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Research, Activism, and Methodologies for Uncovering and Countering Green the City Orthodoxy

Austin Gage Matheney

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Research, Activism, and Methodologies for Uncovering and Countering Green the City Orthodoxy

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Note: U.S. spelling is used in this work

For gramma Annie and Fusha,

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Summary

This thesis explores the intersection of green urbanism and social justice, focusing on the often overlooked consequences of sustainable urban development in cities. It critically examines how initiatives intended to address environmental issues, such as the creation of green spaces, eco-friendly technologies, and sustainable practices, can inadvertently perpetuate social and spatial injustices, particularly through processes like green gentrification. These injustices result in the displacement of marginalized communities and reinforce socio-economic inequalities, despite the stated goal of creating more resilient, sustainable urban environments.

The research is divided into two main sections. The first section, “Uncovering the Green City Orthodoxy,” provides a critical analysis of how cities like Bristol, UK, have pursued green development while simultaneously advancing austerity measures. Through qualitative research methods such as interviews and document analysis, the author reveals how the European Green Capital award has led to policies that favor real estate development and capital accumulation at the expense of social equity. Quantitative studies in this section also examine green gentrification in 28 cities across Europe and North America, demonstrating how different types of green spaces contribute to rising property values and the displacement of vulnerable populations.

The second section, “Countering the Green City Orthodoxy,” shifts focus to grassroots resistance against these green interventions. Using Barcelona as a case study, the thesis examines the role of social movements in challenging neoliberal urban planning and promoting alternative visions of urban greening. Through concepts like “radical spatial imaginaries” and counter-mapping, the author illustrates how these movements resist top-down green initiatives and advocate for more inclusive, socially just urban futures. The research also reflects on the role of academics in supporting these movements, emphasizing the importance of engaged, activist-oriented research practices.

Taken together, this thesis adds to the critical exmainiation of contemporary urban green (re)development by deepening our understandings of green gentrification – through novel quantitative methodologies and also the highlighting of the connections between green gentrification and tourism. Importantly the thesis also offers novel studies of environmental justice activism in a Southern European context, highlighting the differences and similiarites between a US-centric literature. Emerging are working class proposals for green justice and community-baesd green planning. Through politically motivated research and participatory methodologies, activists and scholars may come together to not only uncover and highlight radical ways of existing, but also in making them a reality.

The thesis concludes by questioning the current direction of urban environmental justice scholarship and calls for more critical, action-oriented approaches that address both environmental and social inequities. It highlights the need for future research to explore alternative urban imaginaries and promote more just forms of sustainable urban development. The thesis calls for the further inclusion of anti-displacement and eviction measures in urban greening initiatives, deepining of support and engagement with grassroots movements for more humble and informal greening, as well as further support for situated and participatory research projects and outputs.



Introduction

Introduction

1.1 Motivation

Countless studies underscore the urgent need for intense climate action around the world. They provide and cite models and projections predicting more severe and frequent heat waves (Marx et al., 2021; Mitchell et al., 2016) and droughts (Cook et al., 2018; Mukherjee et al., 2018; Pokhrel et al., 2021), heightened severity of storms (Michener et al., 1997; Allen, 2018; Knutson et al., 2021), alarming levels of 'climate migration' (Kaczan and Orgill-Meyer, 2020; Schewel et al., 2024), and even the potential of future armed conflict due to severe resource shortages (Theisen et al., 2013). These studies are quick to point out that by 2050, the UN projects a sharp increase in the urban population of the world (UNDESA, 2019) – with the upcoming period being deemed the 'urban era'.

Reflecting this, there has been an 'urban turn' in climate change scholarship (Bulkeley and Betsill, 2013; Robin and Acuto, 2023), emphasizing the centrality of urban areas in climate action. This centrality arises due to the urbans' extractive relationships with rural areas for construction materials and energy all while being argued to be key, necessary drivers of economic growth at regional, national, surpranational, and global scales. This 'urban turn' has resulted in increased calls to 'renature' our cities using nature-based solutions (NbS) as to address historical and ongoing injustices while creating resilient, adaptable, and 'smart' urban environments. These cities must be capable of enduring hotter summers, wetter and colder winters, use fewer or renawable resources, be spatially and procedurally equitable, and generally realign our metabolism with 'nature'. Not only can we 'mend' the metabolic rift created and amplified through capitalist urbanization by 'renaturing' our cities, but through this we may also increase the physical and mental health of urban residents (Nieuwenhuijsen, 2021; Subiza-Pérez et al., 2020; Triguero-Mas et al., 2021), foster hardened connections to place (Basu et al., 2022; Cilliers et al., 2015; Mattijssen et al., 2017), and even drive green growth imperatives (Cooper et al., 2024)!

Unfortunately, the current manner in which cities are being 'greened', or how 'sustainable urban development' is being performed, has been shown to be driving injustices in urban *and* rural areas. In the urban, processes of green gentrification are driving processes of dispossession by green accumulation, coupled with environmental racism to harden and create new socioenvironmental divides (Anguelovski et al., 2022b; Cucca et al., 2023; Rigolon et al., 2024). Historically marginalized residents are being pushed into more affordable, often peripheral areas, with less environmental amenities, lower-quality housing stock, and are more exposed to climate impacts. While improvements in urban environments are undoubtedly ocurring throughout the world – leading to advancements in physical and mental health, the reductions of emissions (Nieuwenhuijsen et al., 2024) or offering climate shelters in intense weather events (Amorim-Maia et al., 2023) – their connections to rural extractivism are being blurred. For example, as sustainable transportation is erupting in urban areas, copper and

lithium mining, necessary for the construction of batteries and solar panels, is increasingly destroying rural-ecosystems and displacing, polluting, and killing rural communities and their environmental defenders (Andreucci et al., 2023; Rodrigues et al., 2022; Sepulveda, n.d.; Tran et al., 2020). As the outlining of these (interconnected) rural and urban injustices is growing, we are again reminded of the unequal manner in which the climate crisis is being experienced and the role of 'green' inside the continuation of unjust processes of urbanization.

The current reality of the climate crisis is that formerly colonized communities throughout the Global Souths[1], as well as historically marginalized communities throughout the north, continue to be disproportionately impacted by rapidly worsening climatic conditions, as well as through green projects linked to climate mitigation and adaptation as a part of so-called 'sustainable (urban) development' (Sharp et al. 2024). A 2016 United Nations Office for Disaster Risk Reudction (UNDRR 2016) 'mortality report', revealing that 90% of disaster deaths have and continue to occur in low- and -middle income countries, was called a 'damming indictment of inequality' by then Secretary-General of the United Nations Ban Ki-moon. As Sultana (2022) tells us, recalling the aftermath of the 1991 cyclone in Bangladesh, "[w]e are still colonized, but this time through climate change, the development industry, and globalization" (Sultana, 2022, p. 2).

This dissertation also stems from personal experiences of living within violent environmental conditions as well as using my privilege to escape them. While studying in New Delhi in 2017, I conducted a short internship with a group named *Help Delhi Breathe*. While having been argued to be the 'greenest capital' by members of the Indian government – in terms of overall green coverage (The Indian Express July 2024)– New Delhi consistantly ranks high among the most polluted cities in the world . In my very short internship, I was shocked at the number of premature deaths occuring due to respitory issues contributed to air pollution per year – with 2019 reaching almost 17,500 premature deaths alone (Pandey et al., 2021). My internship was short because I developed respitory issues of my own, coughing up blood and visiting a private hospital several times. Using my privilege, I quickly fled to the outskirts of Paris to breathe in the (relatively!) clean air. However, this time in Bois Colombes – a green and residential suburb known for its quiet streets, community feel, and convenient access to the city - I felt a stark reminder in every breathe that this air's relative cleanliness is maintained at the expense of places like New Delhi. I felt in my body a clear misrepresentation of the metabolic relations of Western urban centers and (urban centers of) the Global Souths. A falseness in the green image of the 'modern' green transition, an ignorance in the temporal reality of the climate crisis, all emerging due to a continued belief in an ability

[1] The term Global Souths, in plural, is purposefully used to highlight the diversity and heterogeneity, intersectionality, and global connections of the vast histories, experiences, cultures, languages, and socio-economic conditions that are generally lumped into a singular term of the 'global south' (Halvorsen and Zaragocin 2022).

to ‘control’ nature and to plan ourselves out of rapidly declining environmental conditions.

