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Climate Change and Urban Resilience in Smart Cities: Adaptation and Mitigation Strategies in Brazil and Germany

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Abstract: Urban resilience is crucial in academic and policy discussions, particularly in balancing urban development and sustainability in both developed and developing countries. In developing nations, rising emissions and vulnerability challenge effective climate change mitigation and adaptation efforts. Advances in Information and Communication Technologies offer significant opportunities despite challenges. The digital revolution is central to enhancing urban management, especially in smart cities. In light of this context, this paper aims to investigate the literature advancements of urban resilience to climate change in smart cities and conduct a multi-case study analysis of adaptation and mitigation strategies in Brazilian and German smart cities, demonstrating their efforts to enhance urban resilience to climate challenges. The research used two main methods: a bibliometric analysis to review literature on climate change, urban resilience, and smart cities, and case studies of urban resilience practices in 10 smart cities from Brazil and Germany. The literature review highlights the increase in research on this theme, identifying five thematic clusters that reveal relationships among study topics and suggest future research directions. The cases highlighted local initiatives in Brazilian and German smart cities to enhance urban resilience to climate pressures, revealing notable differences due to varying levels of development and investment.

Keywords: urban resilience; climate change; smart cities; adaptation; mitigation; case studies

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1. Introduction

Earth has undergone significant transformations caused directly or indirectly by human beings. Physically, climate change is increasingly evident, and socially, a major transformation is the urbanisation of mankind; these two phenomena are closely related. The population concentration in urban centres has been a hallmark of world development, representing approximately 55% of the world's population. In Latin America and the Caribbean, almost 80.7% of the population lives in urban areas, while in Europe the figure is 74.5%. At the beginning of the 20th century, this rate was only 10% of the world's

population. By 2050, 68% of people will live in urban environments [1]. In parallel, the concentration of CO_2 (carbon dioxide) in the atmosphere, the main greenhouse gas—GHG, increased by around 30% in the 20th century when compared to the previous one. It is estimated that the average global temperature rose by about 0.7 °C in the last century, and it is predicted that it could increase by up to another 5 °C over the present century, according to reports from the Intergovernmental Panel on Climate Change [2].

In 2023, South America experienced its hottest year on record, while Europe had its second warmest year [3]. Moreover, extreme weather events, such as floods, droughts, and rising sea levels, have become more frequent, consequently affecting various parts of the globe in different ways and primarily damaging the poorest regions, including in Latin America and Europe. These events can lead to heavy flooding, critical infrastructure damage, serious health impacts including human losses due to excess urban heat, and further disruptions in urban life, and often coastal cities are substantially exposed [4].

In this context, urban resilience has gained importance in academic and policy discussions [5], considering the fact that it must be considered alongside efforts to promote urban development and sustainability [6]. Urban resilience is an urban system's ability to maintain or quickly restore desired functions in the face of a disturbance, to adapt to changes, and to transform systems that limit current or future adaptive capacity rapidly [7]. It involves the capacity to recover and continue providing primary functions in the face of disasters and other risks [8], considering adaptation and mitigation strategies.

Nevertheless, the reality of resilience to climate change differs between developed and developing countries. Despite increased emissions, including greenhouse gases, and heightened vulnerability to climate change, taking action to mitigate and adapt to climate change is challenging in cities in developing countries [9]. These cities are struggling with worsening congestion, air pollution, crime, waste management, and unemployment issues. Moreover, urban mitigation and adaptation goals in these countries will have to be achieved as co-benefits of interventions targeted at solving pressing urban problems. The effective and synergistic use of selective urban interventions could help solve existing urban problems and achieve climate change mitigation and adaptation objectives [10].

In the context of these challenges, the opportunities revealed by advances in Information and Communication Technologies (ICTs) must be considered. In recent decades, ICTs have provided a revolution in data generation, process management, and innovations in the integration of digital infrastructures and systems, which has impacted various sectors of the economy and the social and professional relationships of individuals, transforming them into sources of data in real time. Software companies, consultancies, and start-ups, among other new forms of organisations, have developed solutions capable of meeting the various individual and collective demands that arise amid the transformations of the digital world and people's daily lives. In this scenario, the possibilities provided by the digital revolution are at the centre of the debate on the application of technology in urban management, especially when analysing the context of smart cities [11]. In the context of this digital revolution in urban environments, the Internet of Things (IoT) has played a key role in the development of smart cities. IoT architectures enable the optimisation of resource allocation and urban services by connecting networks of sensors, devices, and applications, thus enabling real-time data collection, analysis and automated decision-making in city systems [12]. Recent research also highlights that the integration of IoT with artificial intelligence (AI) further extends these capabilities, supporting adaptive and intelligent urban management solutions that increase efficiency, sustainability, and quality of life in cities [13].

The concept of smart cities was first addressed in the 1990s, with the aim of highlighting the importance of ICTs to overcome the challenges of cities within a global knowledge

economy [14,15]. However, the concept gained notoriety in the scientific debate in the second half of the 2000s, for example, with the study of Giffinger et al. [16], understanding the smart city as a blend of smart economy, people, governance, mobility, environment, and living, built on the combination of endowments and activities of self-determined, independent, and aware citizens. Corroborating this, for Caragliu et al. [17], urban performance does not depend only on the infrastructure (physical capital) of a city but also, more and more, on the availability and quality of knowledge communication and social infrastructure (human and social capital). Table 1 provides an overview of some of the components seen in smart cities. By integrating these elements, smart cities aim to create a more efficient, sustainable, and liveable urban environment.

Table 1. Some of the elements seen in smart cities.

Item	Features
Citizen Engagement	Participation of residents to report issues, provide feedback, and participate in city planning.
Environmental Education	Efforts to raise awareness and educate residents about environmental issues and sustainability.
Care with Public Spaces and Parks	Well-maintained and accessible green spaces that encourage outdoor activities and social interactions.
Provisions of Emergency Response Systems	Technologies that improve the efficiency and effectiveness of emergency services.
Availability of Online Learning Resources	Platforms that offer educational content and training programmes for different age groups.
Accessible Services	Public services designed to be inclusive and accessible to all, including those with disabilities or limited mobility.
Digital Inclusion	Efforts to ensure all residents have access to digital technologies and the internet, reducing the digital divide.

Becoming smart has been a way for cities to seek innovative solutions to deal with the problems and challenges they face, such as climate change [18,19]. This approach has become a topic of interest for technology communities [20], governments and international organisations [21,22], and academia [23], configuring a new arrangement of sustainable development [24]. In the context of achieving sustainable, technological, and equitable urban transformation, smart cities offer a wide range of innovative services in various sectors such as transportation, healthcare, public safety, traffic control, pollution, and waste management [25,26]. As a result, there has been a rise in initiatives aimed at modernising urban service infrastructure and creating better environmental, social, and economic conditions [27,28]. These initiatives must be closely aligned with the specific needs and realities of both developed and developing countries, taking into account their unique characteristics.

Given this context, this paper aims to investigate the literature advancements of urban resilience to climate change in smart cities and conduct a multi-case study analysis of adaptation and mitigation strategies in Brazilian and German smart cities, demonstrating their efforts to enhance urban resilience to climate challenges.

2. Climate Change Impacts and the Cities' Agenda

Climate change is recognised as one of the most pressing challenges facing humanity today, and it has far-reaching consequences across various settings and contexts, including both rural and urban areas. It has an economic impact that cannot be quantified, in addition

to impacting social relations, population levels, disease expansion, and environmental displacement. In particular, a well-established link exists between climate change and urbanisation [29–31].

Cities face a significant threat from extreme weather events, and cities need to address efforts to manage their environmental and infrastructure impacts [32]. Extreme heat events, such as the urban heat island (UHI) effect, are increasing with severe consequences [33]. Water quantity and quality in cities are also negatively impacted [34]. Research shows that global warming and urbanisation will cause more intense heat extremes [35,36].

Reducing the impact of climate change requires targeting public policies [37] and technological and product innovations by organisations, adjusting consumption patterns and waste generation by consumers [38], as well as adopting resilience strategies in the context of urban environments [2]. In this way, environmental and social issues have gained considerable space on the world agenda and have challenged globalisation.

In 2015, the Paris Agreement to the United Nations Framework Convention on Climate Change [39] encouraged the development of measures to reduce GHGs in order to contain the global temperature increase by up to 2 °C, making efforts to limit this warming increase by up to 1.5 °C by the end of the 21st century. Also in 2015, a commitment signed by UN member countries—the 2030 Agenda—presented the Sustainable Development Goals (SDGs), which serve as guidelines for actions seeking to improve people's lives. Among these SDGs, there is a specific one for Sustainable Cities and Communities (SDG 11), which aims to make cities and human settlements inclusive, safe, resilient, and sustainable. There is also an SDG directed at climate change (SDG 13), which proposes measures to combat climate change and its impacts [40]. Furthermore, the Sendai Framework for Disaster Risk Reduction 2015–2030 guides the need to adapt territories to the impacts of climate change to reduce disaster risks, which incur irreparable loss of life and financial and infrastructure damage [41].

It should be noted that although climate change is inevitable no matter how significant the reduction in emissions [42], a climate strategy that seeks to reduce its impacts is necessary. In view of this, organisations and governments have come to rely on mitigation and adaptation strategies as alternatives to these changes [43]. As urbanisation expands, it worsens climate change. However, it could also provide a valuable opportunity to aid in climate change adaptation and mitigation efforts, particularly, but not only, in coastal regions [44]. It is crucial to encourage breakthroughs in science and technology to initiate adaptation and mitigation measures in cities or raise awareness about climate change's causes and consequences, making it a priority policy concern for governments [45]. While mitigation strategies aim to address the causes of climate change, adaptation strategies aim to reduce its impacts [46].

From the perspective of mitigating climate change and reducing GHG emissions, urban planning plays a crucial role in shaping cities and impacting energy demand. Studies indicate that various aspects of urban design significantly impact travel patterns, influencing the use of vehicles [47]. Compact urban developments with higher population densities and mixed land uses help save energy, while dispersed urbanisation, low population densities, and segregated land uses lead to increased motor vehicle usage and higher greenhouse gas emissions [48].

Regarding adaptation to the effects of climate change, the organisation of urban space is probably even more relevant. The urban areas most vulnerable to extreme weather events, especially in areas occupied by poorer populations, should be the object of urban regularisation policies. Initiatives and good practices in transformative adaptation to climate change in cities may pursue some pathways: improving knowledge of climate risks and awareness of vulnerability; enhancing preparedness and promoting sustainability,

considering socio-economic contexts; and supporting policy-making and mobilising the public towards increased resilience [9].

Adaptation strategies are also vital to reducing the risks [8], including the concept of rights and justice [49], and to increasing resilience and enabling sustainable development [45]. To address global climate change, taking action in urban centres is crucial. Building the capacity for adaptation in urban areas, including the spatial planning approach, is urgent [50,51], even more so in developing countries [52,53].

However, while most developed countries (e.g., Germany) have already presented their planning focused on sustainability as a strategy and implemented such in several government spheres—national, state, and municipal [54], there is a different reality in developing countries (e.g., Brazil), where most of the time an integrated planning strategy is practically non-existent, and there are few instruments for measuring results [55], which evidences the importance of creating a favourable local context for urban sustainable development [56]. According to Leal Filho et al. [9], to maximise investments in urban areas while addressing social issues in developing countries, there is a necessity for transformative approaches to investments in low-carbon and climate-resilient infrastructure.

