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Is Climate-Neutral the New Smart and Sustainable City? A Review Towards Urban Climate Neutrality

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Abstract

The role of cities in sustainable development has gained increasing importance since the adoption of the Rio Declaration and Agenda 21, culminating in SDG 11 of the 2015 UN 2030 Agenda. Among the challenges of urban sustainable development, climate change has been recognized as a central one, positioning cities as fundamental actors in mitigation and adaptation efforts. In parallel with discourse on sustainable cities, the concept of smart cities has been presented as a tool aimed at improving urban resilience through technology and data-driven decision-making. The article investigates whether climate neutrality is becoming the new imaginary of sustainable cities, by analysing the emergence, development, and future perspectives of the dominant sustainable and smart city imaginary in the governance of sustainable development, both at the international and European levels. We review the main scholarly literature and policy documents by tracing the evolution of ideas, practices, and policies that have shaped the modern concept of the sustainable city. We then examine how this concept has expanded to include concerns about climate change adaptation and mitigation through smartness, often overlooking the issue of social inclusion for the most vulnerable.

Keywords

climate neutrality; climate urbanism; SDG 11; smart cities; sustainable cities

1. Introduction

At least since the publication of the Brundtland Report in 1987 and the adoption of Agenda 21—the action plan drafted during the 1992 Earth Summit—the central role of cities and municipalities in attaining sustainable development was made explicit. It has since become accepted knowledge that decisions taken at

the local level are critical to tackle environmental degradation and climate change (Beretta, 2018; Bulkeley et al., 2015). Recent influential global initiatives reaffirm the role of cities in responding to environmental degradation, particularly climate change. 2015 has been, in this regard, a defining year for global climate action and sustainable development. While Pope Francis was presenting his global call to action to respond to the socio-environmental crisis with a warning against the technocratic paradigm (Francis, 2015), international organizations were laying the groundwork for the global governance of sustainability and climate change for the following decades. The United Nations (UN) 2030 Agenda for Sustainable Development (UN, 2015) and the Paris Agreement signed at the UN Framework Convention on Climate Change COP21 (UNFCCC, 2015) have helped lay the pathway for tackling global environmental concerns, building on the long-standing discourse of sustainable development. To meet the targets set by both documents, the role played by cities and urban areas for sustainable development and climate action has become even more fundamental than before, especially considering that 55% of the global population lives in urban settlements—a percentage that is projected to increase up to 68% by 2050 (UN DESA, 2019). Furthermore, while cities cover less than 2% of the Earth's surface, the last IPCC Report highlights that 70% of global GHG emissions are being produced at the urban level (IPCC, 2022). Within this framework, the role of cities for the global governance of sustainable development and climate change becomes central.

Cities not only contribute to environmental harms but are also significantly impacted by the effects of climate change (Bulkeley et al., 2015). The last IPCC Report is clear in this instance: "In all cities and urban areas, the risk faced by people and assets from hazards associated with climate change has increased (high confidence)....Evidence from urban and rural settlements is unequivocal; climate impacts are felt disproportionately in urban communities, with the most economically and socially marginalized being most affected (high confidence)" (IPCC, 2022, p. 909). This statement is central to legitimizing the adaptation efforts promoted by the resilient city model (Hatuka et al., 2018). However, cities are also moving strongly and rapidly towards mitigation efforts, on the road to climate neutrality. Seto et al. (2021), for instance, highlight that by 2020, there were already more than 800 cities worldwide that had made commitments for net-zero pathways. We have reached a point of global scientific consensus on the link between climate change impacts at the urban level and questions of environmental and climate justice. However, while this consensus has gained greater traction in local adaptation policies (Hughes & Hoffmann, 2020), the connection between inequalities and mitigation policies has remained less explored. More specifically, although fairness issues in mitigation have been strongly advocated at the global level and in North-South relations—particularly within the framework of the UNFCCC (Adger et al., 2006)—questions of a just transition to net zero still require great attention at the local and urban levels.

To support this premise, we examine how the discourse on sustainable cities has evolved within the international governance framework of sustainable development, culminating in Sustainable Development Goal (SDG) 11 of the 2030 Agenda—"Make cities and human settlements inclusive, safe, resilient and sustainable"—which includes environmental and climate action, especially through Target 11.b (UN, 2015). We choose to focus on the sustainable city, based on the principles of sustainable development and SDG 11, since it is undoubtedly the "dominant policy narrative among the world's major cities" (Long & Rice, 2019, p. 993; see also de Jong et al., 2015) and has shaped the urban development agenda for the last decades. We furthermore maintain that "smart cities," which have gained worldwide recognition (Helbing et al., 2021) and have increasingly featured in academic research (de Jong et al., 2015), are presented as the means to enhance urban resilience through technological advancements and data-driven decision-making (Beretta,

2015). While both frameworks represent the "currently predominant paradigms of urbanism" (Bibri et al., 2023, p. 10), we contend that recent policy initiatives, such as the European Mission Cities, signal the rise of a new urban imaginary: the climate-neutral city. This emerging imaginary appears as a "natural" successor to both sustainable and smart cities, combining environmental targets with technological solutions under a decarbonization mandate. In line with the literature on climate urbanism (Long & Rice, 2019), we hypothesize that climate change has become a central legitimizing narrative in urban planning—frequently mobilized to justify technocratic and neoliberal development strategies.