This belief and aim to control nature is central to eco-modernization, which relies on technological innovations, market-based mechanisms, and regulatory reforms to manage and mitigate environmental issues (Latour, 2007; Bellamy Foster, 2012; Arsel 2016; (Bond, 2022; Hagbert et al., 2020). The eco-modernization stance promotes technological control through engineered solutions and optimistically views human ingenuity as capable of solving environmental problems. This mindset runs strong in the rolling out of nature-based solutions (NbS) and payments for ecosystem services (PES), which often commodify and market nature, reducing it to economic values, all while promoting sustainable (urban) development (Anguelovski and Corbera, 2023; Gómez-Baggethun and Ruiz-Pérez, 2011; Kotsila et al., 2021; Robertson, 2006). These dynamics, then, not only continue and push the world towards a hegemonic asipiration named ‘modernity’, which is known to be “an impossible dream based on unsustainable resource consumption and an illusion of control” (Lawhon et al., 2023, p. 15) but also perpetuates a continued idealogical division between humans and nature, or urban and rural, blurring metabolic realities. These dominant, market-based mechanisms through which the green transition is playing out has led to the conceputalization of a ‘green city orthdoxy’ which provides a moral basis for and drives sustainable urban development (Anguelovski and Connolly, 2022.; Connolly, 2019; Garcia-Lamarca et al., 2021).

This thesis is thus an exploration of what I tell myself is a case of ‘misplaced modernity’, an invented concept which personally helps me in better understanding contemporary realities. More precisely put, this thesis is a discussion of the coloniality of power (Mignolo 2010; Quijano, 2000) inside of contemporary ‘green’ or ‘sustainable’ (urban) (re)development. The coloniality of power, as articulated by Anibal Quijano and Walter Mignolo, refers to the enduring structures of power and knowledge established during colonialism that continue to shape modern socities and their drive towards ‘modernity’. Quijano emphasizes how colonialism created global racial, political, and economic hierarchies that persist today, matintaining the dominance of Eurocentric cultures and marginalizing non-Western epistemologies. Mignolo builds on this by highlighting the control of knowledge production as a crucial aspect of coloniality and advocates for ‘decolonization’, which involves rejecting Western epistemic dominance and acknowlodging and fostering independent, alternative knowledge systems.

In the context of sustainable urban development and environmental justice, scholars have operationalized the concept of coloniality to critique and reform traditional frameworks. They argue that addressing environmental injustices requires acknowledging colonial histories and continuations and integrating indeginous and alternative knowledge systems (Álvarez and Coolsaet, 2020; Anguelovski et al., 2022a). In urban settings, this means addressing spatial inequalities and promoting inclusive development that benefits all residents, ensuring that modernization does not replicate colonial patters of exclusion and exploitation. In the process of both greening cities and

conducting critical research on the impacts of contemporary green urban (re)development, it has become clear that we continue to be linked to the colonial matrix of power and are in dire need of epistemic disobedience and increased direct action in a pursuit of decolonizing our minds, our cities, and our planet(Anguelovski et al., 2022a; Pulido and De Lara, 2018; Safransky, 2014; Swyngedouw and Heynen, 2003; Tornel, 2023).

In this way, this thesis is not motivated by a moral necessity and call to renature the city as to confront climate change. I am not driven by a desire to preserve pristine nature, to reach higher levels of 'eco-efficiency', or reaching liberal conceptualizations of justice (Anguelovski and Martínez Alier, 2014). What I am motivated by is the recognition and outlining of multiple modernities – from their most extractive to their most modest manifestations through an analysis of so-called 'green' cities. Of 'thinking Europe otherwise' (Boatcă, 2021). Decolonizing the way in which I think and write about the urban, urban socio-natures[2], and urbanization processes more generally. Trying to better understand the realities which our fixation on a 'modern ideal' of what green *ought to* resemble may blind us to. In this way, this thesis is driven by a core question of *what are the social limits to the green city orthodoxy and how is it being contested from below?* The conceptual journey which translates the empirics of this thesis, exploring and answering this core question, first began when I engaged with scholarly work reconceptualizing the 'urban' from a *form* to a *process* (Angelo and Wachsmuth, 2015; Derickson et al., 2024).

I was first influenced by the works of scholars such as Simone, Roy, Robinson, Pieterse, Parnell, and Bayat. Their works emphasize the fluid, dynamic, and relational aspects of urbanization, challenging static and form-based understandings of cities I had previously been engaging with. Their reflections underscore the importance of processes, practices, and the lived experiences of urban residents in shaping urban spaces. Extending discussions of infrastructure beyond those of 'green' or 'grey' (Wachsmuth and Angelo, 2018) to include relational and social networks (of care) (Simone 2004; Binet et al., 2023), informality and everyday practices (Roy, 2011; Silver, 2014) has been crucial in a personal movement towards a 'process' based understanding of urbanization.

In this dissertation, I am interested in exploring the role played by these place-based, relational networks before, during, and after the unrolling of 'green interventions'. This interest arose in the first years of my doctoral studies when I became fascinated with

[2] The analysis of urban socionatures travels through various fields and scholarly gazes. At first, largely associated with the field of urban political ecology (UPE) (see Heynen, Kaika and Swyngedouw 2006), scholars of 'urban socionatures' recognize humans as dialectically enrolled in the natural world – with our cities having arisen from the transformation of nature (Kantz 1998) through social metabolic processes. The transformation of nature into urban infrastructures involves the intense use of resources – be it the concrete, iron, timber, water, or plants – mobilized within socio-economic systems which in turn create and maintain injustices through a maldistribution of power. Put differently, social metabolic processes are "discursively, politically, and economically mobilized and socially appropriated to produce environments that embody and reflect positions of social power" (Heynen, Kaika and Swyngedouw 2006: 6).

Wangui Kimari's approach to research and narrative capabilities. Specifically, I was stuck thinking about their 'conceptual metaphor' of *ecologies of exclusion* (Kimari 2021) – both in the metaphor in itself and in how the piece is written around this metaphor. With an analytical focal point of a water pump in the "slum" of Mathare, Nairobi, Kimari's 'conceptual metaphor' highlights how *ecologies of exclusion* "are geographies materialized through the interplay of historical socio-political and economic disenfranchisement that operate in tandem with severe environmental crises" (Kimari, 2021, p. 2). Research shows that the lens of *ecologies of exclusion* not only helps to illustrate the systemic nature of the injustices arising through the intertwining of environmental degradation and social marginalization, which is being perpetuated by urban planning and governing, but also how community members in Mathare actively resist marginalization through collective actions and solidarity – often at deadly costs. While Kimari (2021) examines life around a water pump, other grassroots movements in popular neighborhoods[3] throughout Nairobi, and elsewhere throughout the continent, are engaging in drastically improving their urban environments through river restoration, park construction, and urban gardening/farming. Residents come together to pool their local knowledge, social networks, and activisms to navigate and contest oppressive urban planning policies while improving their urban environments. Adding to the voices of scholars striving to better understand urban socio-natures in the Global Souths, analyses such as Kimari's have significantly added to the available conceptual and methodological toolkit by challenging the dominant paradigms emerging from Western academia. This 'provincialization', then, may reveal truths about our societies that we may not be capable of telling ourselves (Gregory, 2004, Roy 2018). Put differently, rather than measuring the world through a standard built upon European histories and societies, perhaps we should instead analyze how they have been and continue to be entangled with 'othered' spaces.