In this context, it is increasingly necessary to plan cities to make them more sustainable and resilient, considering different contexts. According to the IPCC [2], urban resilience is the capacity of a city to absorb disturbances, maintain its normal functioning, and avoid collapse. For this, the city must be prepared for the effects of climate change, identify the impact of its actions on the advancement of these changes, and seek ways to reduce this impact. Sustainable urban development aims to promote its quality of life and reduce negative socio-environmental impacts. Therefore, it is necessary to consider the relevance of cities and urban planning, looking at where the primary sources of GHG are concentrated and the points where areas and populations are most vulnerable to the resulting risks. Thus, discussions on climate change must strongly consider the role of cities, both from the perspective of mitigation and adaptation [2].

Currently, smart city initiatives and strategies have been incorporated into the agenda of local and national governments around the world to propose solutions to the most diverse urban problems, among which are climate issues [18]. Smart cities are, for example, capable of combining technological elements in different areas of urban planning with the challenge of facing climate change [57], modifying traditional patterns of urban development that are intensive in carbon and fossil fuel consumption towards a more sustainable and efficient model of resource use [58,59], and effectively contributing to the climate change agenda.

3. Methods

This study aims to investigate the literature advancements of urban resilience to climate change in smart cities and conduct a multi-case study analysis of adaptation and mitigation strategies in Brazilian and German smart cities, developed using two principal methods. First, a bibliometric analysis was used to conduct the literature review and explore connections between climate change, urban resilience, and smart cities. The second research method was the case study, where an analysis was conducted to highlight urban resilience practices in a group of 10 Brazilian and German smart cities.

In the literature review, bibliometric analyses were conducted on the Web of Science database (WoS) to identify peer-reviewed papers covering studies related to climate change, resilience, and smart cities. The decision to exclusively use the Web of Science (WoS) database was owing to its recognised reliability, broad multidisciplinary coverage, and the quality of its available metadata. According to Pranckutė [60], WoS was the first international bibliographic database of wide scope and, over time, has established itself as one of the most influential and traditionally used sources for journal selection, research evaluation,

and bibliometric analysis. In this context, WoS proves to be an appropriate choice to ensure the robustness and credibility of the data employed in the present study. Although the WoS is widely recognised for its reliability and structured metadata, its selective coverage, particularly of English language research, may overlook relevant studies published in local languages or in applied fields more frequently indexed in other databases. This limitation could influence the formation of thematic clusters and affect the representation of locally driven urban initiatives.

The methodological procedures adopted in the first stage did not affect the identification of cities. This is because the selection of cases was not directly linked to the systematic literature review. The following search string was used: TS ("Climate change" and "resilien*" and "Smart Cit*"). It filtered the document types by article, review article, early access, or editorial material with no set time restriction, so all publications in the historical period covered by the WOS were considered. The first study on these topics was published in 2014, and all of them published up to the search date (25 April 2024) were analysed, totalling 98 documents. The abstracts, titles, and keywords were reviewed in order to eliminate those unrelated to the specific field of study, resulting in 2 documents being eliminated before performing the analysis of the results. Figure 1 illustrates the 96 publications categorised by WoS classification on a treemap chart, considering the 10 most relevant categories, where the categories of environmental sciences, environmental studies, green sustainable science technology, and urban studies stand out. Larger rectangles represent a higher proportion of publications in the WoS category, with the number indicating total publications by discipline, with 76 articles, 19 review articles, 1 early access, and 1 editorial material.

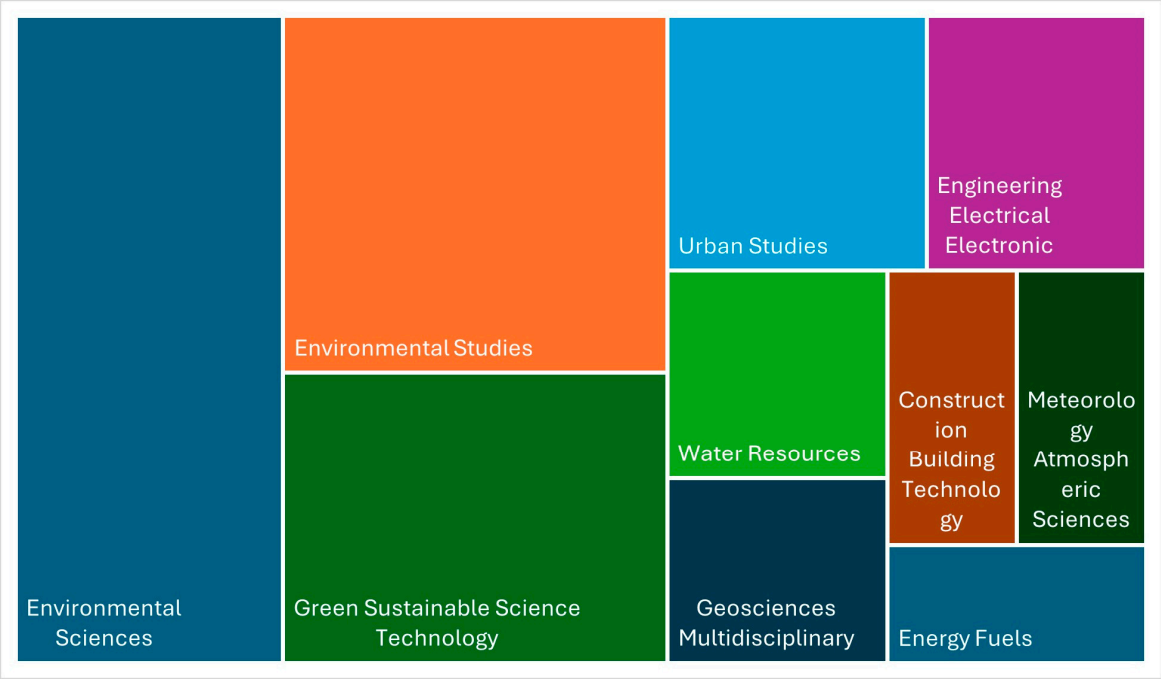

Figure 1. Publications categorised by WoS classification.

The bibliometric analysis of the 96 publications was based on the co-occurrence of terms using VOSviewer software, version 1.6.20 [61], to construct and visualise bibliometric networks graphically, as suggested by van Eck & Waltman [62]. Bubble size indicates term frequency, while stronger connections between bubbles signify a higher likelihood of terms co-occurring and forming thematic clusters, represented by colours. The relationships

between keywords are depicted by the strength of the connecting ties among the nodes, in accordance with Carvalho et al. [63].

The second stage with a qualitative approach was based on the study of multiple cases [64] from a set of 10 Brazilian and German smart cities to evidence practices of urban resilience to climate change. Curitiba, Florianópolis, Porto Alegre, Rio de Janeiro, and São Paulo in Brazil and Berlin, Dresden, Frankfurt, Hamburg, and Munich in Germany were analysed. The data collected for the cases is based exclusively on secondary data from policy documents and peer-reviewed academic publications, identified through a narrative literature review.

The cases were chosen based on their regional relevance, the availability of suitable documentation in the literature, previous experience in climate change resilience, and their recognition as some of the smartest cities in their respective countries, considering the rankings of Connected Smart Cities for Brazilian cities and IMD Smart City Index 2023 for German cities [65,66]. Specifically, the selection focused on cities that consistently appear at the top of these rankings, which consider different indicators such as mobility, environment, technology, innovation, governance, and quality of life. This approach ensures that the study includes cities that are leaders in digital transformation and smart city initiatives, as well as having established strategies and documented experiences in urban resilience and climate adaptation, considering the context of their respective countries. By comparing examples from Brazil and Germany—two countries with different economic, social, and technological contexts—the research has the potential to highlight shared challenges and context-specific approaches to increasing urban resilience within smart city frameworks. The comprehensive review of previous literature guided this approach, providing insights into the analysis of the cases and allowing for a holistic examination. This enabled a comparison of the different realities and significantly enriched the overall understanding of their strategies for tackling climate change in the context of their smart city initiatives.

4. Results and Discussion

The following section presents the findings of two separate investigations: a literature review and a set of case studies. The results are divided into two sections. The first section presents an analysis of the literature on the topics of urban resilience and smart cities. The second section presents the results of the case studies, which were conducted in 10 smart cities in Brazil and Germany. These case studies were conducted to provide examples of urban resilience practices in action.

4.1. Literature Review on Climate Change, Urban Resilience, and Smart Cities

This section presents the findings of the literature review, encompassing research on climate change, resilience, and smart cities. The number of publications has significantly increased in recent years, as illustrated in Figure 2. The first two publications on the analysed themes date back to 2014, with the most substantial growth occurring since 2019. In 2023, 26 studies were published on this topic.

Table 2 below displays the main journals in which the analysed studies were published. It is evident that the journals Sustainability, with 11 publications, and Smart Cities, which has 7 studies published on this topic, are significant sources of reference for studies related to this theme.

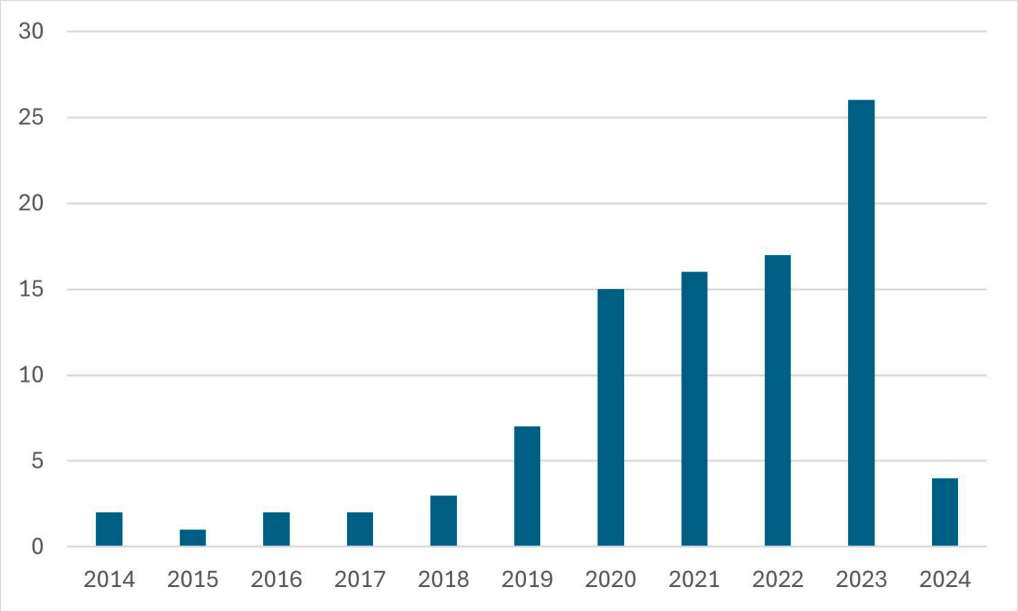

Figure 2. Number of publications in recent years.

Table 2. Publication Titles.

Publication Titles	Record Count	% of 96
Sustainability	11	11.458
Smart Cities	7	7.292
International Journal Of Disaster Risk Reduction	4	4.167
Sustainable Cities And Society	4	4.167
Frontiers In Environmental Science; Journal Of Cleaner Production; Land	3	3.125

The authors with the highest number of publications on this topic are Allam, Z. and Sharifi, A., who have each published 5 studies. Table 3 displays all the authors who have published two or more studies during the analysed period.

Table 3. Number of publication per author.

