures: Speculative participatory design to avoid ecocidal smart cities. In Proceedings of the 15th Participatory Design Conference: Short Papers, Situated Actions, Workshops and Tutorial-Volume 2, Hesselt/Genk, Belgium, 20–24 August 2018; ACM: New York, NY, USA, 2018; p. 34.
70. Yigitcanlar, T. Smart cities: An effective urban development and management model? *Aust. Plan.* **2015**, *52*, 27–34. [CrossRef]
71. Heitlinger, S.; Bryan-Kinns, N.; Comber, R. The right to the sustainable smart city. In Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems, Glasgow, UK, 4–9 May 2019; ACM: New York, NY, USA, 2019; p. 287.