Cities of the Global Souths are often framed as 'unique' and are characterized by their informality (Pieterse, 2011) coming together to create an 'other wordly' aura. However, if we are able to view all cities as 'ordinary' (Robinson, 2002) and thus capable of producing urban theory (Roy, 2016), our conceptual frameworks are then able to see the uniqueness (and thus ordinary character) of *all* cities. While many of these places, such as Naples, Barcelona, Santorini, or Marseille, are perceived as 'other wordly', 'mediterranean' cities, their informality and uniqueness, seen rather as 'proper' and 'cultured', reveals the centrality of white supremecy in colonial processes of othering (Safransky, 2014). A continued coloniality in our capabilities to see, recognize, and give space to urban realities. If we are unable to look beyond these colonial frames in our

[3] Jonathan Silver (2014), like many critical urban scholars, uses the term "popular neighborhoods" instead of terms like "slums" or "informal settlements" to move away from the negative and often stigmatizing connotations associated with those latter terms. The words "slum" and "informal settlement" typically emphasize deprivation, illegality, or disorder, and they often come with a colonial and paternalistic gaze that frames these areas as problems needing top-down intervention. By using the term "popular neighborhoods," Silver (2014) aims to emphasize the agency, resilience, and creativity of the residents living in these areas. The term acknowledges that these neighborhoods are shaped and sustained by the collective action and everyday struggles of the people who live there, making them "popular" in the sense of being places for and by the people.

understanding of processes of urbanization, we are thus telling a story without all of its protagonists. Ourselves as academics washing over and invisibilizing already existing socio-natures which may represent pathways and play key roles in moving towards a systematic change in the organization of our socioecological systems.

All in all, I have been significantly influenced by urban scholars from and studying the Global Souths, particularly throughout sub-Saharan Africa. The way "green" is celebrated in Europe, and how European cities are increasingly idealized and celebrated, presents many issues. Through my work, I attempt to uncover the hidden and invisibilized realities occurring within northern 'green' cities. Simultaneously, I aim to bring to light radical visions of urban greening, which are emerging from social movements and from drastically different forms of urban existence found on the urban fringe—areas that are often overlooked in mainstream academia.

Coming now to Barcelona, the main focus of this thesis, the city has recently reasserted its position as a global city of fashion and design through the hosting of large scale and mega-events. Previous mega events, such as the 1929 Barcelona International Exhibition to the 1992 Olympic games, have had long lasting effects on the urban fabric of Barcelona. Large scale urban (re)development, such as through the demolition of 'informal' neighborhoods in places such as Montjuic (Castro-Varela, 2022), el Poblenou (Marrero Guillamón 2003), el Carmelo (Golda-Pongratz and Urban, 2024) and la Sagrera (Wynn, 2024), led to large demographic changes to the city. As Marrero Guillamón (2003) notes, el Poblenou, between 1975 and 1986, lost 19% of its population.

The most recent reassertion has manifested in events such as a Louis Vuitton[4] fashion show inside the famous Parc Güell which destroyed stairs inside the now UNESCO world heritage site (La Vanguardia, 2024) all while brutal police aggression was carried out against tactivists (The Guardian, 2024). Mega-events like the 2024 Copa América sailing competition are forcing neighbors of *La Barceloneta* – a port neighborhood with a historically working-class fishing and harbor community – to show ID to gain access to their neighborhood and thus their homes. The event is reportedly using up to 100,000 liters of water daily primarily for maintaining the boats and supporting event infrastructure all while the region is hopeful to emerge from a drought which has already led to severe water restrictions (Euronews, 2024) and fines (Euronews, 2024b). Mega-events like a June 2024 Formula-1 event involved the re-asphalting of city streets – costing taxpayers 1.4 million euros – for rich athletes to do 'burn outs' and 'donuts' next

[4] Luis Vuitton, a luxury fashion brand criticized for promoting a culture of overconsumption, insufficient action on sustainability goals, a lack of transparency, greenwashing, unsustainable levels of energy consumption and waste production, as well as animal welfare concerns, was allowed to hold their fashion show inside Parc Güell only after a mayoral decree which stated, amongst other things, that Luis Vuitton ,and thus the event, "coincides with the values and policies promoted by the Barcelona City Council:...to climate change, responsible purchases, and the promotion of diversity and inclusion" (Betevé, 2024). Private events of this nature are normally not allowed due to strict restrictions aimed at protecting the Parc Güell's cultural and historical significance.

to a recently green pacified street (Green Axis) inside a low emissions zone seem to becoming a new norm.

This global event identity sits uncomfortably with a more recent green and feminist identity. From aspects such as the famous superblocks initative (Mueller et al., 2020; Nieuwenhuijsen et al., 2024), plans to increase the creation and maintenance of urban green spaces, its integrated public transportation achievements, the city's promotion of renewable energy, energy efficiency, waste management, and a circular economy, as well as climate adaptation and resilience initiatives, public participation and inclusivity, and international leadership and collaboration in networks, today Barcelona is also globally considered a leader in urban sustainability. All while bolstering a strong identity around it.

Alongside of the disastrous effects of these mega-events[5], 'integrated green gentrification'[6] trends in the city are driving ecologies of exclusion. Studies highlight the physical health benefits for middle-upper class residents in areas surrounding the city's newest flagship programs due to a drop in air pollution levels (ISG studies). Those stand in clear disconnect and contrast with working and lower-class residents in neighborhoods like Nou Barris which face more intense heat waves and have access to fewer amenities (Vasconcelos et al., 2024; Amorim-Maia et al., 2023). The combination of new green planning, competitive urbanism, and global real estate development in Barcelona are pushing residents to peripheral, more affordable neighborhoods with lesser access to the ecosystem services enjoyed in wealthier, more central and well-connected areas. This displacement – linked or not to green gentrification itself but always to real estate speculation and/or the associated housing crisis – has far too often led to tragic outcomes, including residents taking their own lives before being forcefully evicted due to an inability to pay fees (El Nacional, 2024). In Barcelona, 12 suicide attempts have occurred between January and April 2024 driven by looming evictions (ibid), with peripheral neighborhoods like Cuitat Meridiana experiencing suicide rates three times higher than the city average (El Pais, 2024).

The slow and rapid violence of climate change, alongside the injustices created and reinforced by climate mitigation efforts, deeply affect residents of the city and are widely criticized and faught against by 'popular infrastructures' [7]. However, these critical issues are not the main focus in discussions about Barcelona's 'green transition' in the media, social media, or wider academic circles. Rather cities around the world turn to

[5] The adjective of 'disastrous' is taken quite literally in that these events have led to the destruction of stairs inside a UNESCO world heritage site, laws, freedom of passage through and occupancy of public space, the overconsumption of a scarce resource (water!), and the physical damage to residents bodies (through police aggression).

[6] 'Integrated green gentrification' means that "greening plays an explanatory role roughly on par with that of new development and/or new transit" (Anguelovski et al. 2022).

[7] The term 'popular infrastructures' is borrowed from Ruiz-Cayuela and García-Lamarca's (2023) discussion of 'reproductive urban commons' through a study of *la Bloc La Bordeta* squat in the Sant's district of Barcelona. They themselves "borrow [the term] from Catalan grassroots movements [who deploy the term to] designate community controlled and politically loaded infratsructures that support autonomus projects and social movements" (ibid 2023: 2).

Barcelona as a model from which to plan themselves out of the looming climate crisis. This desire to 'be like Barcelona' is further supported by academics who flock to the city to quickly research the superblocks or to enjoy a sabbatical. While European cities are often perceived as 'different' from their 'Southern' counterparts, all-while continuing to dictate how these cities 'ought to' develop, it is just as much the story which we academics are telling about ourselves which continues to halt decolonization and a true movement towards green and just futures.

The chapters of this thesis are thus a reflection of my personal journey in attempting to unmask (both personally and academically) the ongoing coloniality of power inherent in Western, contemporary green planning practices and highlight voices of the excluded, those termed to be 'below'. In the remainder of this introductory chapter, I outline the key concepts operationalized throughout the thesis. I begin by outlining the 'umbrella' concept of this thesis – the 'green city orthodoxy' – which is deployed to highlight the hegemonic status of an imaginary stricken with a thirst for 'modernity'. Continuing, I highlight the material ripples which are being outlined as associated with the 'green city orthodoxy' throughout Europe and North America, with a focus on green gentrification. I then offer a bringing-together of conceptual currents and calls from urban political ecology and (urban) environmental justice scholarship for academics and their works to aid in the recouping of alternatives as to foster futures which are truly green and just. I include three boxes throughout which highlight co-authored pieces, not fully included in this dissertation, which expand on concepts and issues discussed below. The introduction then concludes with a laying out of the research objectives, gaps, and design.