The present review aims to critically examine how the conceptual building blocks of sustainable and smart urbanism are being reconfigured within the discourse of the climate-neutral city. To make this case, the review is structured with an initial methodological note, followed by a genealogical-analytical section on sustainable and smart cities that traces how these concepts have contributed to the emergence of climate neutrality as a new urban imaginary. By climate-neutral cities we understand "cities that have committed to an emissions reduction target with a goal of at least an 80% reduction in GHG emissions by a given year from baseline or have signed up to an initiative committing to such a decarbonization goal" (Seto et al., 2021, p. 380), which implies important structural and infrastructural changes for city planning and citizens' behavior. In this light, the climate-neutral city can be seen as a hybrid—one that emerges at the intersection of the sustainable city's ethical imperative of cities bearing responsibility for environmental action and the smart city's technological promise of optimization.

The first analytical section traces the evolution of the sustainable city paradigm through key global events and agreements—such as the 1992 Rio Conference, Rio+20, and the adoption of the UN 2030 Agenda—and shows how this discourse helped position cities as central actors in the governance of sustainability and, increasingly, climate action. This trajectory reflects a shift toward interpreting sustainable development primarily in environmental terms, while reinforcing the role of cities, beyond the nation-state, in the multilevel governance of climate change (Betsill & Bulkeley, 2003). The second analytical section turns to the smart city discourse, emphasizing the central role of digitalization and ICT in advancing a vision of urban efficiency, optimization, and control. We interpret this discourse as closely aligned with neoliberal rationalities, positioning technology as both a solution and strategy for managing urban complexity. In the concluding discussion, we argue that the emerging imaginary of the climate-neutral city draws upon and hybridizes elements from both these discourses, thereby promoting it to a new urban imperative. The use we make of the term *imaginary* reflects the fact that urban climate neutrality is not merely a new policy goal but a reconfiguration of urban futures: one that aligns climate objectives with technological and market-oriented governance, and that may risk reinforcing existing inequalities if not critically examined. We conclude by reflecting on what this means for the future of urban sustainability beyond 2030.

2. Methodological Note

Adopting an interpretative perspective, we performed a historical review of the literature to analyse how the two dominant discourses of sustainability and smartness in urban policy and planning have shaped the emerging discourse of urban climate mitigation. This is done by employing genealogy (Foucault, 1977) as a method that "emphasizes the 'process' and action or practice aspects of discourse arrangements and the meaning of power-knowledge complexes" (Keller, 2013, p. 50). While we adopt a rather loose interpretation of the genealogical method, by mainly developing a narrative literature review of both scholarly works and

policy documents, we adhere to Koopman's account, following which "genealogy at its best involves a critique in the form of the historical problematization of the present" (2013, p. 2). Rather than conducting a purely historical analysis of a concept's development, genealogy facilitates inquiry into the multiplicity of factors, discourses, and practices that shape the conditions of truth in the present. We do not offer a comprehensive history of the development of the climate-neutral city discourse, but rather a genealogy of how two seemingly separate discourses—on sustainability and smartness—have come to shape the present understanding of the climate-neutral city. While we do employ a genealogical method, we do not necessarily apply a strictly Foucauldian reading of the issue at hand, but rather an approach aimed at tracing the roots of an emerging imaginary (Jasanoff & Kim, 2015) based on the review of existing dominant knowledge in the global urban agenda (Parnell, 2016). As explained by Jasanoff (2015), sociotechnical imaginaries are "'collectively held and performed visions of desirable futures' (or of resistance against the undesirable), and they are also 'animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology'" (p. 19). The term helps to better understand how scientific knowledge and technological innovations interact with social and political processes in shaping visions of the future. The theory emphasizes that these imaginaries are not only about what technologies can do but also about how they align with societal values, identity, and governance.

The choice of the narrative literature review emphasizes the idea that the field of urban sustainability research and practice is characterized by overlapping and contested bodies of knowledge that cannot be adequately captured through purely systematic methods. A narrative review, while open to critique for subjectivity, can offer the necessary flexibility to critically engage with dominant paradigms, such as urban sustainable development. The selection of literature—which comprises 14 international policy documents on sustainable, smart, and climate-neutral cities, as well as around 70 scholarly papers—was driven by thematic and theoretical relevance rather than exhaustiveness or objectivity. Inclusion criteria involved peer-reviewed scholarly works that critically engage with "sustainable cities," "smart cities," and "climate-neutral cities," published in English and Italian mainly since 2000. Furthermore, some of the most relevant policy documents concerning the global governance of sustainable urban development were analysed, including UN, European, and national initiatives of particular relevance for sustainable, smart, and climate-neutral cities—as an example, these spanned from the Agenda 21, to the 2030 Agenda and the New Urban Agenda, to the preparatory documents for the European Mission Cities. Since we believe that urban efforts towards climate mitigation can have a significant impact on how cities will be governed and shape urban social orders and practices for years to come, "if we are to reconstruct our present so that it may yield better futures, we first need a grip on the materials out of which our present has been constructed in the past" (Koopman, 2013, p. 12).