Authors	Record Count	% of 96
Allam Z	5	5.208
Sharifi A	5	5.208
Shaw R	3	3.125
Ariyaningsih; Baghersad M; Bibri SE; Dianat H; Fernández CG; Khatibi H; Khavarian-Garmsir AR; Peek D; Wilkinson S	2	2.083

Figure 3 presents the results of the bibliometric analysis of climate change, resilience, and smart cities based on the co-occurrence of terms. The analysis is based on the co-occurrence of terms, using keywords that occur at least 3 times, resulting in 71 items. There are five thematic clusters, each associated with a different colour.

The first cluster, in red, focuses on climate change management in the context of urbanisation, including aspects related to green infrastructure and ecosystem services [67–69]. Kaluarachchi [70], for example, analyses the advantages of combining smart and green infrastructure components in urban design policies, providing not only climate change

resilience but also the improvement of citizens' quality of life. Publications in this cluster also take into account specific aspects of climate change management processes, including emissions [71], temperature [72–74], and rainfall [75,76].

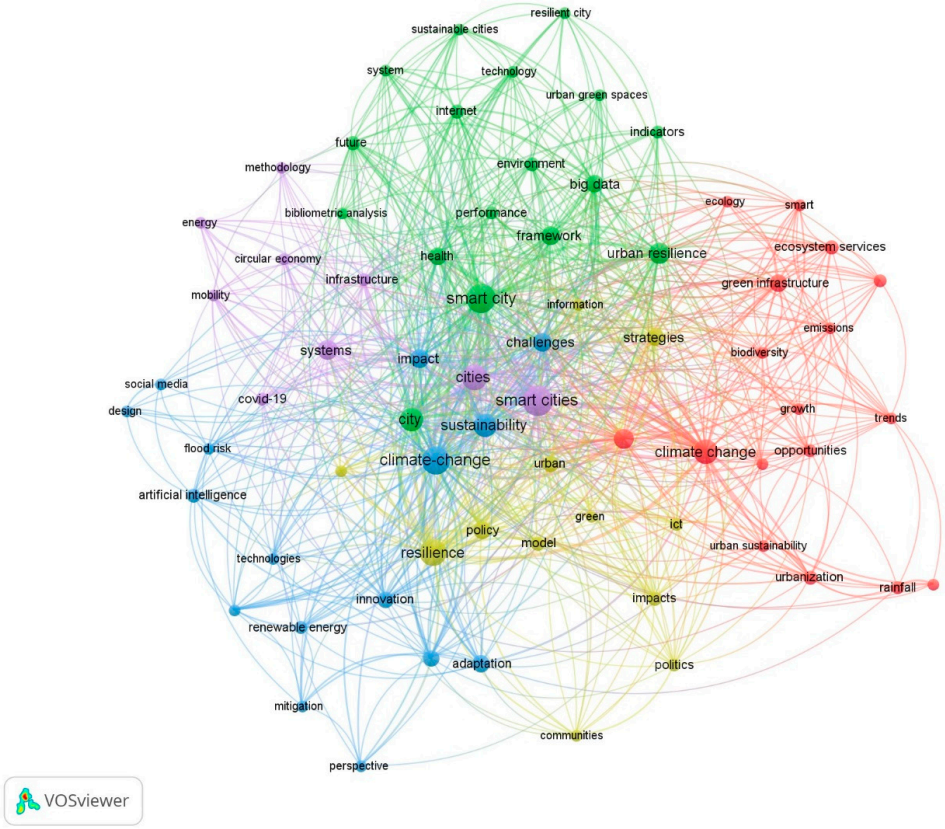

Figure 3. Co-occurrence of the terms in climate change, resilience, and smart cities.

The green cluster is related to smart cities and urban resilience, considering the analysis and the development of frameworks and indicators of performance [77–80]. Some studies in this cluster are focused on technological aspects [81], such as digital twins and big data [82,83] and the internet of things [84]. Health [85] and environment, including urban green spaces in the context of sustainable cities [86], are also pertinent topics in these publications.

The third cluster in blue covers studies related to climate change and sustainability, including impacts [87] and challenges [88,89]. Adaptation [90,91] and mitigation [92,93] practices are discussed, such as in the study of [94], who report elements of adaptation to climate change in European smart cities initiatives. In addition, the analysis of innovations for this purpose includes the use of technologies such as artificial intelligence [95,96] and recent advances in renewable energies [59,97]. There are also studies looking at governance processes [98,99] and risk analysis, such as the studies addressing flood risk by Ariyaningsih & Shaw [100] and Motta et al. [101].

The yellow cluster involves studies related to resilience, focusing on strategies, policies, and politics [57,102], including describing experiences in specific cities, such as in Romania [103]. Urban development is a significant focus [104], particularly concerning community resilience [74,105]. De Jong et al. [58], for example, analyse different concepts and denominations of city approaches, such as sustainable, smart, and resilient, focusing on comprehending their implications for urban development and regeneration policy and practice.

The last cluster in purple considers publications on smart city infrastructure [68,106,107], including mobility [108,109] and energy [110]. The circular economy is also present in this analysis, such as in the publication of Maiurova et al. [92]. Finally, there are references to studies that consider the scenario of the COVID-19 pandemic and climate change on urban dynamics, considering its impact and lessons for resilience, such as the studies of Kakderi et al. [111] and Moglia et al. [112].

4.2. Case Studies in Brazilian and German Smart Cities

In this section, selected cases of smart cities in Brazil and Germany are presented. These cases address practical approaches for enhancing urban resilience in the face of climate change (Table 4). In addition, the cases are discussed to understand the development of the strategies adopted, taking into account their different contexts.

Table 4. Case Examples of Urban Resilience to Climate Change in Brazilian and German Smart Cities.

City, Country Population	Practices of Urban Resilience in Smart City Context	References
São Paulo, Brazil Pop. 12.3 million	Climate change has been part of the local agenda in São Paulo since 2003, where it is crucial to consider its social, political, and economic complexities and their interconnectedness. Projects and Activities in urban mobility, energy efficiency, and governance process are developed and planned.	Di Giulio et al. [113]; Goers et al. [114]; Torres et al. [115]; Lamas et al. [116]
Rio de Janeiro, Brazil Pop. 6.7 million	The Plan for Sustainable Development and Climate Action aims to build policies based on the Sustainable Development Goals and include smart initiatives. Some initiatives such as the Neutral District Project and "Porto Maravilha" include concepts of resilience and smart cities. However, the smart city agenda still prioritises the economic and political aspects of techno-driven urban transformation.	Da Silva & Buendía [117]; Mendes [118]; Rio de Janeiro City Government [119]
Curitiba, Brazil Pop. 1.7 million	Sustainable urban transport and GHG emissions reduction through smart mobility initiatives, including the implementation of renewable energy sources to supply urban public transportation and triple helix governance.	Fryszman et al. [120]; Lira & Lofhagen [121]; Miranda & Rodrigues da Silva [122]
Porto Alegre, Brazil Pop. 1.3 million	Smart governance has a relevant role in city development, fostering collaboration between the public and private sectors and promoting innovation and technological advancement. The Master Plan is based on coordinating land use and zoning to address climate issues, but there are weaknesses in building, cartography, and social aspects, creating a lack of support for tackling the issue of rising temperatures.	Macadar & Lheureux-De-Freitas [123]; Viale Pereira et al. [124]; Viegas et al. [125]
Florianópolis, Brazil Pop. 508.826	One of the smartest Brazilian cities, standing out in the technology and innovation, health, safety, and entrepreneurship categories, Florianópolis has a potential innovation ecosystem while still having structural issues to deal with pertaining to climate change. The project Agenda Floripa 2030/2040/2050 includes initiatives that explore the city's innovative and smart potential to address solutions, with the premise of "Humane Smart cities".	Bonatti et al. [126]; Yigitcanlar et al. [127]; FloripAmanha [128].

Table 4. *Cont.*

City, Country Population	Practices of Urban Resilience in Smart City Context	References
Berlin, Germany Pop. 3.6 million	The Berlin Energy and Climate Protection Programme 2030—BEK 2030 includes a climate-friendly mobility plan of comprehensive measures for the mobility of citizens. In the role of smart-mobility, Berllin is planning the expansion of cycle paths and public transport networks, more car and bike sharing offers, and investments in electric mobility.	Cepeliauskaite et al. [129]; Creutzig et al. [130]; Senate Department for Urban Mobility, Transport, Climate Action, and the Environment [131]
Hamburg, Germany Pop. 1.8 million	Smart solutions are helping the city improve its flood resilience, especially in managing flood risks, considering the digital twin approach. Simulation of extreme rain events to understand them and contribute to forward-looking urban planning, in the context of Hamburg's Climate Plan.	Abebe et al. [132]; Josipovic & Viergutz [83]
Munich, Germany Pop. 1.4 million	Munich has made a clear commitment to finding a healthy balance between smart technologies and practical solutions for people in their daily lives by utilising the concept of Smart Data. The goal is to create a solution that collects, analyses, and provides access to data that deliver benefits to residents and/or the entire city, co-creating resilience and liveability in their development model.	Kutty et al. [133]; Morishita-Steffen et al. [134]
Frankfurt am Main, Germany Pop. 753.056	One of the smartest global cities, Frankfurt has seen relevant advances in digital inclusion, cybersecurity, privacy, green technologies, and innovative communities. The development of a smart irrigation system for urban trees is a highlighted example of a solution.	Gimpel et al. [135]; Vanli [136]
Dresden, Germany Pop. 554.649	Smart solution addressing the challenges and helping the city to improve its flood resilience, considering the big data approach to support the decision-making process.	Josipovic & Viergutz [83]; Saxon State Office for the Environment, Agriculture and Geology [137]

4.2.1. Brazilian Cities

In São Paulo (pop. 12.3 million), Brazil's largest city, climate change has been part of the local agenda since 2003, when it was part of the Cities for Climate Projection Campaign. In 2009, it became the first city in Brazil to implement a Municipal Climate Law with specific objectives. Additionally, the new Master Plan introduced in 2014 incorporates participatory platforms that promote sustainable solutions for urban mobility [113]. For example, the São Paulo Smart Mobility Program is developed in two pillars: (1) efficiency in the management, planning, and operation of public transport, as well as in the regulations related to urban mobility, creating a more integrated and efficient transport planning and management process aimed at recovering demand for public transport and reducing emissions, and (2) decarbonisation, sustainable mobility, and social inclusion policies, improving the regulatory and policy framework to provide more inclusive urban mobility services for women and people in socioeconomically vulnerable situations [116].

Furthermore, smart urban governance is crucial in a megacity like São Paulo, considering its social, political, and economic complexities and their interconnectedness. Some innovative urban policies may be cited, such as the digital platform Geosampa, with its updated statistical and geospatial information as well as quantitative and qualitative indicators of urban and environmental policies [113]. Based on the study by Torres et al. [115], it is imperative for climate change adaptation in São Paulo to be integrated with local devel-

opment and poverty reduction initiatives. The identification of impacts and vulnerabilities and the evaluation of adaptation options should be a regular part of the public manager's responsibilities and must involve the participation of the communities.

According to Goers et al. [114], policymakers are strongly interested in promoting biomass energy, betting on bioelectricity, and replacing polluting energy sources with green fuels. Additionally, the latest plan for the energy sector, São Paulo State's Energy Plan 2030, set up long-term goals to promote the delivery of less pollutant and climate-warming energy sources and the improvement of energy efficiency.