1.2.1 Green city orthodoxy

In its most basic form, the 'green city orthodoxy[8]' represents a prevailing set of beliefs or principles emphasizing the importance of environmental sustainability in the (re)development and management of urban spaces (Connolly, 2019; Anguelovski et al. 2018; Garcia-Lamarca et al., 2021) . The term 'orthodoxy' is used to convey how these beliefs have become widely accepted and institutionalized, forming a dominant or hegemonic paradigm in urban planning and development. Scholars argue that this orthodoxy now reflects a hegemonic global regime of 'greening' (Conolly, 2019), where urban sustainability practices are promoted as universally beneficial and necessary for modern cities (Anguelovski, Connolly and brand 2018;). This orthodoxy often supports integrating green technologies, promoting green spaces, and advancing sustainable practices such as efficient energy use, waste reduction, and eco-friendly transportation systems. However, the 'green city orthodoxy' did not emerge 'naturally'; rather, it is a

[8] I choose to employ the singular term 'orthodoxy', rather than orthodoxies, not to argue there exists one singular form in which urban centers are being 'greened', but rather to drive home the fact that there exists an overarching trend in contemporary green urban planning which continues to be driven by Western, European epistemologies and neoliberal processes of capital accumulation.

dynamic concept reflecting evolving ideas about the relationship between urban (re)development and the natural environment (Angelo, 2021).

This connection has been critiqued by scholars who have and continue to argue that the green city orthodoxy can reinforce existing inequalities by promoting projects that align with neoliberal principles, such as prioritizing economic efficiency, privatization, and market-based solutions over public welfare (Brand, 2007; Whitehead, 2013; Kotsila et al., 2021; Neidig et al., 2022; Angelo, 2019; Bakker, 2010). This often manifests in the form of public-private partnerships, the commodification of urban space, and the emphasis on attracting investment and real estate development. As it has evolved, this orthodoxy is seen to have 'gone global' through a combination of international agreements (Baravikova, 2020; Sirakaya et al., 2018), technological advancements (hui et al., 2023; Steinberg et al., 2012), and collaborative networks (Goh, 2021). The global spread and adoption of these ideas have solidified the green city orthodoxy as the dominant framework for urban development, often marginalizing alternative perspectives and approaches (Anguelovski et al., 2018; Anguelovski et al., 2020).

An environmental justice (EJ) movement emerged in the 1980s to address these disparities, focusing on the disproportionate environmental burdens borne by marginalized, especially African-American, communities. Dorceta Taylor expanded this discourse with her comprehensive analysis of the environmental movement's historical and contemporary dynamics. In their book "The Environment and the People in American Cities" (2009), Taylor explored the socio-economic and racial dimensions of urban environmental issues, arguing for more inclusive and equitable approaches to urban sustainability. Just as the green city orthodoxy continued to evolve, so did the environmental justice literature, with some scholars drawing distinctions between 'waves' of EJ scholarship (Pellow 2018) noting moments of expansion in the conceptual, geographical, temporal, and methodological undercurrents.

One particular current within the environmental justice (EJ) movement examines the injustices related to the distribution of green space, often referred to as 'green space justice' or 'green equity' (Rigolon et al., 2021; Chen et al., 2024; Xu et al., 2018). This line of inquiry builds on early EJ studies that focused on distributional injustices, such as the uneven exposure to environmental hazards, by highlighting significant disparities in access to parks, trees, and recreational areas – and thus the ecosystem services arising from these green amenities - across different socio-economic and racial groups (Walker 2009; Lazarus 1992; Schlosberg, 2004). Wealthier, predominantly white neighborhoods typically enjoy greater access to these green spaces. In contrast, poorer and often racially diverse communities are frequently underserved, leading to what scholars describe as 'green space inequity' and 'environmental racism' (Pulido, 1996; Kern and Kovesi, 2018).

In contemporary studies, the largest critique of the green city orthodoxy has expanded to include more nuanced concepts such as green gentrification and its associated

conceptual kin – such as green gaps (Anguelovski et al., 2019) or green rents (Anguelovski, 2023). This scholarship examines how neoliberal urbanization intersects with urban greening initiatives to create socio-spatial inequalities, which often result in the displacement of historically marginalized residents to more affordable and often more grey, polluted, and climate-exposed areas. This is in large part because processes of neoliberal urbanization very often prioritize economic growth and market mechanisms over social equity and intrinsic and placed based valuations of nature (Kotsila et al., 2021). This often results in the privatization of public spaces and deregulation of building codes, zoning laws, and environmental protections that favors private real estate development (see box 1) (Schilling and Logan, 2008; Anguelovski et al., 2024; Dell'Anna, Bravi and bottero, 2022). This shift has profound implications for urban spaces, driving redevelopment and beautification projects that increase property values and attract higher-income residents. This process can displace long-standing, lower-income residents, as rising living costs force them to relocate. Green gentrification thus highlights a 'green paradox' (Anguelovski et al., 2018; Du and Zhang, 2020) where environmentally motivated 'improvements' lead to social displacement, worsened inequalities with regards to access to green and blue space, and negative impacts on physical and mental health (see box 2). Green gentrification scholars (and activists) denounce the appropriation of EJ struggles for greener neighborhoods to the detriment of historically marginalized and racialized residents.

Box 1.

Does greening generate exclusive residential real estate development? Contrasting experiences from North America and Europe.
Urban Forestry & Urban Greening (2024): 128376

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With the branding of a city as green increasingly serving to amplify attractiveness andinvestment while also contributing to patterns of green gentrification, the incentive to link real estate development and green space is growing. Yet, little is known about the extent to which this incentive has generated a spatial relationship between green space and newly constructed housing at the city-wide level and in ways that can be compared between cities. This gap in knowledge makes it difficult to precisely indicate the implications for housing rights, affordability, and broader goals of urban green justice. In response, this study explores quantitative trends in 26 mid-sized North American and European cities, utilizing greening and real estate data from the last three decades. Results show that greening becomes a more significant driver of development over time and that operates to attract development in a growing number of cities, although more so in US cities. Next, in order to contextualize the quantitative results, we employ qualitative field data gathered through field work in Atlanta and Amsterdam. We contrast the greening and development trajectories of these cities by examining implications for housing rights and social justice, accounting for the fact that those cities exhibit different green gentrification trends, as demonstrated in the literature. Green gentrification is indeed a proxy for understanding housing justice implications in the relationship between greening and development. We find that Amsterdam's legacy of housing rights and policies acts as a protection against growing inequities embedded in the relationship between urban greening, development, and gentrification. In contrast, Atlanta embodies patterns of historic racial segregation and continued gentrification of Black neighborhoods which urban greening has further intensified. This analysis shows that greening can attract real estate development across a city, but the implications need not always be harmful to social equity.

Adding to the exploration of the material, social, and emotional injustices associated with 'urban greening', the discursive power of sustainable urban development – encompassing its social meanings and future imaginaries – is increasingly being recognized as fundamentally intertwined with its economic idealogy and associated sociomaterial repurcussions. Research in this area is shedding light on the connections between 'green branding' of cities or neighborhoods and inequitable (urban) green (re)development (Garcia-Lamarca et al. 2021; Shokry et al. 2022; Lewartoska et al. 2024; Dunlap 2017). Urban green branding is most visible in global and regional 'competitions' wherein 'green capitals' (European green capital award), 'sustainable cities' (Sustainable Cities and Human Settlement awards), 'livable cities' (International Awards for Livable Communities), or 'climate-smart Cities' (C40 Cities Awards) are highlighted as 'best practice' examples, establishing standards to which other cities *ought to* strive towards in fears of being left behind (Roy and Ong, 2011). The mere *application* to some of these competitions plays a significant role in shifting the dominant frame of urban (re)development of city halls and requires and consumes a meaningful amount of energy and time of city officials. The status of 'green capital', however, has been argued to offer little in terms of increasing the quality of urban environments in spatially just ways (see chapter 1) and can instead be a demonstration of greenwashing practices.

Box 2.

Gentrification Pathways and their health impacts on historically marginalized residents in Europe and North America: Global qualitative evidence from 14 cities
Health and Place 72 (2021): 102698

Authors:

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As global cities grapple with the increasing challenge of gentrification and displacement, research in public health and urban geography has presented growing evidence about the negative impacts of those unequal urban changes on the health of historically marginalized groups. Yet, to date comprehensive research about the variety of health impacts and their pathways beyond single case sites and through an international comparative approach of different gentrification drivers and manifestations remains scarce. In this paper, we analyze qualitative data on the pathways by which gentrification impacts the health of historically marginalized residents in 14 cities in Europe and North America. We build on 77 interviews with key neighborhood stakeholders. Data analysis indicates four main concurrent processes: Threats to housing and financial security; Socio-cultural displacement; Loss of services and amenities through institutional gentrification; and Increased risks of criminal behavior and compromised public safety. Gentrification is experienced as a chain of physical and emotional community and individual traumas – an overall shock for historically marginalized groups – because of permanent pressures of insecurity, loss, state of displaceability, and the associated exacerbation of socio-environmental disadvantages.