3. Emergence and Evolution of the Sustainable City

3.1. The Sustainable City in Practice in Global Policies

It is argued that the discourse of sustainable development has been central to the blooming of the climate-neutral city initiatives of recent years, as it has been developed since the 1980s through international organizations, quickly becoming the "dominant global discourse of ecological concern" (Dryzek, 2022, p. 149). Sustainable development gained momentum, starting with the publication of the Brundtland Report in 1987 (World Commission on Environment and Development [WCED], 1987), whereby the WCED was tasked to

formulate a "global agenda for change" (WCED, 1987, p. 1). Central to the Brundtland concept of sustainable development is the idea that economic progress and environmental conservation can be harmonized, ensuring that present needs are fulfilled without compromising the capacity of future generations to meet their own. In this light, sustainable development has been understood as a win-win concept that allows for the restoration of environmental degradation, while simultaneously stimulating economic development that should thus help reduce poverty, all by considering issues of international and intra- and intergenerational justice (Betsill & Bulkeley, 2003). The fundamental interconnection of environmental, economic, and social issues addressed through sustainable development positions green growth (i.e., economic growth decoupled from environmental resource depletion) as a key strategy for poverty reduction. In this framework, the report highlights the role that cities and urban settlements can have for sustainable development and how widespread citizens' participation can aid in the process. By devoting Chapter 9 to "The urban challenge," the report has helped lay the ground for two central processes that have come to define the international discourse of sustainable cities. On the one hand, the principle of multilevel governance for sustainable development (Betsill & Bulkeley, 2003; Hooghe & Marks, 1997) involves an expansion of actors beyond the nation-state, both vertically and horizontally (Bulkeley et al., 2015). This principle has also been identified as a "polycentric" landscape in urban climate action, among which global city networks play a central role (Acuto et al., 2024). This also suggests a shift in the power balance between the actors, at least in principle, "to both higher (transnational) and lower (local) levels of political organization" (Dryzek, 2022, p. 158). On the other hand, in interpreting the role of citizens' participation in decision-making processes as a guarantee of more equitable societies, the concept of sustainable development has overshadowed the other dimensions of justice in environmental policy, namely justice as distribution (of good and bad, and of rights and responsibilities) and justice as the recognition of pre-existing inequalities (Fraser, 2009; Schlosberg, 2007). Contentment with the notion that participation alone improves equity within cities and globally, along with the belief that economic growth resolves poverty, has contributed to an understanding of sustainable development that strongly favors two of its three founding pillars—environmental and economic—while giving less attention to equity (Long & Rice, 2019). In this instance, Dryzek highlights how "sustainable development has been increasingly linked to the idea of 'green growth,' which covers only the economic and environmental pillars, not social justice" (Dryzek, 2022, p. 156).

Through the subsequent international commitments and conferences on sustainable development, the idea of sustainable cities in these terms has been further developed. Particularly at the 1992 UN Conference on Environment and Development in Rio de Janeiro, cities were recognized as having a more active role in achieving sustainable development. Chapter 28 of Agenda 21—the document adopted after Rio—is devoted to "local authorities' initiatives in support of Agenda 21" (UN, 1992). In this framework, local authorities have been called upon to begin consultative and participatory efforts for developing Local Agenda 21 (LA21), an initiative that has attracted significant local, national, and international attention and mobilization. "Through consultation and consensus-building, local authorities would learn from citizens and local, civic, community, business, and industrial organizations and acquire the information needed for formulating the best strategies. The consultation process would increase household awareness of sustainable development issues" (UN, 1992, n. 28.3). As we can appreciate from this statement, rather than promoting a vision to tackle urban inequalities, the envisioned participatory processes should help educate and raise awareness of the citizens on the challenges of urban sustainability. This understanding unveils another widely accepted principle that has come to shape sustainability politics: the role of science and technology as legitimizing forces for urban sustainability transitions (Miller & Levenda, 2017).

Successive initiatives at the international level have further supported these dynamics by stressing the possibility of cities to move and act for sustainable development beyond the nation-state, and through international networks such as C40 and ICLEI (Acuto et al., 2024). In this regard, Bulkeley (2006) focuses on the role that best practice dissemination for sustainable cities plays in supporting mainstream political rationalities of urban development: "It is evident that best practice entails more than the articulation of technical knowledge, or practical know-how. It is at once a political rationality about appropriate urban futures, and a governmental technology through which the urban sustainability problem is rendered governable" (2006, p. 1041). From her perspective, international initiatives such as UN-HABITAT and the Best Practices and Local Leadership Programme, established in 1997, have also emphasized the dissemination of best practices for sustainable urban development, thereby overshadowing the view that urban sustainable transitions are inherently political and contested (Miller & Levenda, 2017). In a similar vein, Cociña et al. draw an analysis of the processes of knowledge translation, i.e., "looking at how knowledge has been articulated, circulated and valued" (2019, p. 130) in the global urban agenda between research and practice. Through a historical perspective, the authors explore how different forms of knowledge—particularly from research and community-based initiatives—have interacted with, influenced, or been marginalized in shaping global urban policies and discourses. They conclude that global urban agendas are co-produced through negotiations of power and representation, yet these processes largely reproduce existing power unbalances. Moreover, the "data-bias" (Cociña et al., 2019, p. 139) that has characterized the most recent global urban initiatives could inhibit the emergence of viable alternative forms of knowledge.

3.2. The Limits of the Sustainable City Concept

The 1990s have seen an increasing number of international initiatives, as well as literature trying to delve deeper into the idea of the sustainable city and what the city can do for sustainable development (Satterthwaite, 1997). While agreement as to what the sustainable city should look like has yet to be found. Even the most recent initiatives since the beginning of the 21st century seem to reinforce the dynamics identified previously. Within the framework of the global governance of sustainable development, a key milestone after Rio was the 2002 World Summit on Sustainable Development, held in Johannesburg, South Africa, also known as Rio+10. However, it was especially at Rio+20—the UN Conference on Sustainable Development held in Rio de Janeiro in 2012—that urban sustainable development received significant attention, and the groundwork was laid for future commitments in this area. Most notably, Rio+20 occurred during a period of global economic apprehension following the 2008 financial crisis, which significantly influenced the latest conception of sustainable development, making it even more focused on green growth (Bina, 2013). The severity of the economic and environmental crises has prompted the international community to recognize the need for concerted action and has further drawn attention to the role that cities can play in achieving sustainable development. This led to the adoption, in 2015, of the UN Agenda for Sustainable Development, also known as the 2030 Agenda, and its SDGs (UN, 2015).