In Rio de Janeiro (pop. 6.7 million), the Plan for Sustainable Development and Climate Action (PDS) aims to build policies based on the Sustainable Development Goals (SDGs) and include smart initiatives. Among the sustainable projects of the plan, the Neutral District Project expects to implement actions to reduce greenhouse gas emissions (GHG), starting in the downtown region. This project is developed with some principles of smart cities, considering walkability, environmental education, health, participation, and the adoption of clean technologies. In addition, in terms of economy and innovation, the PDS targets to attract R$10 billion in investments in smart city projects, with emphasis on the energy, creative economy, technology, life sciences, and financial services sectors [119]. According to Da Silva & Buendía [117], the project "Porto Maravilha" is also an urban innovation element with concepts of smart cities and resilient cities, including solutions and technology tools developed by start-ups supported by the private sector to improve the efficiency and functioning of the city. However, according to Mendes [118], the smart city agenda is still limited to addressing the challenges of climate change in Rio de Janeiro. Smart city policies have prioritised the economic and political dividends of a techno-driven urban transformation over citizen well-being and climate change adaptation and mitigation [118].

Curitiba (pop. 1.7 million) is a great example of sustainable urban transport and GHG emissions reduction through smart mobility initiatives. Recognised as a pioneer in the Bus Rapid Transit Sýstem—BRT, associated with adequate land use planning [122], the city has made efforts to effectively implement renewable energy sources to supply urban public transportation, including the replacement of the bus fleet with the hybrid electric system and the use of biofuels in the Hibribus project [121]. In a socio-technical innovation approach, smart urban mobility is applied in Curitiba, considering its historical planning perspective. Incremental and continuous advances have brought positive results over time [120]. The Hibribus project considers consolidating the triple helix, with effective participation by companies, universities, and the public sector in the governance process.

In Porto Alegre (pop. 1.3 million), smart initiatives have been part of the planning agenda, where smart governance has a relevant role [124]. In this scenario, the Office of Innovation and Technology—INOVAPOA—is a department that aims to foster collaboration between businesses and universities, develop joint projects, and promote innovation and technological advancement [123]. In its scope, the Programa Governo Digital (Digital Government Program) was established in 2022 to institutionalise the digital transformation strategy of the municipality of Porto Alegre. It aims to connect or enhance existing actions through a transversal articulation of various areas of public administration [138]. According to Viegas et al. [125], the Master Plan of Porto Alegre is based on coordinating land use and zoning to address climate issues. However, there are weaknesses in building, cartography, and social aspects that are important for addressing urban climate variability issues. Furthermore, the document lacks provisions for monitoring local climate, greenhouse gas emissions, and energy efficiency, providing insufficient support for tackling the issue of rising temperatures [125].

Florianópolis (pop. 508.826) is considered one of the smartest Brazilian cities [139], in first position on the Connected Smart Cities 2023 Ranking, and stands out in the technology and innovation, health, safety, and entrepreneurship categories [65]. Sabatini-Marques et al. [140] revealed the potential of Florianópolis' innovation ecosystem but highlighted that the city still has structural issues to deal with [127]. These issues relate to the gap between the potential to grow and the acknowledgement from key actors to support the overall territory development while considering its complex dimensions, especially by amplifying the ecosystem's vision and addressing innovation for the common good [140].

According to Bonatti et al. [126], Florianópolis faces climate impacts, and there are problems associated with climate adaptation, especially in vulnerable communities, where residents point to areas such as education, sanitation, and social assistance as their most important local problems. Considering this context, the project Agenda Floripa 2030/2040/2050 [128] is an effort by local stakeholders that includes initiatives that explore the city's innovative and smart potential to address solutions, with the premise of "Humane Smart Cities" to adapt to and mitigate climate change through the pillars of socio-environmental sustainability, urban sustainability, and fiscal and public governance. The new terminal at Hercílio Luz Floripa Airport is considered an example of a project that bonds the principles of a smart city by considering energy efficiency, improving air quality, and reducing greenhouse gases, including Green Airport certification, while using more efficient technology and local governance, resulting in improved mobility and stimulating the local economy [128].

4.2.2. German Cities

Berlin (pop. 3.6 million), Germany's largest city, recognised as one of the smartest cities in Europe [141], has implemented a comprehensive plan to become carbon-neutral by 2050. The plan, which is called the Berlin Energy and Climate Protection Programme 2030—BEK 2030, was adopted in 2018 and includes a set of strategies and measures for mitigating climate change and adapting to its consequences, focusing on relevant fields of action: buildings and urban development, energy supply, economy, transport, and private households and consumption. The Senate Department for Urban Mobility, Transport, Climate Action, and the Environment, which is responsible for the program's implementation, monitors the status of the indicators and outcomes through a digital monitoring and information system named biBEK. In line with the principles of smart governance, the system has two main functions: providing transparency and access to data and results, as well as allowing for critical assessment of the measures [131].

In this scenario, smart urban transport is a prioritised field in Berlin, where business, science, and municipal policy are rapidly developing expertise and interest in digitalisation governance. The efforts for smart sustainable mobility include sharing services for cars, bicycles, and scooters, with a crucial action of the Innovation Center for Mobility and Societal Change—InnoZ [130] and the expansion of public transport networks and cycle paths [129], including mobility services supported by the end-user digital applications, with positive impacts observed [142,143]. The case of Berlin is in line with [144], who argue that connected mobility is making cities safer, greener, and more efficient in Germany, highlighting the benefits of Connected, Cooperative, and Automated Mobility (CCAM) and its positive effects on GHG emissions reduction.

In Hamburg (pop. 1.8 million), technology is helping the city improve its flood resilience, especially in managing flood risks, by considering the digital twin approach. Smart solutions have been used in extreme rain event simulations, with the aim to understand them and contribute to forward-looking urban planning, examining possible ways to adapt to the consequences of climate change [83]. Abayneh Abebe et al. [132] suggested that

implementing flood adaptation measures in Hamburg at the household level is crucial to reducing the vulnerability of communities to flooding. By using coupled agent-based and flood models, decision-makers can effectively examine the role of household adaptation measures in flood risk management. The Climate Plan for Hamburg, with the aim to be CO2-neutral by 2045, considers smart solutions and measures and is divided into six areas: private households; commerce, trade, and services; industry; transport; energy transition; and cross-sectoral fields of activity. An updated version of the plan in 2023 includes concrete measures in a strengthened expansion of the infrastructure for electricity, heat, hydrogen, and charging points for electric vehicles; an early photovoltaic requirement for existing buildings; and a solar green roof requirement [145].

In Munich (pop. 1.4 million), the concept of smart data rather than big data is present in a smart governance perspective, along with a commitment to finding a healthy balance between smart technologies and practical solutions for people's daily lives, prioritising privacy and data protection. Efforts have been made to create solutions that collect, analyse, and provide access to data that delivers benefits to residents and/or the city into the City Intelligence Platform for the purpose of saving energy, reducing carbon dioxide emissions, and facilitating a cleaner and more efficient traffic flow [134]. German smart cities like Munich prioritise privacy-by-design and distributed data processing in line with the European Union's General Data Protection Regulation (GDPR). Munich's City Intelligence Platform utilises distributed computation models to safeguard personal data. This aligns with Morteza and Chou [146], who highlight methods for preserving privacy in distributed infrastructures by balancing efficiency and privacy trade-offs, providing important context for smart city governance challenges. The city adopts a hybrid model of smart governance, combining hierarchical and network elements and high participatory stakeholder involvement [147]. According to Kutty et al. [133], Munich is one of the highlighted European smart cities that co-create resilience and liveability in their development model with superior performance. As part of the Cultural Heritage in Action (CHA) programmes, for example, investments in culture have been used to promote community well-being, social resilience, and smartly targeted growth and development in Munich [133].

Along with Munich, Frankfurt (pop. 753.056) is one of the smartest global cities that considers some of the smart drivers, including technology, community, infrastructure, innovative economy, and governance, with highlighted advances in digital inclusion, cybersecurity, privacy, green technologies, and innovative communities [136]. The development of a smart and sustainable irrigation system for urban trees is a good example of the application of smart and innovative solutions for urban resilience in Frankfurt, considering elements such as the Internet of Things (IoT) and data analytics [113]. The European Arboricultural Council (EAC) recognised the relevance of the green infrastructure in Frankfurt, naming it the "European City of the Trees 2014". With a vision to halve its total energy consumption by 2050 and cover the remaining energy requirements with renewable energies from within the city and the region, the "100% Climate Protection Master Plan" was adopted in 2012. Some smart solutions have been considered in this context, such as mobility, which must be socially, ecologically, and economically compatible. This involves incentives for cycling and local public transport, as well as initiatives for electric and hybrid buses [148].

To address the challenges and help improve its flood resilience, Dresden (pop. 554.649), the capital of Saxony state, has considered the big data approach. According to Josipovic & Viergutz [83], the city's project considers integrating information shared publicly on social networks into the decision-making process for flood protection as a smart solution to benefit flood management. Data provided by images from social media are used to assess the current situation and to develop adequate options for action. Furthermore, the Flood

Information and Management System of the Saxony State Flood Center [137], which has been in operation since 2018, collects and analyses water level data across the entire federal state, where the data are collected centrally, evaluated, and communicated automatically to more than 1000 recipients.

4.2.3. Comparative Between the Brazilian and German Cities

Based on the cases presented above, Table 5 summarises the main similarities and differences between the Brazilian and German cities mentioned, based on the challenges faced, smart initiatives, governance models, and resilience strategies.

Table 5. Similarities and differences between the Brazilian and German cities.

	Brazilian Cities	German Cities
Challenges	Social, political, and economic complexities (e.g., São Paulo); climate change adaptation, considering social inequalities and vulnerabilities in communities (e.g., Florianópolis); urban infrastructure, gaps in climate monitoring and energy efficiency (e.g., Porto Alegre); limitations in integrating smart city agendas with social welfare (e.g., Rio de Janeiro).	Balancing smart technologies and privacy/personal data (e.g., Berlin and Munich); adapting to specific climate risks such as floods (e.g., Hamburg and Dresden); digital inclusion and cyber security (e.g., Frankfurt).
Smart Initiatives	Digital platforms for urban and environmental data (e.g., Geosampa in São Paulo); smart and sustainable mobility programs (e.g., São Paulo Smart Mobility, Hibribus in Curitiba); urban innovation and government digitalisation projects (e.g., Porto Maravilha in Rio de Janeiro, INOVAPOA in Porto Alegre); sustainability projects with a social focus (e.g., Agenda Floripa 2030 in Florianópolis). GHC emission reduction with clean technologies (Neutral District Project in Rio de Janeiro).	Digital systems for monitoring and transparency (biBEK in Berlin); intelligent mobility with car sharing and cycle paths (e.g., Frankfurt, Dresden, and Berlin); use of IoT and data analysis for urban irrigation (e.g., Frankfurt); integration of social data for flood management (e.g., Dresden); data-driven energy and traffic management (City Intelligence Platform in Munich); digital twin approach for flood simulation and urban planning (e.g., Hamburg)
Governance Models	Participatory and collaborative urban governance, involving companies, universities and the public sector (e.g., triple helix model in Curitiba, INOVAPOA in Porto Alegre, innovation ecosystem in Florianópolis). Emphasis on local policies integrated with social development and poverty reduction (e.g., São Paulo).	Hybrid model combining hierarchical and networked, with high stakeholder participation (e.g., Munich). Smart governance with intensive use of digital platforms for transparency and monitoring (e.g., Berlin with biBEK).
Resilience Strategies	Focus on adaptation integrated with local development, reduction in social and environmental vulnerabilities (e.g., São Paulo and Florianópolis); use of sustainable transportation (e.g., BRT in Curitiba); coordination of land use for climate issues (e.g., Porto Alegre) projects to reduce emissions and increase energy efficiency (e.g., São Paulo State Energy Plan).	Comprehensive carbon neutrality plans (e.g., Berlin 2050, Hamburg 2045, Frankfurt 2050); use of digital technologies for risk management (e.g., digital twin for floods in Hamburg); co-creation of resilience and liveability (e.g., Munich); smart systems for climate monitoring (e.g., Dresden).