'Vienna's Gleis 21 project: A model of sustainable urban living'. 'Barcelona's superblocks transform city living to combat climate crisis'. 'Medellin's green corridors: a breath of fresh air in urban planning'. 'Freiburg's Vauban: A Model Neighborhood for Sustainable Living'. These are headlines coming from global news stations such as DW, international finance institutions like the World Bank, and think tanks such as the World Economic Forum to highlight what they deem as 'best practices' in sustainable urban

development. As green interventions in specific locations continue to be carried out, their travelling, or flow, onto different urban fabrics occurs through the creation of networks (Goh, 2021). Ideally these networks would bring together the private sector, academic and research institutions, international organizations, government agencies, NGOs, and grassroots organizations, fostering collaboration between diverse actors (ibid). However, the coloniality of dominant epistemologies may lead to circumstances, for example, in which a group of Dutch water management experts lead a global network of urban climate adaptation professionals who, through a homogenization of strategies which overlooks local contexts and voices of local communities, can exacerbate existing inequalities and vulnerabilities as opposed to more placed based approaches (ibid). We can see, then, that a 'green orthodoxy' has not only 'gone global' due to its elevation to a 'hegemonic social imaginary' but importantly also as an ongoing colonial relationship the West exerts onto the 'rest'.

1.2.2 Green (social/spatial/radical) imaginaries

A diverse, yet interconnected, range of literatures, such as urban environmental justice (Garcia-Lamarca 2021; Anguelovski et al. 2020; Neidig et al. 2023), urban environmental sociology (Angelo ; cite), critical human geography (Watkins 2015), urban political ecology (Gabriel 2015; Kaika and Swyngedouw 2014), and degrowth (Varvarousis 2019) operationalize the notion of the *social imaginary* in their analyses to explore how collective beliefs, symbols, and shared understandings shape and are shaped by the ways in which urban environments and nature are conceived, created, and managed. Hillary Angelo (2019, 2020) emerges from this group with a thorough and provocative investigation into nearly 150 years of urbanization in Germany's Ruhr region to offer an intricate outlining of a '*green* social imaginary' through the lens of *urbanized nature*. Key features in this outlining are the movement from green being a substantive, direct good, towards green becoming an indirect, or moral desire to be sought for. This then causes 'green' to become wrapped within the language of universality wherein green is always good and its benefits will reach all layers of society through a natural 'trickle-down effect process'. As 'green' is depoliticized, then, uneven power dynamics promote a certain *form* or *type* of 'sustainable urban development', although all manifestations of the green imaginary view their own *type* of green in positive light. Through this lens, Angelo critiques the dominant form of sustainable urban development, revealing how the hegemonic manifestation of urbanized nature is biased towards urban experiences, romanticizes and commodifies nature, and treats it merely as a backdrop for urban life (Angelo 2021). Joining the masses, this perspective argues for more inclusive and diverse understandings of nature that go beyond the urban-centric viewpoint.

Although greening is indeed a social imaginary being operationalized by various actors for different normative visions of society – in other words having reached a wide level of legibility and largely being accepted as truth without excessive popular questioning –, I see no reason to why we must *only* use this frame of thinking and analyzing to further critique the state and neoliberal capital through the lens of 'green/sustainability'. Put differently, focusing instead on radical manifestations of urbanized nature - or those

imaginaries which aspire for a society that continuously builds and evolves its institutions (Castoriadis, 1987)—may offer a way to chart progressive and emancipatory transformations from within existing conditions (Swyngedouw 2023: 38). In other words, shifting our focus away from 'urban greening' in its top-down, large scale, hegemonic manifestations towards the non-hegemonic, radical imaginaries may help "...to contribute to the realization of [just] sustainable futures" (Temper et al., 2018: 747). Placing attention on radical, non-hegemonic green imaginaries and revealing alternative visions for or functions of urban nature may play a role, albeit small, in bringing grassroots movements into the network of ecological flows (Goh, 2021) while enhancing our understanding of how urbanized nature is manifesting in local contexts.

Viewing greening as a social imaginary illuminates the persistent 'city vs. nature' binary within urban planning. This perspective reveals that the operationalization of green as a cure for urban ills inadvertently underscores a separation from nature. For instance, projects like the *Parc dels Tres Turons* (park of the three hills in Catalan, discussed in chapters 4 and 5), which integrate housing within park areas, exemplify how certain types of greening can deepen this divide rather than bridging it. The concept of green often becomes a superficial remedy, failing to address the underlying disconnect between urban environments and natural ecosystems.

This insight is significant as it highlights how the dominant imaginary perpetuates a misunderstanding of the metabolisms between cities and their surrounding environments. It becomes evident that there is a critical need for a better comprehension of the relationships between space and scales within urban planning. This understanding is not only crucial for developing more integrated and holistic approaches to urban development, but in building more integrated and holistic critiques to the urbanization of nature as well by highlighting imaginaries which are being invisibilized.

When shifting an analysis from the *social* to the *radical* imaginary, space is shown to be integral to uncovering alternatives to the instituted society (Stoetzler and Yuval-Davis, 2002; Khasnabish, 2008; Asara, 2020). Transitioning from the social to the spatial imaginary is thus a crucial step in this shift in analysis. While the social imaginary focuses on shared beliefs and values within society, the spatial imaginary considers how these beliefs are materially and spatially manifested in urban environments. This shift is essential for understanding the practical implications of these imaginaries and their impact on urban planning and development. In other words, a shift towards analyzing spatial imaginaries in their radical manifestations pushes for an understanding and outlining of the relationship between discursive action and material change. In aiming to continue down this path, I next outline how all of these conceptual and theoretical endeavors led me to believe in the importance of engaged and situated research practices which manifested through political action research.

1.2.3 Scholar activism

Environmental justice research has rich roots in scholar activism – starting as a grassroots movement within marginalized communities and evolving into a more formalized academic discipline (Frickel, 2004; Taylor, 2011; Martinez-Alier et al., 2011). Despite this focus on engaging in direct action and aiming for your outputs to be politically provocative and impactful, EJ scholarship has been critiqued for its historical shortcomings in alleviating environmental injustices (Noonan 2008). One such critique argues that EJ's exportation, from its historical roots in the United States to areas across the Global Souths, drives colonial understandings of power and justice in both scholarly and activist circles (Robinson 2018; Alveraz and Coolsaet 2020). In other words, forcing epistemologies or ways of seeing and existing in the world onto other histories and spaces with little to no contribution to addressing inequalities on the ground.

As EJ scholarship has evolved, however, so too have its conceptual and methodological underpinnings. 'Second wave' EJ scholarship (Pellow, 2018), through this expansion, has pushed boundaries and argues for a continued and necessary engagement with new tools in methodologies, new ways of seeing and communicating at the intersection of research and civic activism, in the aim to counter injustices playing out in real time. With recent research arguing academic projects on urban sustainability to be "engag[ing] with justice in ambiguous and often tokenistic ways…" which "[may] therefore reproduce injustice[s]" (Lugar, Kotsila and Anguelovski 2022: 15-16), this shift becomes ever-more important. In the end, following decades of academic and activist energy being poured into outlining the environmental injustices being experienced throughout the world, perhaps it is time to focus on recouping alternatives to the system we so thoroughly critique (see box 3). As Swyngedouw (2023) recently asked, would moving beyond a mere 'critique' towards "chart[ing] the contours that might permit a progressive and emancipatory transformation from within actually existing conditions and possibilities" (ibid) not represent a truly critical approach to research?