Among the 17 goals, SDG 11 focuses on making cities and human settlements inclusive, safe, resilient, and sustainable, and addresses the challenges of rapid urbanization, aiming to ensure that cities are well-planned, environmentally friendly, and equitable (UN, 2015). Not unlike the LA21, SDG 11 represents an even deeper acknowledgment that local governments and other non-state actors, beyond the state, play a fundamental role in achieving sustainable development. The adoption of a specific goal on cities has resulted from a growing network of urban and non-state actors advocating for greater commitment to addressing the

challenges of urbanization and urban equity (Cociña et al., 2019). As Revi noted, while SDG 11 is only one out of 17 "the global discussion around the New Urban Agenda (NUA) of HABITAT III has made it moderately clear that most of the SDGs will never be achieved without sustainable urbanization, and vice versa" (2016, p. xi). In fact, just one year after the adoption of the Agenda, the third HABITAT conference of the UN was held in Quito, which adopted a "NUA" (UN, 2017). With a specific focus on urban settlements, this agreement could be seen as the operational and strategic framework to support the realization of SDG 11. But while both SDG 11 and the NUA express high expectations, there is a general lack of prioritization, financial and institutional capacity that make it unlikely for both to deliver their goals in a timely manner (Revi, 2016). Instead of establishing more binding political commitments in this direction, the overall approach of the 2030 Agenda has been described as "global governance by goal setting" (Biermann et al., 2017; Koch & Krellenberg, 2018). The focus here is less on legally binding engagements and more on the monitoring and reporting of data: "Consequently, the success of the SDGs does not depend on the strict application of existing laws and regulations, but rather on those "weak" instruments such as reporting on the process" (Koch & Krellenberg, 2018, p. 3), with a direct involvement of cities to monitor progress and provide data.

While the 2030 Agenda and the UN-HABITAT III New Urban Agenda introduced a more explicitly universal framing of "sustainable cities," Kaika (2017) argues that, in practice, this shift primarily reinforced the emphasis on systemic monitoring and reporting—often through indicators and data-driven mechanisms, even if qualitative and voluntary (see e.g., UCLG & UN HABITAT, 2020). While this data-driven approach is undoubtedly useful for global comparison and advancement tracking, even relating to experience previous than the 2030 Agenda, Bulkeley and Betsill noticed that "this propensity for analyses of urban sustainability to focus on technocentric models and wish-lists of measures which should be introduced...has meant that critical questions concerning the political struggles which take place in defining what urban sustainability might entail have been neglected" (2005, p. 43). The centrality of data, indicators, footprints, and other science- and data-driven measures has become the rule for sustainable cities, and the way to obtain all this information has increasingly become equated with "smart" (Kaika, 2017). In this instance, Cociña et al. highlight how, in the preparation phases of HABITAT III, there has been a strengthened "focus on *expert-led* processes and *measurable data* as the main kind of inputs labelled as valuable knowledge" (2019, p. 138). This principle is then recalled in the final UN-HABITAT III text, which calls for "robust science-policy interfaces in urban and territorial planning and policy formulation and institutionalized mechanisms for sharing and exchanging information, knowledge and expertise, including the collection, analysis, standardization and dissemination of geographically based, community-collected, high-quality, timely and reliable data" (UN, 2017, p. 39, in Cociña et al., 2019, p. 138), and makes explicit reference to the smart-city approach to reach its goals (Cociña et al., 2019). In a similar vein, the centrality of measurable data is a central feature in climate urbanism, which refers to the processes through which climate change has become a primary driver of urban planning and governance, slowly replacing the attention of sustainable urbanism for general environmental performance with specific carbon accounting and emission reduction targets (Long & Rice, 2019). Climate urbanism is emerging as a priority in urban planning over sustainable urbanism because it aligns more directly with the urgency of SDG 13 "Climate Action" and the Paris Agreement targets by prioritizing carbon reduction and resilience-building. This reframing of SDG 11 through a climate-first lens emphasizes mitigation and adaptation as strategic priorities in urban planning, whereby technology, ICT, and the smart city approach have become essential tools for governments in addressing climate change.

4. Emergence and Evolution of the Smart City

The scientific literature agrees (see, e.g., Alawadhi et al., 2012; Fischer, 1995; Petroccia et al., 2020) that the term *smart city* originated in California's Silicon Valley in the early 1990s, when two well-known multinational companies, IBM and CISCO, proposed an ideal city model centered on high technology, with a strong focus on digitalization in the development of urban infrastructures and services.

The term has gained significant attention and become popular since the 2007–2008 global financial crisis. Bria and Morozov (2018) highlight how, in a context in which states had fewer resources to invest in public infrastructure and services, these large companies, essentially in a monopoly position, could sell their services to public administrations at a low price. Authors explain how the smart city concept has been artificial from the beginning, created by large technology companies to sell their services to public administrations. They proposed a "one-size-fits-all, generic" solution that can then work anywhere: a technological, technocratic solution that presents almost all problems as technical problems, with no ideological or political background. In particular, in 2008, IBM launched the *Smarter Planet* project, which aimed to use smart technology and systems to create smarter electricity grids, as well as food, water, health, and traffic systems. In 2009, IBM introduced the *Smarter Cities Challenge*, an initiative in which IBM experts assisted cities worldwide in addressing their most critical challenges by providing recommendations on how to make the city smarter and more efficient.