The comparison shows that both Brazilian and German cities prioritise participatory governance and the use of digital solutions to increase urban resilience. However, Brazilian cities place more emphasis on integrating climate adaptation with social inclusion and local

development, which reflects their higher levels of social vulnerability and infrastructure challenges. On the other hand, German cities focus on comprehensive carbon neutrality strategies, advanced digital monitoring, and data-driven approaches, all supported by robust infrastructure and a strong emphasis on privacy and cybersecurity.

These differences are reflected in the smart initiatives. In both Brazil and Germany, digital platforms and innovative technology are used, but with different objectives. Brazilian cases generally emphasise social and environmental inclusion, while German cities focus on data-driven solutions and the energy transition. This distinction highlights the socio-economic and developmental differences between the two contexts analysed. Although both contexts invest in smart mobility and innovative urban solutions, the Brazilian approach is more focused on tackling social inequalities, while the German model uses technological sophistication and integrated planning for climate resilience.

4.3. Connections Between Literature Review and Case Studies in Brazilian and German Cities

Based on the results of the literature review, which identified thematic clusters through bibliometric analysis, and the findings from case studies in Brazilian and German cities, there is a clear alignment between the smart initiatives of the analysed cities and the themes identified in the literature. Below, Table 6 illustrates the connections between these clusters and examples of specific smart city practices encountered in the case studies.

Table 6. Connections between literature review and case studies.

Cluster	Key Themes	Case Study Connections
Red Cluster	Climate change, green infrastructure, ecosystem services, and emissions.	- Berlin, Hamburg, and Frankfurt: Comprehensive plan to reduce emissions and become carbon-neutral. - Rio de Janeiro: Neutral District Project to reduce GHG starting in the downtown region.
Green Cluster	Smart cities, urban resilience, indicators, digital twins, big data, and IoT.	- Berlin: Digital monitoring and information system of the status of the indicators and outcomes named biBEK - Hamburg: Digital twin for flood simulation and urban planning. - Frankfurt: IoT-based smart irrigation for urban trees. - São Paulo: Geosampa platform for data-driven governance. - Munich: Smart data, with a healthy balance between smart technologies and practical solutions, prioritising privacy and data protection.
Blue Cluster	Adaptation/mitigation, AI, renewable energy, governance, flood risk	- Curitiba: Renewable energy in public transport (Hibribus). - Porto Alegre: Smart Governance promoting innovation and technological advancement (INOVAPOA). - Dresden: Smart solution to improve its flood resilience.
Yellow Cluster	Resilience strategies and policies, community resilience, urban development	- Munich: Co-creation of resilience through participatory governance, promoting community well-being and social resilience. - Rio de Janeiro: The Plan for Sustainable Development and Climate Action (PDS) aims to build policies based on the SDGs and include smart initiatives.
Purple Cluster	Smart infrastructure, mobility, and energy.	- Curitiba and Berlin: Smart mobility initiatives (BRT system and hybrid buses in Curitiba; shared services and bike lanes via InnoZ, in Berlin). - Florianópolis: Hercílio Luz Floripa Airport as a project that bonds the principles of a smart city by considering energy efficiency.

The connections presented in Table 6 showcase various smart initiatives observed in the Brazilian and German cities analysed, along with their associations to the thematic clusters identified through the bibliometric analysis of the literature. The unique characteristics of each city and their specific contexts play a significant role in these associations. Notably, it is evident that most of the key themes identified in the literature align with the initiatives found in the cities included in this study.

5. Conclusions

This study investigated the advances in the literature on urban resilience to climate change in smart cities and conducted a multiple case study analysis of adaptation and mitigation strategies in Brazilian and German smart cities. Through the literature review and the cases presented, it was possible to demonstrate the efforts to increase urban resilience to climate challenges, especially in the cities analysed, by considering their specific realities.

The review of the literature on urban resilience to climate change in smart cities has shown the progression of scientific research on this topic. It highlights the increasing trend of studies that consider urban planning strategies to address current climate challenges. The analysis of co-occurrences revealed the formation of five thematic clusters, which represent the relationships between study topics in this area. These results contribute to identifying research paths and future agendas for scientific development in this field.

In the context of the cases presented, it was possible to highlight the local initiatives implemented by Brazilian and German smart cities in order to increase their urban resilience to climate pressures. Significant differences were identified between the realities of the two countries, considering the different levels of development and investment, corroborating the literature. Consistent initiatives with long-term urban planning aimed at urban resilience and the presence of smart solutions were observed in some German cities, such as in the cases of Berlin, Dresden, and Hamburg. It is also evident concerning data protection and privacy in some German cases, for example, in Munich, where a healthy balance between smart technologies and practical solutions by utilising the concept of Smart Data is seeking, and in Frankfurt, where advances in digital inclusion, cybersecurity, privacy, and green technologies.

In Brazilian initiatives, efforts in smart governance were evidenced, such as in São Paulo and Florianópolis, where initiatives that explore the city's innovative and smart potential to address climate solutions were found. However, in some cases, such as in Rio de Janeiro, the smart city agenda is still limited to addressing the challenges of climate change and prioritising the economic and political results of a techno-driven urban transformation. In this sense, there is concern that smart city agendas may reinforce existing inequalities if they do not explicitly address the needs of vulnerable populations. Although São Paulo and Rio de Janeiro, for example, have made progress in smart city initiatives—such as the São Paulo Smart Mobility Program and the Porto Maravilha project—it should be noted that these efforts may unintentionally deepen social exclusion. In both cities, access to the benefits of new technologies is often unequal, with marginalised groups facing barriers to participation. Similarly, in some cities, there is a limitation in the scope of initiatives for urban resilience. In Porto Alegre, for example, there are evident smart governance efforts that include climate issues, but the urban planning, in the context of the city's Master Plan, is mainly focused on coordinating land use and zoning to address climate issues, and there are weaknesses in building, cartography, and social aspects that are important for addressing urban climate variability issues. A consistent case in Brazilian reality is the experience of Curitiba, where sustainable urban transport and GHG emissions reduction through smart mobility initiatives were evidenced, for example, in the context of the Bus

Rapid Transit System—BRT. From a historical planning perspective, Curitiba has made efforts to implement renewable energy sources to supply urban public transportation, such as with a hybrid electric system and biofuels.

This study has some limitations that can be highlighted. Regarding the literature review through bibliometric analysis, a limitation of this study is the exclusive use of the WoS database. While the WoS is known for its rigorous indexing standards and global reach, relying exclusively on this database can lead to selection bias. This is because it does not cover the entire range of scientific output indexed in other databases like Scopus and Google Scholar. In regard to the multi-case study, it should be noted that these cities do not fully represent the experience of the countries in which they are located, namely Brazil and Germany. It is an analysis of the experiences of these cities by exploring their initiatives and considering their relevance in the context of smart city solutions that address climate change issues. Given the limitations mentioned, future research is recommended to understand aspects not covered in this study. In particular, research could be carried out using other research methods, especially those that can cover a larger number of cities in a comprehensive way with quantitative approaches.

Finally, this study's contributions are highlighted, especially with regard to the complementarity of the methods used, which allows for the understanding of the evolution of a relatively recent topic and the practical application of this concept in selected cities. Climate action is urgent, and it is crucial to consider it within the urban development agenda, which includes smart solutions to address climate issues.

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References

1. United Nations, Department of Economic and Social Affairs, Population Division. World. Urbanization Prospects 2018: Highlights (ST/ESA/SER.A/421). 2019. Available online: https://population.un.org/wup/assets/WUP2018-Highlights.pdf (accessed on 1 May 2024).
2. Intergovernmental Panel on Climate Change—IPCC. *Climate Change 2022: Contribution of Working Groups I, II and III to the Sixth Assessment Report of the IPCC, 2022*; IPCC: Geneva, Switzerland, 2022.
3. NOAA National Centers for Environmental Information, Monthly Regional Analysis for Annual 2023. Published Online January 2024. Available online: https://www.ncei.noaa.gov/access/monitoring/monthly-report/global-regions/202313 (accessed on 21 February 2024).
4. Jabareen, Y. Planning the resilient city: Concepts and strategies for coping with climate change and environmental risk. *Cities* **2013**, *31*, 220–229. [CrossRef]
5. Amirzadeh, M.; Sobhaninia, S.; Sharifi, A. Urban resilience: A vague or an evolutionary concept? *Sustain. Cities Soc.* **2022**, *81*, 103853. [CrossRef]
6. Leichenko, R. Climate change and urban resilience. *Curr. Opin. Environ. Sustain.* **2011**, *3*, 164–168. [CrossRef]
7. Meerow, S.; Newell, J.P.; Stults, M. Defining urban resilience: A review. *Landsc. Urban Plan.* **2016**, *147*, 38–49. [CrossRef]
8. Hamilton, W.A.H. Resilience and the city: The water sector. *Urban Des. Plan.* **2015**, *162*, 109–121. [CrossRef]