Approaches to 'scholar-activism' take many shapes and sizes, ranging from community engaged research (CER) (Mikesell et al., 2013), situated research (Simonsen et al., 20021), political action research (PAR) (Noffke, 2009; Kemmis, 2013), militant research (Halversen, 2015; Ruiz-Cayuela forthcoming), participatory action research (PAr) (Baum et al., 2006), advocacy research (Gilbert, 1997), or emancipatory research (Oliver 1997) – all containing their own rich scholarly traditions. The dominant approach to this thesis, namely political action research, did not emerge as a chosen approach, but rather best outlines my involvement with social movements which emerged 'naturally' through broader engagement with activists throughout Barcelona by the research group where I am based. Knowing this, political action research is understood to be a method where researchers actively engage in political movements or campaigns as part of their research process (Kemmis 2013). This type of research is explicitly geared towards political change, with researchers often participating in protests, advocacy, or policymaking and in turn refining their research by taking the learning from this participation into consideration.

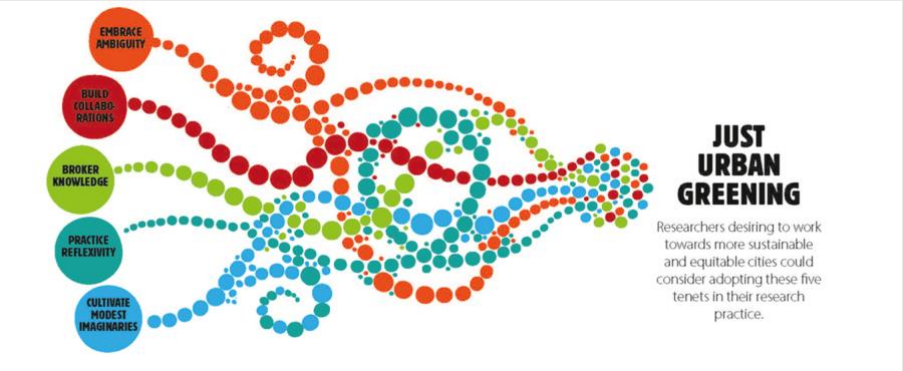
PAR focuses on participatory methods to bring together diverse groups of participants from communities or neighborhoods where environmental inequalities are particularly stark and researchers are committed to using their resources and projects to bring in those participants to address them in some ways. Ethnographic and narrative methods like storytelling and autoethnography document experiences, while critical and reflexive methodologies analyze power dynamics (Noffke 2009). Focus groups and workshops can foster community engagement, provide deep insights, build trust, encourage collaborative problem-solving, and support action-oriented outcomes. Throughout my dissertation, my research was co-developed, implemented, and accompanied by visual and creative methodologies, such as participatory mapping events, public information sessions at civic centers, a cine forum night, and meetings with various levels of the city administration.

Box 3.
The intersection of justice and urban greening: Future directions and opportunities for research and practice
Urban Forestry & Urban Greening 95 (2024): 128279.

Authors:

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The global uptake of green infrastructure in urban settings holds considerable promise for fostering both social and ecological benefits. Recognizing the imperative to ensure equitable distribution of these advantages, this paper draws on the rich traditions of justice considerations within urban studies to inform research on urban greening. Focusing on three key trends - reconceptualizing the 'urban' category, acknowledging the role of historical processes in shaping contemporary uneven and unjust geographies, and considering power dynamics in infrastructure development - we propose five tenets for advancing justice-focused urban greening research. These tenets encourage researchers to act as knowledge brokers, practice reflexivity, recognise the complex dimensions of justice which diversity of scale might reveal, embrace uncertainty, and cultivate a “modest imaginary” concerning infrastructure projects.



Engaged approaches, such as PAR, are argued to be crucial to (urban) environmental justice (research) because it directly involves and aims to empower affected communities, striving to ensure their voices are central to the research process and outcomes/outputs (Bacon et al., 2013). It delivers context-specific solutions and actionable insights that may inform policies and practices due to academics’ priviledged

poisition in the eyes decision makers due to our enrollment in 'formal' institutions (Godden et al, 2020). Engaged research practices may also better build trust and foster long-term partnerships, seen as essential for sustained environmentlal justice efforts. Its interdisciplinary approach provides comprehensive insights, while its flexibility allows for adaptable and responsive research. Overall, I engaged in these research practices not only because they generated valuable knowledge for my dissertation but also because they may contribute to driving meaningful, community-led change towards cities which are green *and* just for all.

1.3 Research Objectives, Design, and Gaps

1.3.1 Research objectives and design

This section delineates the primary research objectives and questions that have steered the overall research framework and the individual empirical chapters. Within, a comprehensive structure of the thesis is supplied, captured in table 1. Subsequently, I will conclude with an examination of the research gaps in which the collection of works in this doctoral dissertation aim to exist.

Drawing from the above expanded scholarship exploring contemporary green urbanisms, as well as various approaches to scholar-activism, the broad objective of this thesis is to uncover the injustices arising out of the green city orthodoxy as well as how these injustices are being contested from residents and citizens on the ground. This thesis holds at its core the quite simple and open ended question of: ***what are the social limits to the green city orthodoxy and how is it contested from below?*** The thesis is then structurally split into two general empirical sections that present my research: section a) Uncovering the Green City Orthodoxy and section b) Countering the Green City Orthodoxy. In the exploration of this broad objective, my research was steered by the following sub-research questions:

Table 1. Summary of thesis output

Output	Research Question	Study focus/objective	Methods & Data
SECTION A.	---	---	---
Chapter 1. **A Green Capital for All? Austerity, Inequalities, and Green Space in Bristol** First-authored book chapter published in , (expanded for the	how do austerity measures influence the implementation and outcomes of green initiatives in cities like Bristol, and what are the broader implications for social equity and sustainability?	A focus on the historic evolution of an urban greening discourse and the implications of its enrollment in austerity politics;	Qualitative: Semi-structured interviews with activists, decision makers, and developers in; deductive coding;

purposes of this thesis)			
Chapter 2. **Urban Greening and Gentrification: Evidence from 28 Global North Cities** Collaborative article published in (Anguelovski et al., 2022)	to what extent does the introduction of new public green spaces attribute to gentrification, and how does this vary across different urban contexts and time periods?	28 mid-sized cities in Europe and North America; to determine the extent to which variation in new public green- spaces added during a given time period explains gentrification in the period immediately following, in the presence of covariates.	Quantitative: Spatial autoregressive Bayesian model to measure city-wide spatial trends of green gentrification across 28 cities across 9 countries in North America and Europe.
Chapter 3. **Exploring Green Gentrification In 28 Global North Cities: The Role Of Urban Parks And Other Types Of Greenspaces** Collaborative article published in Environmental Resaerch and Letters 2022	How do different greenspace typologies influence gentrification processes, and how do these effects vary across time periods and geographical contexts?	28 mid-sized cities in Europe and North America; empirical evidence on the relationship between greenspaces and gentrification regarding associations with different greenspace types remains scarce.	Quantitative: Spatial autoregressive Bayesian model to measure the types of green space most associated with green gentrification across 28 cities in 9 countries in North American and Europe
SECTION B.	---	---	---
Chapter 4. **Illuminating Radical Spatial Imaginaries: Counter-Mapping Environmental Justice Struggles For The City Yet To Come** First-authored article accepted in Environment and Planning E: Nature and Space 2024	What radical imaginaries and intersecting needs does counter-mapping reveal vis-à-vis the green (neoliberal) city orthodoxy?	Construction of a conceptual framework to understand radical spatial imaginaries and their materialities; To understand and make visible the radical spatial imaginaries of urban environmental justice movments in Barcelona	Qualitative: Semi-structured interviews; document analysis; open coding; discourse analysis
Chapter 5. **Urban Green Extractivism: nature-based disposession and popular organizing against Barcelona's *Parc dels Tres Turons*** Single authored paper submitted to Antipode in September 2024	how does 'green extractivism' manifest in urban (re)devevlopment projects (like in Barcelona's Parc dels Tres Turons), and what are the socio-ecological consequences for existing communities?	A critical analysis of the realities surrounding the *Parc dels Tres Turons* in Barcelona; to critique the particular *type* of park being constructed through the lens of 'urban green extractivism'; to highlight already existing socio-natures and placed based, idealized futures	Qualitative: Political action research; ethnographic field notes; informal interviews; document analysis; participant observation
Chapter 6. **A Space of Possibilities:**	What is the role of situated research and researchers in that	Reflection of one day event co-organized between ICTA-UAB	Qualitative: Participant observation; focus groups; open coding

Situated Research from/with *La Casa dels Futurs* First authored article (Type: Intervention) published in Antipode 2023	transformative and climate-justice driven process? What role can/do researchers/activists play in the other extending/achieving legitimacy?	researchers and activist group *Casa dels Futurs*	

I explore these research questions in six (four first-authored, two co-authored) standalone empirical chapters, deploying both qualitative and quantitative methodologies throughout the thesis. While the second section of the thesis focuses solely on Barcelona, the first section places its focus outside of Barcelona as to speak more broadly to and highlight the globalized reality of the the 'green city orthodoxy'.