The discourse on smart cities, initially strongly centered on ICT topics, has evolved into conceptual variations that tend to progressively take a more holistic view (Capdevila & Zarlenga, 2015). The California Institute for Smart Communities was among the first to focus on how communities could become smart and how a city could be designed to implement information technologies (Alawadhi et al., 2012). Some years later, the Center of Governance at the University of Ottawa began criticizing the idea of smart cities as being too technically oriented. In this reading, the smart city should have a strong governance-oriented approach that emphasizes the role of social capital and relations in urban development (Albino et al., 2015). In an important work, Nam and Pardo (2011) considered three core factors: technology (infrastructures of hardware and software), people (creativity, diversity, education), and institutions (governance and policy). At the European level, the work of Giffinger et al. (2007) remains central, where the authors propose a ranking of "smart cities" of European medium-size cities based on an analytical framework composed of six characteristics: smart economy, smart people, smart governance, smart mobility, smart environment, and smart living. Consequently, a smart city can be defined as one that performs effectively across these six characteristics.

4.1. The Smart City in Practice in Global Cities

Many countries and cities have launched their own smart city projects to resolve urbanization issues and challenges. In 2020, UN-HABITAT (2020) launched the flagship program People-Centered Smart Cities, acknowledging the transformative potential that digital technologies can have for sustainable urban development. Moreover, UN-HABITAT (2022) published a guide on *Urban Planning Law for Climate Smart Cities* to help countries establish legal frameworks necessary for effective domestic implementation of the Paris Agreement. The U.S. was among the first countries to launch a smart city project, incorporating many of the *Smarter Planet* concepts promoted by President Barack Obama. In 2015, the U.S administration announced a new "Smart Cities" Initiative for investing over 160 million U.S. dollars in federal research,

aiming to help local communities tackle their urbanization challenges, such as traffic congestion and climate-change effects (The White House, 2015). In the same year, the Government of India adopted the National Smart Cities Mission, an urban renewal and retrofitting program to develop smart cities across the country, making them citizen-friendly and sustainable (https://smartcities.gov.in). In 2017, the Hong Kong government unveiled the *Hong Kong Smart City Blueprint*, a set of smart city initiatives and pilot projects aimed at addressing challenges such as population aging and resource scarcity (ITB, 2017). In the same year, Singapore approved its Smart Nation Initiative (Ho, 2017); in Europe, Amsterdam was one of the first cities adopting a Smart City program (Carlo Francesco, 2016). The European Union defined a smart city as a city seeking to address public issues via ICT-based solutions based on a multi-stakeholder, municipally-based partnership (Beretta, 2018; European Parliament, 2014). European cities had been experiencing an increasing process of urbanization for years, with over two-thirds of the population already living in cities, and increasing the burden on energy, transportation, water, buildings, and public spaces. In this context, ICT was considered a key enabler for cities in addressing these challenges, permitting solutions that were both highly efficient and sustainable, and able to generate economic prosperity and social well-being (Beretta, 2018).

The EU demonstrated its strong conviction in smart cities from the outset: in March 2010, it proposed the Europe 2020 Strategy to exit the financial crisis and prepare the EU economy for the challenges of the following decade. The document was titled *2020—A Strategy for Smart, Sustainable and Inclusive Growth*, including smartness of growth among its main objectives.

4.2. The Limits of the Smart City Concept

When the term was first used in the 1990s, the focus was on the significance of new ICT regarding modern infrastructures within cities. The "smart city" label diffused in the first years of the new century as an "urban labelling" phenomenon. As Hollands explains (2008, p. 305), the terminology "smart city" is to a degree rhetorical: "What city does not want to be smart or intelligent?" The problem is that, as no city wants to be considered "dumb," technologies are quickly implemented to sell the city as a "smart city." The city thus protects its image and improves its competitive capacity by positioning itself as an attractive city for business, citizens, and tourism (Del-Real et al., 2021).

The concept of smart cities grew from the 1990s until today and has received considerable attention in recent years. In the first stage, the development of the smart city concept has been led by an efficiency-based, technocratic, and neoliberal view of urban development, which mainly sees technology and public-private partnership as the means to optimizing the management of urban processes (Kitchin, 2014, 2015; Vanolo, 2018). Over time, this technocratic vision has evolved to make room for more soft components, such as human capital, social capital, and cultural heritage, or more holistic and comprehensive objectives, such as quality of life, safety, and environmental protection. As Caragliu et al. (2011) state, "a city [is] smart when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance" (2011, p. 70).

Nevertheless, several authors showed how the smart cities concept remained attached to neoliberal principles such as market efficiency, an increasing role of the private sector, and competitiveness (Kitchin, 2015; Vanolo,

2018). Also driven by the adoption of the 17 SDGs of the UN Agenda set for 2030, the growing recognition of the limits of a smart urban development model that focuses solely on market efficiency and competitiveness has led scholars and policymakers to rethink their understanding of smart cities (Almirall et al., 2016; Capdevila & Zarlenga, 2015; Gadecki, 2018; Hsu et al., 2018; Pick, 2017; Wang et al., 2021; Zvolska et al., 2019).