9. Leal Filho, W.; Balogun, A.L.; Olayide, O.E.; Azeiteiro, U.M.; Ayal, D.Y.; Muñoz, P.D.C.; Nagy, G.J.; Bynoe, P.; Oguge, O.; Yannick Toamukum, N.; et al. Assessing the impacts of climate change in cities and their adaptive capacity: Towards transformative approaches to climate change adaptation and poverty reduction in urban areas in a set of developing countries. *Sci. Total Environ.* **2019**, *692*, 1175–1190. [CrossRef]
10. Barbier, E.B.; Hochard, J.P. The impacts of climate change on the poor in disadvantaged regions. *Rev. Environ. Econ. Policy* **2018**, *12*, 26–47. [CrossRef]
11. ICLEI. *Relatório Analítico Cidades Inteligentes pelo Clima*; ICLEI: São Paulo, Brazil, 2017.
12. Papaioannou, C.; Dimara, A.; Papaioannou, A.; Tzitzios, I.; Anagnostopoulos, C.-N.; Krinidis, S. Hierarchical Resources Management System for Internet of Things-Enabled Smart Cities. *Sensors* **2025**, *25*, 616. [CrossRef]
13. Nguyen, H.; Nawara, D.; Kashef, R. Connecting the Indispensable Roles of IoT and Artificial Intelligence in Smart Cities: A Survey. *J. Inf. Intell.* **2024**, *2*, 261–285. [CrossRef]
14. Rana, N.P.; Luthra, S.; Mangla, S.K.; Islam, R.; Roderick, S.; Dwivedi, Y.K. Barriers to the development of smart cities in indian context. *Inf. Syst. Front.* **2019**, *21*, 503–525. [CrossRef]
15. Shayan, S.; Kim, K.P.; Ma, T.; Nguyen, T.H.D. The first two decades of smart city research from a risk perspective. *Sustainability* **2020**, *12*, 9280. [CrossRef]
16. Giffinger, R.; Fertner, C.; Kalasek, R.; Kramar, H. *Smart Cities: Ranking of European Medium-Sized Cities*; Vienna University of Technology: Vienna, Austria, 2007.
17. Caragliu, A.; Bo, C.D.; Nijkamp, P. Smart cities in Europe. *J. Urban Technol.* **2011**, *18*, 65–82. [CrossRef]
18. Marchetti, D.; Oliveira, R.; Figueira, A.R. Are global north smart city models capable to assess Latin American cities? A model and indicators for a new context. *Cities* **2019**, *92*, 197–207. [CrossRef]
19. Mora, L.; Deakin, M.; Reid, A. Strategic principles for smart city development: A multiple case study analysis of European best practices. *Technol. Forecast. Soc. Change* **2019**, *142*, 70–97. [CrossRef]
20. Mulligan, C.E.; Olsson, M. Architectural implications of smart city business models: An evolutionary Perspective. *IEEE Commun. Mag.* **2013**, *51*, 80–85. [CrossRef]
21. *ISO 37120:2018*; Sustainable Cities and Communities—Indicators for City Services and Quality of Life. International Organization for Standardization: Geneva, Switzerland, 2019.
22. European Parliament. *Mapping Smart Cities in the EU. European Parliament—Directorate General for Internal Policies—Policy Department A: Economic and Scientific Policy*; European Parliament: Strasbourg, France, 2014; 200p. Available online: https://www.europarl.europa.eu/RegData/etudes/etudes/join/2014/507480/IPOL-ITRE_ET(2014)507480_EN.pdf (accessed on 1 May 2024).
23. Kummitha, R.K.; Crutzen, N. How do we understand smart cities? An evolutionary perspective. *Cities* **2017**, *67*, 43–52. [CrossRef]
24. Sta, H.B. Quality and the efficiency of data in "smart-cities". *Future Gener. Comput. Syst.* **2017**, *74*, 409–416. [CrossRef]
25. Zhu, S.Y.; Li, D.Z.; Feng, H.B.; Gu, T.T.; Hewage, K.; Sadiq, R. Smart city and resilient city: Differences and connections. *Wiley Interdiscip. Rev.-Data Min. Knowl. Discov.* **2020**, *10*, e1388. [CrossRef]
26. Genari, D.; Costa, L.F.; Savaris, T.P.; Macke, J. Smart Cities e o Desenvolvimento Sustentável: Revisão de literatura e perspectivas de pesquisas futuras. *Rev. Ciências Adm.* **2018**, *20*, 69–85.
27. Obringer, R.; Nateghi, R. What makes a city "smart" in the Anthropocene? A critical review of smart cities under climate change. *Sustain. Cities Soc.* **2021**, *75*, 103278. [CrossRef]
28. Liang, D.; De Jong, M.; Schraven, D.; Wang, L. Mapping key features and dimensions of the inclusive city: A systematic bibliometric analysis and literature study. *Int. J. Sustain. Dev. World Ecol.* **2022**, *29*, 60–79. [CrossRef]
29. Hoornweg, D.; Sugar, L.; Trejos Gomez, C.L. Cities and greenhouse gas emissions: Moving forward. *Environ. Urban* **2011**, *23*, 207–227. [CrossRef]
30. Meerow, S.; Newell, J.P. Urban resilience for whom, what, when, where, and why? *Urban Geogr.* **2019**, *40*, 309–329. [CrossRef]
31. Elmqvist, T.; Andersson, E.; Frantzeskaki, N.; McPhearson, T.; Olsson, P.; Gaffney, O.; Takeuchi, K.; Folke, C. Sustainability and resilience for transformation in the urban century. *Nat. Sustain.* **2019**, *2*, 267–273. [CrossRef]
32. Kaspersen, P.S.; Halsnæs, K. Integrated climate change risk assessment: A practical application for urban flooding during extreme precipitation. *Clim. Serv.* **2017**, *6*, 55–64. [CrossRef]
33. Zhao, Y.; Sultan, B.; Vautard, R.; Braconnot, P.; Wang, H.J.; Ducharne, A. Potential escalation of heat-related working costs with climate and socioeconomic changes in China. *Proc. Natl. Acad. Sci. USA* **2016**, *113*, 4640–4645. [CrossRef]
34. Duran-Encalada, J.A.; Paucar-Caceres, A.; Bandala, E.; Wright, G. The impact of global climate change on water quantity and quality: A system dynamics approach to the US–Mexican transborder region. *Eur. J. Oper. Res.* **2017**, *256*, 567–581. [CrossRef]
35. Argüeso, D.; Evans, J.P.; Pitman, A.J.; Di Luca, A. Effects of city expansion on heat stress under climate change conditions. *PLoS ONE* **2015**, *10*, e0117066. [CrossRef]

36. Suzuki-Parker, A.; Kusaka, H.; Yamagata, Y. Assessment of the impact of metropolitan-scale urban planning scenarios on the moist thermal environment under global warming: A study of the Tokyo metropolitan area using regional climate modeling. *Adv. Meteorol.* **2015**, *2015*, 693754. [CrossRef]
37. European Environment Agency—EEA. *Urban Sustainability Issues—What Is a Resource-Efficient City?* Publications office of the European Union: Luxembourg, 2015.
38. Purkus, A.; Hagemann, N.; Bedtke, N.; Gawel, E. Towards a sustainable innovation system for the German wood-based bioeconomy: Implications for policy design. *J. Clean. Prod.* **2018**, *172*, 3955–3968. [CrossRef]
39. Paris Agreement to the United Nations Framework Convention on Climate Change, Dec. 12, 2015, T.I.A.S. No. 16-1104. Available online: https://unfccc.int/sites/default/files/resource/parisagreement_publication.pdf (accessed on 1 May 2024).
40. Cepal, N.U. The 2030 Agenda and the Sustainable Development Goals: An Opportunity for Latin America and the Caribbean. 2016. Available online: https://repositorio.cepal.org/server/api/core/bitstreams/6321b2b2-71c3-4c88-b411-32dc215dac3b/content (accessed on 1 May 2024).
41. United Nations Office for Disaster Risk Reduction. The Sendai Framework for Disaster Risk Reduction 2015–2030. 2015. Available online: https://www.undrr.org/media/16176/download?startDownload=20240524 (accessed on 1 May 2024).
42. Intergovernmental Panel on Climate Change—IPCC. *Climate Change Impacts, Adaptation and Vulnerability*; Cambridge University Press: Cambridge, UK, 2007.
43. Intergovernmental Panel on Climate Change—IPCC. *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the IPCC*; IPCC: Geneva, Switzerland, 2014.
44. Leal Filho, W.; Modesto, F.; Nagy, G.J.; Saroar, M.; YannickToamukum, N.; Ha'apio, M. Fostering coastal resilience to climate change vulnerability in Bangladesh, Brazil, Cameroon and Uruguay: A cross-country comparison. *Mitig. Adapt. Strateg. Glob. Chang.* **2018**, *23*, 579–602. [CrossRef]
45. Revi, A.; Satterthwaite, D.; Aragón-Durand, F.; Corfee-Morlot, J.; Kiunsi, R.B.R.; Pelling, M.; Roberts, D.; Solecki, W.; Gajjar, S.P.; Sverdlik, A. Towards transformative adaptation in cities: The IPCC's Fifth Assessment. *Environ. Urban.* **2014**, *26*, 11–28. [CrossRef]
46. Nordhaus, W. *A Question of Balance: Economic Modeling of Global Warming*; Yale: New Haven, CT, USA, 2008.
47. Jenks, M.; Jones, C. *Dimensions of the Sustainable City*; Springer: London, UK, 2010.
48. Ewing, R.; Bartholomew, K.; Winkelman, S.; Walters, J.; Chen, D. *Growing Cooler: The Evidence on Urban Development and Climate Change*; Urban Land Institute: Washington, DC, USA, 2008.
49. Ziervogel, G.; Pelling, M.; Cartwright, A.; Chu, E.; Deshpande, T.; Harris, L.; Hyams, K.; Kaunda, J.; Klaus, B.; Michael, K.; et al. Inserting rights and justice into urban resilience: A focus on everyday risk. *Environ. Urban.* **2017**, *29*, 123–138. [CrossRef]
50. Lu, Y.W.; Zhai, G.F.; Zhou, S.T.; Shi, Y.J. Risk reduction through urban spatial resilience: A theoretical framework. *Hum. Ecol. Risk Assess.* **2021**, *27*, 921–937. [CrossRef]
51. Carter, J.G.; Cavan, G.; Connelly, A.; Guy, S.; Handley, J.; Kazmierczak, A. Climate change and the city: Building capacity for urban adaptation. *Prog. Plan.* **2015**, *95*, 1–66. [CrossRef]
52. Bossio, C.F.; Ford, J.; Labbé, D. Adaptive capacity in urban areas of developing countries. *Clim. Change* **2019**, *157*, 279–297. [CrossRef]
53. Vajjarapu, H.; Verma, A.; Gulzar, S. Adaptation Policy Framework for Climate Change Impacts on Transportation Sector in Developing Countries. *Transp. Dev. Econ.* **2019**, *5*, 3. [CrossRef]
54. Geiger, L.; Thudium, G. International Climate Policy: An introduction to the climate regime and the initiatives adopted by Germany and China. *Século XXI—Rev. Ciências Sociais* **2018**, *9*, 54–69.
55. Frey, K.; Barcellos, Z. Parâmetros para Análises Comparativas de Experiêcias Internacionais de Governança Metropolitana. In *Governança Multinível e Desenvolvimento Regional Sustentável. Experiências do Brasil e da Alemanha*; Carneiro, J.M.B., Frey, K., Eds.; Oficina Municipal: São Paulo, Brazil, 2018.
56. Dubou, G.; Bichueti, R.S.; Costa, C.R.R.da.; Gomes, C.M.; Kneipp, J.M.; Kruglianskas, I. Creating Favorable Local Context for Entrepreneurship: The Importance of Sustainable Urban Development in Florianópolis, SC, Brazil. *Sustainability* **2022**, *14*, 10132. [CrossRef]
57. Moraci, F.; Errigo, M.F.; Fazia, C.; Campisi, T.; Castelli, F. Cities under Pressure: Strategies and Tools to Face Climate Change and Pandemic. *Sustainability* **2020**, *12*, 7743. [CrossRef]
58. de Jong, M.; Joss, S.; Schraven, D.; Zhan, C.J.; 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]
59. Serban, A.C.; Lytras, M.D. Artificial Intelligence for Smart Renewable Energy Sector in Europe—Smart Energy Infrastructures for Next Generation Smart Cities. *IEEE Access* **2020**, *8*, 77364–77377. [CrossRef]
60. Pranckutė, R. Web of Science (WoS) and Scopus: The Titans of Bibliographic Information in Today's AcademicWorld. *Publications* **2021**, *9*, 12. [CrossRef]