1.3.2 Research gaps

The topic of 'research gaps', in my experience, which may be true for all, is a deeply personal journey of exploring 'gaps' in my personal understandings and curiosities through the recognition and exploration of 'gaps in the literature'.

The first section of this adventure began with an opportunity to explore through what mechanisms a city achieves the title of being a 'green capital' in a context of austerity politics and how this 'label' plays out in favor of real estate developers and 'green finance' while at the expense of historically deprived wards. By situating these processes within the broader history of environmental activism in Bristol and the ongoing impacts of austerity and neoliberalism on the British population, I was first able to gain a deeper understanding into the dynamics of contemporary urban environmental justices (Chapter 1). In the two following chapters, I was able work with a team which was developing novel methodologies to conduct large scale and intricate quantitative studies of green gentrification in Europe and North America (Chapter 2 and 3). Through this experience, I was offered the chance to take part in cutting edge research around the main themes of my thesis, pushing forward not only mine but the literature at large's understanding of the varying roles the (re)development of urban green spaces has on gentrification patterns. From the integration of austerity politics and 'urban greening' initiatives in the analysis of economic, social, and environmental realities in Bristol, to offering a novel methodological approach to measuring and analyzing green gentrification, this section offers unique approaches to analyzing contemporary 'green' realities.

Through an intense focus on building my own understanding of how contemporary urban greening dynamics are unfolding, I was pushed towards needing a change in my analytical focus. As I began to examine more deeply the literatures discussing the discursive power of *urbanized nature*, my focus then shifted towards the grassroots, as outlined above. From here, the personal drive for uncovering research gaps was theoretically 'closed' – with the focus of my research then emerging through and from activist struggles. The personal experience, however, was far from closed and rather

became a central aspect of my research. This personal journey continues on now as I continue to explore the vast literatures on engaged research practices.

Section two begins with a personal necessity to 'have a grasp' on the wide ranging literatures which operationalize and explore the term of the 'social imaginary'. Through a brief engagement with the literature, I was left dumbfounded, feeling I had very little idea of what the term denotes as I felt it to be deployed in a wide range of literatures for very different purposes (perhaps the term social imaginary has become a social imaginary…). After months of hairloss due to a continued state of misunderstanding, I then finally emerged with a conceptual framework which allowed myself to understand the term and how it may be deployed within my research. This conceptual framework was then operationalized to analyze a 'map' which was developed by our research lab, in collaboration with social movements throughout Barcelona, as to amplify their struggles, reveal the ulitity of the conceptual framework, and thus reach peace in my relationship with the concept of the 'social imaginary'. Chapter 5 then zooms in on one of the 13 case studies from chapter 4 – namely Barcelona's *Parc dels Tres Turons*. Chapter 6 then offered me a chance to reflect on my more 'politically motivated and engaged research' with other researchers and activists, allowing me to further reflect on my position within (my) research and how to foster more just approaches to the research process.

Put more 'formally':

The first section of the thesis addresses the imperative to broaden our comprehension of the historical and ongoing interplay between green (re)development and gentrification processes, paying specific attention to a 'best case example' of the 2015 European Green Capital of Bristol, UK in the context of enduring austerity politics. The next two co-authored chapters then respond to the necessity of enhancing our methodological tools and approaches, thereby deepening our understanding of green gentrification trends across different geographies and time periods. By examining these dynamics, the thesis aims to contribute to a more nuanced perspective on how green initiatives intersect with and potentially drive gentrification, highlighting the complexities and varied impacts of these processes (Long, 2016; Angelo, 2019; Anguelovski et al., 2022; Sax et al., 2022).

Section two is largely driven from an emerging critique from the fields of urban political ecology and urban environmental justice. Put succinctly in Swyngedouw's recent *'Critique of (urban) political ecology'* (2023), "there is nothing inherently critical or progressive about the current state of 'political ecology', urban or not, neither as a practice nor as a theoretical perspective" (ibid: 38). A 'truly critical' approach to studying and analyzing the city would move beyond mere 'critique' towards "chart[ing] the contours that might permit a progressive and emancipatory transformation from within actually existing conditions and possibilities" (ibid). A drive to map already existing circumstances and opportunities lead me to engaging in activist-centered research and pushed me to uncover the following research gaps:

Chapter 4 begins with a simple question posed to the growing literature which is examining the discursive power of (urban) greening – its social meanings and imaginaries of the future. Although consensus is growing around Angelo's conceptualization of *urbanized nature*, the literature continues to maintain a focus on critiquing the hegemonic, mainstream ideas about greening while giving less attention to counter and subaltern imaginaries and their development and meaning (see Oscilowicz et al. 2023). This then led me to delve further into the expansive literature on the 'social imaginary', wherein I ask: If a social imaginary is being operationalized by various actors with different normative visions for society, why must our attention be so heavily placed on critiquing the instituted society? This interest was also fueled by several critiques highlighted throughout my broad literature review of the social imaginary as a concept and its deployment within urban climate research (Delanty 2021; Varvarousis 2019). These critiques highlight that the expanding use of the social imaginary in the social sciences is greatly reducing the concepts worth, through mutating it into a state of vagueness at the expense of precision. This then has hindered the formulation of a robust framework to explain diverse empirical case studies. In response, this chapter offers a conceptual framework through which to analyze the performance of radical spatial imaginaries before then operationalizing this framework to empirically analyze 13 struggles for environmental justice in Barcelona through a counter-mapping exercise.

Moving on, chapter five uses the lens of 'green extractivism' (Dunlap et al., 2024) to offer a holistic critique of the Ajuntament de Barcelona's plans for the 'new' *Parc dels Tres Turons*. While largely a rural lens, the notion of 'green extractivism' is deployed as an analytical frame through which to uncover the extractivist nature of the 'new' park and large scale urban green infrastructure (re)development more broadly. I examine how the leveraging of socioecological and climate crises is used to bolster existing markets or create new profit-generating opportunities and the way in which ecological sustainability claims are used to justify extraction. Through engaging in PAR, I analyze informal interviews, ethnographic field notes, and document analysis from my extended fieldwork to highlight how the city of Barcelona's planning of the PTT is socially and spatially selective, washes over placed-based histories and current uses of already existing green space, drives unjust housing practices, sacrifices an area already overburdened with tourism, all while laying the ground for the future gentrification of the area. This findings not only emerge through a critical analysis of the city's plans for the PTT but also from the critiques emerging from social movements in the area. My analysis shows that already the existing mixed-use park which weaves housing throughout would represent a path towards green and just futures through an acceptance/recognition of already existing socionatures in the periphery of Barcelona. Socionatures which may not be driven by a thirst for modernity.

The last chapter represents a reflection on conducting situated research from/with academics and activists. Through co-conducting a workshop on situated research practices and the co-analysis of data and our personal emotions after the event, the co-

organizers and I came to find that the emotional aspect of conducting situated research is a much less discussed aspect in the literature. Oftentimes this underplays the caring and stimulating space offered to academics from social movements to collectively reflect on our previous experiences and future desires. Through engaging in this reflection during this event, we were able to highlight key facets for establishing just processes for situated research – namely understanding research as a process, the importance of from where and for whom agendas and frameworks are developed as well as the importance of language(s), and lastly the importance of the (connections to) place. Importantly, the text represents a call for local government to open up empty and underused properties to climate and other social justice movements as to provide access to spaces to organize, share resources, and educate communities on placed-based issues and as to foster possible avenues towards just futures.

Overall, this thesis aims to address critical gaps in our understanding of the complex and often contradictory processes underlying urban greening and gentrification, particularly in the context of differing political and social landscapes. By examining cases such as the austerity-driven green branding of Bristol and the more progressive, yet still contentious, green politics of Barcelona, this research sheds light on how these dynamics play out in diverse urban settings. The thesis links these contexts to the broader concept of green extractivism, revealing how neoliberal urbanization processes can co-opt environmental sustainability narratives to serve economic interests, often at the expense of social equity.