Moreover, investments aimed at attracting the so-called creative class (Florida, 2017), associated with the development of tourism, and the wide adoption of global digital platforms have driven negative effects, such as inequalities, gentrification, and segregation (Cocola-Gant & Gago, 2019; Florida, 2017; Frenken & Schor, 2019; Ganzaroli et al., 2021). Smart cities and, in particular, the so-called creative cities (Florida, 2002) risked becoming polarized not only economically, but also socially and culturally, with, on one hand, the "creative" workers and, on the other, the "uncreative class" lacking knowledge or specialization in technologies. In smart cities, inequalities often exist not only in work and living conditions and areas of residence (Hollands, 2008), but also in the allocation of spaces (Byrne, 1999) and opportunities for free time (Chatterton & Hollands, 2003). Thus, smart cities do not seem particularly positive places concerning class distinction, inclusion, or social justice. As Hollands (2008) maintains, although such cities may boast creativity, diversity, tolerance, and culture, they often appear more focused on attracting "creative" workers with technological expertise than on using information technology and art for social inclusion.

The limits of the *smart cities* concept are also shown by Blasi et al. (2022). In their research on the existing literature on smart cities from 1999 to 2021, they highlight how the smart city is still understood as a technological paradigm mainly oriented toward efficiency and effectiveness in the management of urban processes. Moreover, even if there are scholars warning about the social and environmental risks associated with a smart society (Cardullo et al., 2019; Florida, 2017), most of those risks are largely overlooked and are not part of the current debate on the development of smart cities.

In their literature review, Mora et al. (2019) argued that two competing visions for smart cities had emerged. The first one employs a technology-led and market-oriented approach as the primary driving forces shaping smart cities. The second represents a human-centric and people-driven approach to smart cities, in which technological development is aligned with human, social, cultural, economic, and environmental factors. In this case, the smart city is not conceived as a technological object but as a socio-technical system in which ICTs serve public interests. However, they judged that this second approach had not yet been able to provide the knowledge necessary to move from theory to practice.

Indeed, Del-Real et al. (2021) argue that smart city technologies are being implemented without any consideration for their impact on society. Rather than being neutral, smart city technologies are viewed as neoliberal tools that justify practices of devolution, deregulation, and privatization (Clark, 2020; Greenfield, 2013). Smart city initiatives prioritize technological solutions over political, social, and community-oriented solutions (Greenfield, 2013; Mattern, 2013), providing solutions that benefit private industries rather than citizens and residents (Clark, 2020; Coletta et al., 2019). Beretta (2018) highlights the risks of internal polarization, with the weakest sectors excluded from the international network and at the service of the wealthy (and interconnected). She highlighted that technology risks becoming not a means of greater democracy but, rather, a factor that widens the gap between rich and poor, between those online and offline, and between those obliged to stand by and those in power. Hollands (2008), for example, shows that in the city of San Diego, during the economic boom, poverty levels increased, even though in the previous

decade a low level of unemployment was registered. Furthermore, it has been argued that smart city initiatives facilitate technocratic and top-down forms of governance and government (Vanolo, 2014), based on a spirit of civic paternalism that neglects to actively involve citizens and other stakeholders in addressing urban issues (Shelton & Lodato, 2018).

Paskaleva and Cooper (2022) affirm that, over the last decade, the EU has promoted the use of Smart City initiatives to—among other goals—improve citizens' quality of life. Chang and Smith (2023) conducted a literature review concluding that, since 2019, citizens' quality of life has become a central priority in smart cities studies. Reference is increasingly made to "quality-life oriented smart cities" (Cantuarias-Villessuzanne et al., 2021), "human smart cities" (Keshavarzi et al., 2021), "citizen-centric smart cities" (Shami et al., 2022), "people-centric smart cities" (Ji et al., 2021), "happiness-driven smart cities" (Zhu et al., 2022), and "smart age-friendly cities" (Ivan et al., 2020). However, citizens are often considered as users, testers, or consumers rather than producers and sources of creativity and innovation; instead, there is a need to engage citizens in the co-design of smart processes and solutions; it is necessary to create an effective system of urban management that creates a productive dialogue between government and society, taking into account the opinions of citizens.

Among others, Helbing et al. (2021) argue that the so-called citizen-centered solutions are often based on profiling, targeting, and behavioral change. In that way, they violate values such as privacy, informational self-determination, and other fundamental rights, which are implied by the Universal Declaration of Human Rights. In this respect, Bria and Morozov (2018) point to the process of "data extractivism," whereby web users give up their data for free to large monopolistic companies (Apple, Amazon, Facebook, Google, Microsoft) interested in our consumption patterns, in exchange for having free or very cheap services.

Helbing et al. (2021) highlight the discussion about surveillance-based approaches in smart cities with reference to predictive policing. Great concerns were triggered by the high false-positive rates of the corresponding algorithms (Gless, 2018) and by issues of systematic bias and discrimination (Kim, 2016; Mayson, 2018), for example, against people of color (Obermeyer et al., 2019). Significant discrimination was also found in facial recognition algorithms. The currently promoted human-centred AI approach is insufficient. It lacks coordination capacity and the ability to promote collective intelligence. It also does not sufficiently support the emergence of shared values and collective action to address urban challenges that require cooperation and consensus (Cavazos et al., 2020).