61. VOSviewer. VOSviewer—Visualizing Scientific Landscapes. VOSviewer. 2024. Available online: https://www.vosviewer.com/ (accessed on 1 May 2024).
62. van Eck, N.J.; Waltman, L. Text mining and visualization using VOSviewer. *arXiv* **2011**. [CrossRef]
63. Carvalho, M.M.; Fleury, A.; Lopes, A.P. An overview of the literature on technology roadmapping (TRM): Contributions and trends. *Technol. Forecast. Soc. Change* **2013**, *80*, 1418–1437. [CrossRef]
64. Yin, R.K. *Case Study Research and Applications*, 6th ed.; SAGE Publications, Inc.: New York, NY, USA, 2018. Available online: https://uk.sagepub.com/en-gb/eur/case-study-research-and-applications/book250150 (accessed on 1 May 2024).
65. Connected Smart Cities. Ranking Connected Smart Cities. CSM. 2023. Available online: https://ranking.connectedsmartcities.com.br/ (accessed on 1 May 2024).
66. IMD. *IMD Smart City Index 2023*; IMD: Zurich, Switzerland, 2023.
67. Colding, J.; Wallhagen, M.; Sörqyist, P.; Marcus, L.; Hillman, K.; Samuelsson, K.; Barthel, S. Applying a Systems Perspective on the Notion of the Smart City. *Smart Cities* **2020**, *3*, 420–429. [CrossRef]
68. Viitanen, J.; Kingston, R. Smart cities and green growth: Outsourcing democratic and environmental resilience to the global technology sector. *Environ. Plan. A-Econ. Space* **2014**, *46*, 803–819. [CrossRef]
69. Zahoor, A.; Xu, T.; Wang, M.; Dawood, M.; Afrane, S.; Li, Y.; Chen, J.L.; Mao, G.Z. Natural and artificial green infrastructure (GI) for sustainable resilient cities: A scientometric analysis. *Environ. Impact Assess. Rev.* **2023**, *101*, 107139. [CrossRef]
70. Kaluarachchi, Y. Potential advantages in combining smart and green infrastructure over silo approaches for future cities. *Front. Eng. Manag.* **2021**, *8*, 98–108. [CrossRef]
71. Cavada, M.; Hunt, D.V.L.; Rogers, C.D.F. Do smart cities realise their potential for lower carbon dioxide emissions? *Proc. Inst. Civ. Eng.-Eng. Sustain.* **2016**, *169*, 243–252. [CrossRef]
72. Akinyemi, F.O.; Ikanyeng, M.; Muro, J. Land cover change effects on land surface temperature trends in an African urbanizing dryland region. *City Environ. Interact.* **2019**, *4*, 100029. [CrossRef]
73. Aram, F.; Solgi, E.; García, E.H.; Mosavi, A.; Várkonyi-Kóczy, A.R. The Cooling Effect of Large-Scale Urban Parks on Surrounding Area Thermal Comfort. *Energies* **2019**, *12*, 3904. [CrossRef]
74. Lim, T.C.; Wilson, B.; Grohs, J.R.; Pingel, T.J. Community-engaged heat resilience planning: Lessons from a youth smart city STEM program. *Landsc. Urban Plan.* **2022**, *226*, 104497. [CrossRef]
75. Li, J.D.; Burian, S.J. Evaluating real-time control of stormwater drainage network and green stormwater infrastructure for enhancing flooding resilience under future rainfall projections. *Resour. Conserv. Recycl.* **2023**, *198*, 107123. [CrossRef]
76. Lund, N.S.V.; Borup, M.; Madsen, H.; Mark, O.; Arnbjerg-Nielsen, K.; Mikkelsen, P.S. Integrated stormwater inflow control for sewers and green structures in urban landscapes. *Nat. Sustain.* **2019**, *2*, 1003–1010. [CrossRef]
77. Khatibi, H.; Wilkinson, S.; Baghersad, M.; Dianat, H.; Ramli, H.; Suhatril, M.; Javanmardi, A.; Ghaedi, K. The resilient—Smart city development: A literature review and novel frameworks exploration. *Built Environ. Proj. Asset Manag.* **2021**, *11*, 493–510. [CrossRef]
78. Khatibi, H.; Wilkinson, S.; Sweya, L.N.; Baghersad, M.; Dianat, H. Navigating Climate Change Challenges through Smart Resilient Cities: A Comprehensive Assessment Framework. *Land* **2024**, *13*, 266. [CrossRef]
79. Koens, K.; Melissen, F.; Mayer, I.; Aall, C. The Smart City Hospitality Framework: Creating a foundation for collaborative reflections on overtourism that support destination design. *J. Destin. Mark. Manag.* **2021**, *19*, 100376. [CrossRef]
80. Wendling, L.A.; Huovila, A.; zu Castell-Rüdenhausen, M.; Hukkalainen, M.; Airaksinen, M. Benchmarking nature-based solution and smart city assessment schemes against the sustainable development goal indicator framework. *Front. Environ. Sci.* **2018**, *6*, 355767. [CrossRef]
81. Nitoslawski, S.A.; Galle, N.J.; Van den Bosch, C.K.; Steenberg, J.W.N. Smarter ecosystems for smarter cities? A review of trends, technologies, and turning points for smart urban forestry. *Sustain. Cities Soc.* **2019**, *51*, 101770. [CrossRef]
82. Allam, Z.; Bibri, S.E.; Jones, D.S.; Chabaud, D.; Moreno, C. Unpacking the "15-Minute City" via 6G, IoT, and Digital Twins: Towards a New Narrative for Increasing Urban Efficiency, Resilience, and Sustainability. *Sensors* **2022**, *22*, 1369. [CrossRef]
83. Josipovic, N.; Viergutz, K. Smart Solutions for Municipal Flood Management: Overview of Literature, Trends, and Applications in German Cities. *Smart Cities* **2023**, *6*, 944–964. [CrossRef]
84. Song, T.; Cai, J.M.; Chahine, T.; Li, L. Towards Smart Cities by Internet of Things (IoT)-a Silent Revolution in China. *J. Knowl. Econ.* **2021**, *12*, 578–594. [CrossRef]
85. Lapao, L.V.; Correia, J.C.; Jevtic, M. Public Health Framework for Smart Cities within the Comprehensive Approach to Sustainability in Europe: Case Study of Diabetes. *Sustainability* **2023**, *15*, 4269. [CrossRef]
86. Addas, A. The importance of urban green spaces in the development of smart cities. *Front. Environ. Sci.* **2023**, *11*, 1206372. [CrossRef]
87. Jaroszweski, D.; Hooper, E.; Chapman, L. The impact of climate change on urban transport resilience in a changing world. *Prog. Phys. Geogr.-Earth Environ.* **2014**, *38*, 448–463. [CrossRef]

88. Koop, S.H.A.; van Leeuwen, C.J. The challenges of water, waste and climate change in cities. *Environ. Dev. Sustain.* **2017**, *19*, 385–418. [CrossRef]
89. Pee, L.G.; Pan, S.L. Climate-intelligent cities and resilient urbanisation: Challenges and opportunities for information research. *Int. J. Inf. Manag.* **2022**, *63*, 102446. [CrossRef]
90. An, Y.; Liu, N.; Zhang, L.; Zheng, H.H. Adapting to climate risks through cross-border investments: Industrial vulnerability and smart city resilience. *Clim. Change* **2022**, *174*, 10. [CrossRef]
91. Connelly, A.; O'Hare, P.; White, I. "The best flood I ever had": Contingent resilience and the (relative) success of adaptive technologies. *Cities* **2020**, *106*, 102842. [CrossRef]
92. Maiurova, A.; Kurniawan, T.A.; Kustikova, M.; Bykovskaia, E.; Othman, M.H.D.; Singh, D.; Goh, H.H. Promoting digital transformation in waste collection service and waste recycling in Moscow (Russia): Applying a circular economy paradigm to mitigate climate change impacts on the environment. *J. Clean. Prod.* **2022**, *354*, 131604. [CrossRef]
93. Ragia, L.; Antoniou, V. Making Smart Cities Resilient to Climate Change by Mitigating Natural Hazard Impacts. *ISPRS Int. J. Geo-Inf.* **2020**, *9*, 153. [CrossRef]
94. Fernández, C.G.; Peek, D. Smart and Sustainable? Positioning Adaptation to Climate Change in the European Smart City. *Smart Cities* **2020**, *3*, 511–526. [CrossRef]
95. Ortega-Fernández, A.; Martín-Rojas, R.; García-Morales, V.J. Artificial Intelligence in the Urban Environment: Smart Cities as Models for Developing Innovation and Sustainability. *Sustainability* **2020**, *12*, 7860. [CrossRef]
96. Yigitcanlar, T.; Cugurullo, F. The Sustainability of Artificial Intelligence: An Urbanistic Viewpoint from the Lens of Smart and Sustainable Cities. *Sustainability* **2020**, *12*, 8548. [CrossRef]
97. Esfandi, S.; Tayebi, S.; Byrne, J.; Taminiau, J.; Giyahchi, G.; Alavi, S.A. Smart Cities and Urban Energy Planning: An Advanced Review of Promises and Challenges. *Smart Cities* **2024**, *7*, 414–444. [CrossRef]
98. Kaginalkar, A.; Kumar, S.; Gargava, P.; Niyogi, D. Stakeholder analysis for designing an urban air quality data governance ecosystem in smart cities. *Urban Climate* **2023**, *48*, 101403. [CrossRef]
99. Tozer, L.; Bulkeley, H.; Xie, L.J. Transnational Governance and the Urban Politics of Nature-Based Solutions for Climate Change. *Glob. Environ. Politics* **2022**, *22*, 81–103. [CrossRef]
100. Ariyaningsih; Shaw, R. Integration of SETS (Social-Ecological-Technological Systems) Framework and Flood Resilience Cycle for Smart Flood Risk Management. *Smart Cities* **2022**, *5*, 1312–1335. [CrossRef]
101. Motta, M.; Neto, M.D.; Sarmento, P. A mixed approach for urban flood prediction using Machine Learning and GIS. *Int. J. Disaster Risk Reduct.* **2021**, *56*, 102154. [CrossRef]
102. Ruess, P.; Lindner, R. Knowledge Management for Smart Cities-Standardization and Replication as Policy Instruments to Foster the Implementation of Smart City Solutions. *Smart Cities* **2023**, *6*, 2106–2124. [CrossRef]
103. Broo, D.G.; Lamb, K.; Ehwi, R.J.; Parn, E.; Koronaki, A.; Makri, C.; Zomer, T. Built environment of Britain in 2040: Scenarios and strategies. *Sustain. Cities Soc.* **2021**, *65*, 102645. [CrossRef]
104. Benites, A.J.; Simoes, A.F. Assessing the urban sustainable development strategy: An application of a smart city services sustainability taxonomy. *Ecol. Indic.* **2021**, *127*, 107734. [CrossRef]
105. Ariyaningsih; Shaw, R. Community-Based Approach for Climate Resilience and COVID-19: Case Study of a Climate Village (Kampung Iklim) in Balikpapan, Indonesia. *Land* **2023**, *12*, 650. [CrossRef]
106. Panganiban, E.B.; Padre, R.J.; Baguio, M.A.; Francisco, O.B.; Balderama, O.F. An Urban Water Infrastructure Management System Design with Storm Water Intervention for Smart Cities. *Int. J. Adv. Comput. Sci. Appl.* **2022**, *13*, 306–313. [CrossRef]
107. Sinha, K.C.; Labi, S.; Agbelie, B. Transportation infrastructure asset management in the new millennium: Continuing issues, and emerging challenges and opportunities. *Transp. A-Transp. Sci.* **2017**, *13*, 591–606. [CrossRef]
108. Pultrone, G. The city challenges and the new frontiers of urban planning. *Tema-J. Land Use Mobil. Environ.* **2023**, *16*, 27–45. [CrossRef]
109. Ribeiro, P.; Dias, G.; Pereira, P. Transport Systems and Mobility for Smart Cities. *Appl. Syst. Innov.* **2021**, *4*, 61. [CrossRef]
110. Corsini, F.; Certomà, C.; Dyer, M.; Frey, M. Participatory energy: Research, imaginaries and practices on people' contribute to energy systems in the smart city. *Technol. Forecast. Soc. Change* **2019**, *142*, 322–332. [CrossRef]
111. Kakderi, C.; Komninos, N.; Panori, A.; Oikonomaki, E. Next City: Learning from Cities during COVID-19 to Tackle Climate Change. *Sustainability* **2021**, *13*, 3158. [CrossRef]
112. Moglia, M.; Frantzeskaki, N.; Newton, P.; Pineda-Pinto, M.; Witheridge, J.; Cook, S.; Glackin, S. Accelerating a green recovery of cities: Lessons from a scoping review and a proposal for mission-oriented recovery towards post-pandemic urban resilience. *Dev. Built Environ.* **2021**, *7*, 100052. [CrossRef]
113. Di Giulio, G.M.; Bedran-Martins, A.M.B.; Vasconcellos, M.P.; Ribeiro, W.C.; Lemos, M.C. Mainstreaming climate adaptation in the megacity of São Paulo, Brazil. *Cities* **2018**, *72*, 237–244. [CrossRef]