To get a more general picture, it is interesting to consider the systematic review of existing literature made by Bina et al. (2020), showing a rapidly growing critical literature of smart cities based in the social sciences. They organized their critique into three parts considered to be constitutive of the techno-utopian approach to urban development and management, which resonate with our own conclusions: (1) *Technological solutionism and the economization of urban life*, which refer to configurations of technological with neoliberal visions of urban management. The idea is that smart cities and the use of ICT are not just answers to urban problems but represent a new paradigm of urban development centered around core values of efficiency and productivity (Caprotti, 2015). (2) *Quantitative universalism and reductionism*: Urban systems are monitored through extensive networks of data collection, processed by algorithms and mathematical models (Kitchin, 2014). Urban life is reduced to quantitative language, big data systems and management replace wider urban expertise, and technocratic management replaces democratic policymaking and politics (Beretta,

2018; Chandler, 2015; Madrigal, 2013; Morozov, 2013; Söderström et al., 2014). (3) *The illusion of political neutrality of smart technology*: Technocratic regimes are proposed as the only alternative, in which "urban affairs are framed as an apolitical matter" (Söderström et al., 2014; Vanolo, 2014). The smart model is perceived as an optimizing urban management instrument, through standardized processes for decision-making (Joss, 2016). Furthermore, the smart city model is increasingly shifting from a focus on efficiency toward environmental sustainability (Bibri & Krogstie, 2017) and climate neutrality, as digital tools like AI, digital twins, and urban data platforms are used to plan and optimize low-carbon infrastructures. In this instance, the European Commission's title for the urban carbon neutrality mission—to deliver 112 climate-neutral cities by 2030—is highly symbolic, as it explicitly links smartness and climate neutrality: EU Mission "Climate-Neutral and Smart Cities" (European Commission, 2021).

5. Discussion: From Sustainable and Smart…

We have discussed sustainable and smart cities, offering a critical appraisal of how their dominant adoption mechanisms within the urban governance framework shape understandings not only of the contents of these two concepts but also of how they frame the politics of urban development.

Regarding the sustainable city, we have highlighted four underlying processes related to the global vision of urban governance. First, while the original formulation of sustainable development and its successors, including SDG 11, make explicit reference to equity and justice as one of the three main pillars, most international commitments make few references to the type of justice to be achieved, instead emphasizing participation (i.e., procedural justice) as a means of ensuring equity in policy outcomes and securing citizen buy-in. In this instance, Target 11.3—"By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries" (UN, 2015)—is a good example. As Hatuka et al. highlight, "in the sustainable and resilient [city] concepts, individuals' participation is regarded as part of their responsibility to contribute to the place-making and well-being of the city" (2018, p. 173). Second, the focus of sustainable development has shifted to the environmental and economic pillars, equating sustainability with green growth (Bina, 2013; Dryzek, 2022). Third, multilevel governance, as a shift away from the centrality and sovereignty of the nation-state in environmental and sustainable issues, has allowed an opening to new modes of governance both vertically and horizontally (Bulkeley et al., 2015). With the adoption of the 2030 Agenda, this process has seen a shift towards what has been defined as "global governance by goal setting" (Biermann et al., 2017; Koch & Krellenberg, 2018), whereby monitoring and control of sustainability performance, also by non-national actors, is the premise for the achievement of sustainability goals. This last process implies yet another dynamic, which we consider the fourth underlying principle of urban sustainability: the role of science and technology as legitimizing forces for urban sustainability transitions (Miller & Levenda, 2017) and their ability to depoliticize sustainable development (Long & Rice, 2019). In this instance, there is an increasing recognition that ICT constitutes a promising response to the challenge of urban sustainability (Sengupta & Sengupta, 2022). Contemporary debate in urban and academic literature is increasingly focused on ICT and sustainability as well as their amalgamation, especially for climate objectives, also focusing on the role that AI could play (Bibri et al., 2023). Bibri et al. (2023) highlight that AI could play a significant role in urban sustainability, especially for data-driven environmental management and carbon accounting, but they also recognize some challenges related to the environmental costs and ethical challenges it poses.

With respect to the smart city, three different yet similar tendencies in the international political discourse can be identified. First, the centrality of ICT and technological solutions for smart city initiatives facilitates technocratic and top-down forms of governance and government (Miller & Levenda, 2017). This process rests on the apolitical assumption that science-based, technological fixes are per se good, without contesting the sociotechnical nature of technology in the first place. As asserted by Feenberg (2005, p. 3), the whole technology design is "an ontological decision fraught with political consequences. The exclusion of the vast majority from participation in this decision is profoundly undemocratic." Similarly, in acknowledging the emergence of the smart city as central for the dominant role of science and technology in urban sustainability transitions, Miller and Levenda (2017, pp. 349–350) critically assess how:

> Scientific research on urban sustainability not only produces knowledge about the city and sustainability transitions but also helps to shape political identities, relationships, institutions, and beliefs about sustainability goals (Miller, 2013, 2014). This co-production process can shape the discourse and policy choices around urban sustainability, thereby exercising power.

The issue of power and its distribution brings us to the second process identified concerning smart cities: the central role played by non-governmental, private companies in developing and promoting smart monitoring and control systems. "Smartness reframes urban sustainability challenges as market opportunities for corporations to sell digital solutions" (Evans et al., 2019, p. 588). This tendency implies a neoliberal view of urban development that is based on efficiency principles and the privatization of services. Lastly, there is the role played by citizens and how they are interpreted within the framework of smartness. As it has become clear, citizens are often considered as users, testers, or consumers rather than producers of the technologies implied in the smart city (Cardullo & Kitchin, 2019; Vanolo, 2014). They somewhat feed the monitoring and control systems, without really having a say in how these are designed, leaving an enormous space for ethical considerations.

6. Conclusion: …to Climate-Neutral?

Using a critical historical analysis with a genealogical approach to the literature on sustainable and smart cities, as well as to the main events and policies shaping these concepts, we have identified how these discourses have evolved. Also based on our previous work (Beretta & Bracchi, 2023), we see how these processes have contributed to the framing of an emerging imaginary of the climate-neutral city, especially in the European context. The climate-neutral city, aimed at "radically reducing GHG emissions from urban activities while simultaneously removing GHG emissions from the atmosphere" (Seto et al., 2021), combines most of the characteristics identified for sustainable and smart urban development (Hatuka et al., 2018) into what has been defined as climate urbanism (Long & Rice, 2019). Long and Rice highlight, in particular, how the data bias in the global urban agenda is further exacerbated in climate urbanism, the new policy orientation focused on the centrality of cities for climate action and for protecting their role as engines of economic growth, as "carbon and other GHGs provide clear, measurable objects for regulation and surveillance by urban governance while also serving as a single, publicly legible outcome" (2019, p. 997).

The global and European governance of urban climate change mitigation—which has been developing since the 1990s with experiences such as ICLEI's Cities for Climate Protection program (Acuto et al., 2024; Betsill & Bulkeley, 2003, 2004)—has seen an expansion in scope and scale, especially since the 2015 Paris

Agreement (UNFCCC, 2015). Recently launched initiatives include, e.g., the 2021 C40 Cities Race to Zero Initiative and the 2021 Mission Climate-Neutral and Smart Cities launched by the European Commission. These initiatives indicate a renewed interest in the environmental dimension of the global crises, with climate change as the most pressing environmental issue to be tackled through CO_2eq accounting. They further emphasize the urgency and vulnerability of urban areas and the need for a transition to new energy systems, technological innovation, and (infra)structural modernization. This passage, central to global climate change governance, aligns the discourse of the sustainable city in ecological and economic terms (i.e., green growth) with the central role of technologies in smart cities as indispensable devices for the reduction of emissions (i.e., ecological modernization). The smart city concept has changed the urban ecosystem by embedding digital technologies in the city fabric to enhance the quality of life of its inhabitants, at least in theory. de Jong et al. (2015) show how, since 2010, the concept of smart cities has been on its way to becoming a leading driver of urban sustainability. As stated in the UNDP document "Smart and Inclusive Cities" (2024, p. 4):

> Cities worldwide face increasingly complex challenges while striving to achieve sustainable urban living. It requires a smarter approach to urban development that harnesses the opportunities provided by modern-day technologies while addressing the needs of local communities, businesses, and residents....Facilitating smarter and inclusive city development is one of the pathways toward a sustainable urban future. Smarter and inclusive cities make use of the opportunities provided by emerging technologies to facilitate economic growth, social inclusion, and climate action. Making cities smarter and more inclusive can bring about transformational change in towns and cities to improve the quality of life, protect natural resources, and pursue socio-economic development.

In a nutshell, there is a discursive hegemony of smartness over the current form of sustainable urban development, with a newly rediscovered emphasis on its environmental dimension in terms of urgent climate change responses. Similarly, in presenting the Mission Climate-Neutral and Smart Cities by 2030, the European Commission highlights the co-benefits of a climate transition enabled through technologies:

> To achieve in ten years what Europe plans to achieve in 30 years is a huge challenge that requires a systemic transformation of European cities. Still, this is both necessary and feasible. It is necessary for acting on the global climate emergency and for delivering co-benefits that will improve the health, wellbeing and prosperity of citizens. It is feasible because technologies and innovative solutions for sustainable energy, transport, food, water and material systems already exist. (European Commission et al., 2020, p. 9)

As Tozer and Klenk demonstrate by analysing a similar initiative, the Carbon Neutral City Alliance, there is an emerging sociotechnical imaginary of urban climate neutrality, which is "structuring shifts in policy and practice. There is a focus on technological fixes and innovation as solutions, as well as on influencing the behaviour of individuals" (2018, p. 179). In this vein, the latest UN Report *Synergy Solutions for Climate and SDG Action* (UNDESA & UNFCCC, 2024) highlights how "cities are uniquely positioned to lead the charge in leveraging synergies and limiting trade-offs between the SDGs and climate objectives. Specifically, demand-side climate solutions often implemented in cities offer significant potential for climate-SDG synergies" (p. 15).

Therefore, if we were to ask whether the urban climate neutrality imaginary is based on the assumptions and underlying ideals of both sustainable and smart cities, the answer would likely be affirmative. As critical literature highlights (Castán Broto & Westman, 2020), urban climate politics is often dominated by neoliberal economic interests, perpetuating inequalities and marginalization while prioritizing growth and investment over socio-environmental transformation. This has led to calls for justice-oriented strategies that address underlying political, social, and economic structures driving climate vulnerabilities and risks. In line with existing studies (Hatuka et al., 2018; Long & Rice, 2019; While et al., 2010), we observe a hegemony of climate urbanism in contemporary efforts to steer cities towards more sustainable forms. While it is paramount to engage with climate change for the urban future, we share the apprehension that this urban imaginary may insufficiently account for issues of present and future justice.

This concern also extends to what the future of urban sustainability post-2030 Agenda might entail. Looking at the present, and beyond the 2030 Agenda timeframe, urban sustainability is increasingly being reimagined through the lens of climate action, whereby elements of sustainable and smart urbanism strategically merge to shape new policy priorities towards climate neutrality. This invites further research into how the climate-neutral city imaginary is being institutionalized through international city networks and local initiatives, how it restructures urban governance, and how it is contested or reconfigured by alternative urban actors in ways that reflect broader struggles over equity, inclusion, and recognition. In short, planners and decision-makers should be advised not to overlook the social justice dimension of sustainable urban development in the transition to climate neutrality by adopting more situated and reflexive approaches in the search for solutions.

Conflict of Interests
The authors declare no conflict of interests.

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