114. Goers, S.; Rumohr, F.; Fendt, S.; Gosselin, L.; Jannuzzi, G.M.; Gomes, R.D.M.; Sousa, S.M.S.; Wolvers, R. The role of renewable energy in regional energy transitions: An aggregate qualitative analysis for the partner regions ba-varia, Georgia, Québec, São Paulo, Shandong, Upper Austria, and Western Cape. *Sustainability* **2021**, *13*, 76. [CrossRef]
115. Torres, P.H.C.; Jacobi, P.R.; Momm, S.; Leonel, A.L. Data and knowledge matters: Urban adaptation planning in São Paulo, Brazil. *Urban Clim.* **2021**, *36*, 100808. [CrossRef]
116. Lamas, C.B.; Medeiros, T.F.; Santos, B.M.; Souza, E.P.; Caldeira, G.P.; Di Biase, L.; Lippe, M.I.G. *Programa de Mobilidade Inteligente de São Paulo (Portuguese)*; World Bank Group: Washington, DC, USA, 2023. Available online: http://documents.worldbank.org/curated/en/099042623195036151/P17341408feb7502d0a5e90555bfc2af8b7 (accessed on 1 May 2024).
117. Da Silva, A.T.; Buendía, M.P. Megacities in climate governance: The case of Rio de Janeiro. Meridiano 47. *J. Glob. Stud.* **2016**, *17*, 1–9. [CrossRef]
118. Mendes, V. Climate smart cities? Technologies of climate governance in Brazil. *Urban Gov.* **2022**, *2*, 270–281. [CrossRef]
119. Rio de Janeiro City Government. *Plan for Sustainable Development and Climate Action of the City of Rio de Janeiro—Executive Summary, 2021*; Rio de Janeiro City Government: Rio de Janeiro, Brazil, 2021. Available online: https://www.rio.rj.gov.br/dlstatic/10112/12937849/4337196/Executive_Summary_finalok.pdf (accessed on 1 June 2024).
120. Fryszman, F.; Carstens, D.D.D.S.; Da Cunha, S.K. Smart mobility transition: A socio-technical analysis in the city of Curitiba. *Int. J. Urban Sustain. Dev.* **2019**, *11*, 141–153. [CrossRef]
121. Lira, G.S.de; Lofhagen, J.C.P. Cidades inteligentes e o transporte urbano sustentável com bioenergia: Um estudo de caso de Curitiba, Brasil. *Rev. Tecnol. E Soc.* **2022**, *18*, 207–220. [CrossRef]
122. Miranda, H.F.; Rodrigues da Silva, A.Ô.N. Benchmarking sustainable urban mobility: The case of Curitiba, Brazil. *Transp. Policy* **2012**, *21*, 141–151. [CrossRef]
123. Macadar, M.A.; Lheureux-De-Freitas, J. Porto Alegre: A Brazilian city searching to be smarter. In Proceedings of the ACM International Conference Proceeding Series, Quebec, QC, Canada, 17–20 June 2013; pp. 56–64. [CrossRef]
124. Viale Pereira, G.; Cunha, M.A.; Lampoltshammer, T.J.; Parycek, P.; Testa, M.G. Increasing collaboration and participation in smart city governance: A cross-case analysis of smart city initiatives. *Inf. Technol. Dev.* **2017**, *23*, 526–553. [CrossRef]
125. Viegas, C.V.; Saldanha, D.L.; Bond, A.; Ribeiro, J.L.D.; Selig, P.M. Urban land planning: The role of a Master Plan in influencing local temperatures. *Cities* **2013**, *35*, 1–13. [CrossRef]
126. Bonatti, M.; Lana, M.A.; D'Agostini, L.R.; de Vasconcelos, A.C.F.; Sieber, S.; Eufemia, L.; da Silva-Rosa, T.; Schlindwein, S.L. Social representations of climate change and climate adaptation plans in southern Brazil: Challenges of genuine participation. *Urban Clim.* **2019**, *29*, 100496. [CrossRef]
127. 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**, *11*, 3265. [CrossRef]
128. FloripAmanha. Agenda Floripa 2030/2040/205. 2023. Available online: https://materiais.floripamanha.org/floripa-2030-2040-2050 (accessed on 1 June 2024).
129. Cepeliauskaite, G.; Keppner, B.; Simkute, Z.; Stasiskiene, Z.; Leuser, L.; Kalnina, I.; Kotovica, N.; Andiņš, J.; Muiste, M. Smart-Mobility Services for Climate Mitigation in Urban Areas: Case Studies of Baltic Countries and Germany. *Sustainability* **2021**, *13*, 4127. [CrossRef]
130. Creutzig, F.; Franzen, M.; Moeckel, R.; Heinrichs, D.; Nagel, K.; Nieland, S.; Weisz, H. Leveraging digitalization for sustainability in urban transport. *Glob. Sustain.* **2019**, *2*, e14. [CrossRef]
131. Senate Department for Urban Mobility, Transport, Climate Action, and the Environment. BEK 2030—Berlin Energy and Climate Protection Programme 2030. 2019. Available online: https://www.berlin.de/sen/uvk/_assets/klimaschutz/publikationen/bek2030_broschuere_en.pdf?ts=1705017672 (accessed on 1 June 2024).
132. Abayneh Abebe, Y.; Ghorbani, A.; Nikolic, I.; Manojlovic, N.; Gruhn, A.; Vojinovic, Z. The role of household adaptation measures in reducing vulnerability to flooding: A coupled agent-based and flood modelling approach. *Hydrol. Earth Syst. Sci.* **2020**, *24*, 5329–5354. [CrossRef]
133. Kutty, A.A.; Wakjira, T.G.; Kucukvar, M.; Abdella, G.M.; Onat, N.C. Urban resilience and livability performance of European smart cities: A novel machine learning approach. *J. Clean. Prod.* **2022**, *378*, 134203. [CrossRef]
134. Morishita-Steffen, N.; Alberola, R.; Mougeot, B.; Vignali, É.; Wikström, C.; Montag, U.; Gastaud, E.; Lutz, B.; Hartmann, G.; Pfaffenbichler, F.X.; et al. Smarter together: Progressing smart data platforms in Lyon, Munich, and Vienna. *Energies* **2021**, *14*, 1075. [CrossRef]
135. Gimpel, H.; Graf-Drasch, V.; Hawlitschek, F.; Neumeier, K. Designing smart and sustainable irrigation: A case study. *J. Clean. Prod.* **2021**, *315*, 128048. [CrossRef]
136. Vanli, T. Ranking of Global Smart Cities Using Dynamic Factor Analysis. *Soc. Indic. Res.* **2024**, *171*, 405–437. [CrossRef]
137. Saxon State Office for the Environment, Agriculture and Geology. State Flood Center. 2024. Available online: https://www.umwelt.sachsen.de/umwelt/infosysteme/lhwz/index.html (accessed on 1 June 2024).

138. Prefeitura Municipal de Porto Alegre—PMPA. Programa Governo Digital. 2024. Available online: https://prefeitura.poa.br/pgd#:~:text=O%20que%20%C3%A9?,diversas%20%C3%A1reas%20da%20administra%C3%A7%C3%A3o%20p%C3%BAblica (accessed on 1 June 2024).
139. Fachinelli, A.C.; Yigitcanlar, T.; Sabatini-Marques, J.; Cortese, T.T.P.; Sotto, D.; Libardi, B. Urban Smartness and City Performance: Identifying Brazilian Smart Cities through a Novel Approach. *Sustainability* **2023**, *15*, 10323. [CrossRef]
140. Sabatini-Marques, J.; Yigitcanlar, T.; Schreiner, T.; Wittmann, T.; Sotto, D.; Inkinen, T. Strategizing Smart, Sustainable, and Knowledge-Based Development of Cities: Insights from Florianópolis, Brazil. *Sustainability* **2020**, *12*, 8859. [CrossRef]
141. Akande, A.; Cabral, P.; Gomes, P.; Casteleyn, S. The Lisbon ranking for smart sustainable cities in Europe. *Sustain. Cities Soc.* **2019**, *44*, 475–487. [CrossRef]
142. Becker, S.; von Schneidemesser, D.; Caseiro, A.; Götting, K.; Schmitz, S.; von Schneidemesser, E. Pop-up cycling infrastructure as a niche innovation for sustainable transportation in European cities: An inter- and transdisciplinary case study of Berlin. *Sustain. Cities Soc.* **2022**, *87*, 104168. [CrossRef]
143. Senatsverwaltung Umwelt, Verkehr und Klimaschutz Berlin. Stadtentwicklungsplan Mobilität Und Verkehr Berlin 2030. 2021. Available online: https://www.berlin.de/sen/uvk/_assets/verkehr/verkehrspolitik/step/broschuere_stepmove.pdf (accessed on 1 June 2024).
144. Partani, S.; Qiu, A.; Sattiraju, R.; Tayade, S.; Schotten, H.D. Quantitative Assessment of CCAM Applications on Greenhouse Gas Emissions. In Proceedings of the IEEE Vehicular Technology Conference, Helsinki, Finland, 19–22 June 2022; IEEE: New York, NY, USA, 2022. [CrossRef]
145. Senatskanzlei Hamburg. Zweite Fortschreibung des Hamburger Klimaplans. 2023. Available online: https://www.hamburg.de/resource/blob/949036/4c902bd7090a09f16a600091cfc7a110/d-zweite-fortschreibung-hamburger-klimaplan-data.pdf (accessed on 1 June 2024).
146. Morteza, A.; Chou, R.A. Distributed Matrix Multiplication: Download Rate, Randomness and Privacy Trade-Offs. In Proceedings of the 2024 60th Annual Allerton Conference on Communication, Control, and Computing, Urbana, IL, USA, 24–27 September 2024; IEEE: New York, NY, USA, 2024; pp. 1–7. [CrossRef]
147. Alawadhi, S.; Scholl, H.J. Smart governance: A cross-case analysis of smart city initiatives. In Proceedings of the Annual Hawaii International Conference on System Sciences, Koloa, HI, USA, 5–8 January 2016; IEEE: New York, NY, USA, 2016; pp. 2953–2963. [CrossRef]
148. City of Frankfurt am Main. Masterplan 100% Climate Protection"—Frankfurt am Main, 2013. Available online: https://frankfurt.de/-/media/frankfurtde/frankfurt-themen/klima-und-energie/pdf/energiereferat-79a/masterplan-climate-protection---summarised-version.ashx (accessed on 1 June 2024).