Through a multi-faceted approach, this thesis underscores the magnitude and scope of green injustice, particularly through the lens of green gentrification. By combining quantitative analyses from the two collaborative papers with qualitative insights from the examination of activism in Barcelona, it highlights how green initiatives, while seemingly beneficial, can perpetuate or even exacerbate socio-spatial inequalities. This research also emphasizes the critical role of activism from below, both in challenging the dominant green city imaginary and in proposing alternatives that prioritize social justice. Activist movements in both Bristol and Barcelona are shown to be pivotal in revealing the overlooked or unaddressed consequences of urban greening, as well as in exposing the hypocrisies inherent in top-down green city projects, such as those observed in the Parc dels Tres Turons development.

Furthermore, the thesis reflects on the role of Participatory Action Research (PAR) in supporting and amplifying civic movements, while also acknowledging the limitations of research in effecting change. By engaging directly with communities and activists, this work not only critiques the shortcomings of the green city orthodoxy but also contributes to the development of more just and equitable urban futures. However, it also recognizes the inherent challenges in aligning academic research with grassroots activism, particularly in terms of the power dynamics and resource constraints that can limit the effectiveness of such collaborations.

In conclusion, this thesis provides a nuanced and critical examination of urban green development, emphasizing the need for a more inclusive and socially just approach to creating sustainable cities. It highlights the importance of acknowledging and addressing the varied and often hidden impacts of greening initiatives, and it calls for a more engaged and activist-oriented research agenda that can better support the pursuit of just and sustainable urban futures.

Table 2. Core concepts

Concept	Definition	Chapters
Green city orthodoxy	a prevailing set of beliefs or principles emphasizing the importance of environmental sustainability in the (re)development and management of urban spaces.	All
Green gentrification	the process where environmental improvements in urban areas, such as parks and green spaces, lead to the physical, social, and/or cultural displacement of lower-income residents due to rising property values and living costs.	All
Social imaginary	the shared set of values, institutions, norms, and symbols through which people imagine and make sense of their collective social reality. It shapes how individuals perceive their society, relationships, and roles within it, often influencing collective actions, identities, and social practices.	1, 4, 5
Spatial imaginary	"...cognitive frameworks, both collective and individual, constituted through the lived experiences, perceptions, and conceptions of space itself" (Wolford 2004: p. 410). Spatial imaginaries are understood through three core types: place (define a space of distinction, bounding a place as unique (Chang and Lim 2004; Etham 2005), spatial transformation (narratives of how places should, or deterministically will, evolve through generalized processes of spatial transformation (Boudreau 2007; Lamar and Le Heron 2002; Massey 1999, 2005)), and idealized space (descriptions of kinds of places, disseminating general stories about their universal characteristics (Chang 2010; Ealham 2005; Golubchikov 2010; Jaffe 2012).	5
Radical Imaginary	the ability to imagine life and social institutions not as they currently exist but as that which might be brought into being, the radical imagination is situated in place(s) and emerges from the process of building alternatives and 'acting otherwise' in alternative spaces of social reproduction, spheres of values, and social cooperation" (Khasnabish 2008: 153-157).	5
Green extractivism	Four key facets: (i) leveraging of socioecological and climate crises to bolster existing markets or create new profit-generating opportunities,	4

	(ii) the use of ecological sustainability claims to justify extraction, (iii) green extractivism is intrinsically connected to conventional extractivism, and (iv) green extractivism is based on false assumptions about the renewability of 'resources' or existences.	

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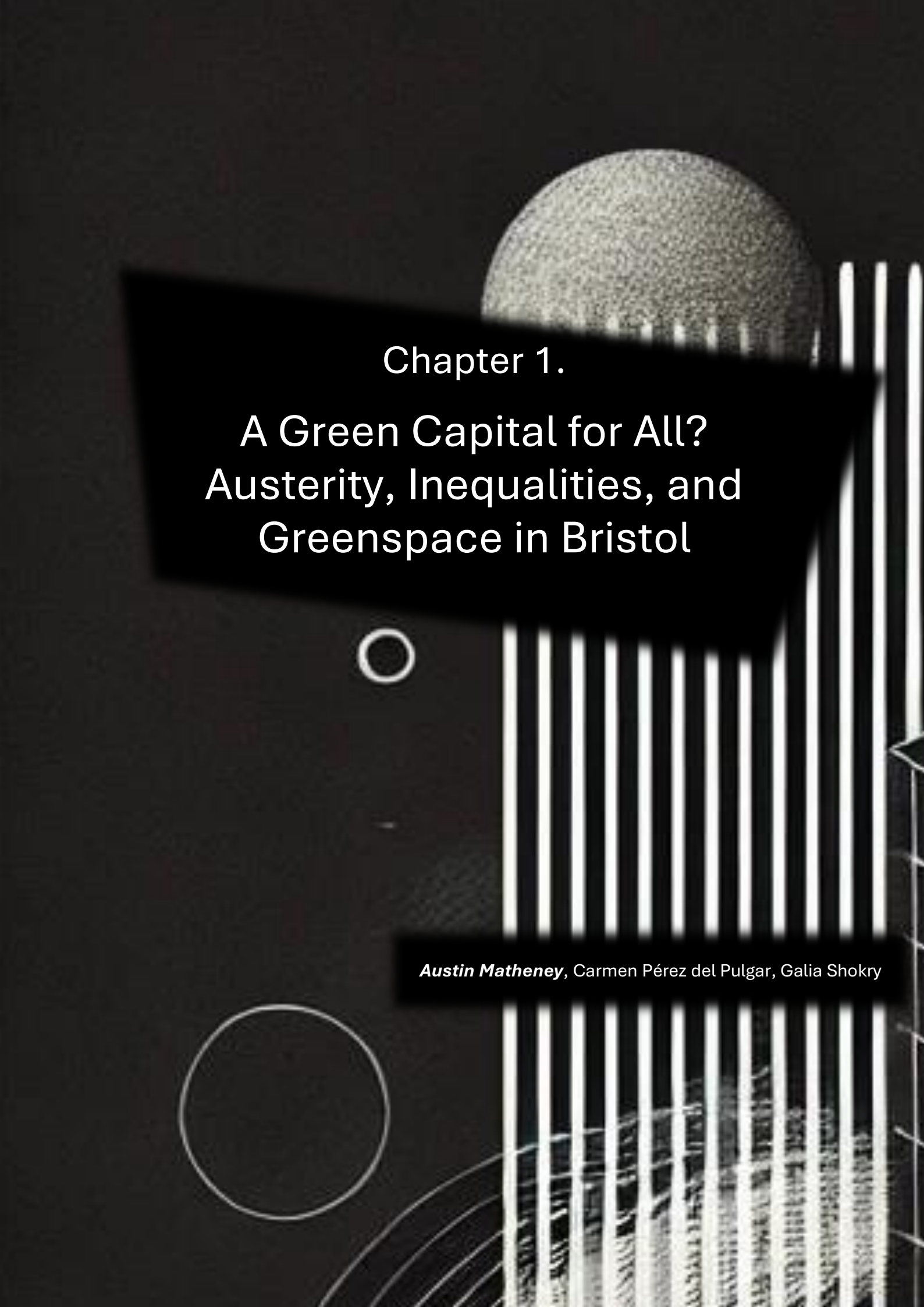
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Chapter 1.

A Green Capital for All? Austerity, Inequalities, and Greenspace in Bristol

Austin Matheney, Carmen Pérez del Pulgar, Galia Shokry

Chapter 1. A green Capital for All? Austerity, Inequalities, and Green Space in Bristol[9]

This chapter represents a personal starting point in the aim to better understand the urban realities within the green transition. Since 2010, there have been 15 cities who have won the award of Europe's 'Green Capital'. After three unsuccessful attempts/applications (2010-2012), Bristol refined its approach and focused heavily on its environmental initiatives – drawing on its over 50 year history of environmental activism – and was awarded the title in 2015. The city's unwavering drive to achieve this title reveals a locally held imaginary of being a leader in urban sustainability, which, as discussed below, is not unfounded. Taking this history and new title together, an attraction to analyze Bristol's green trajectory and contemporary relalities was birthed. How is a city which has historically been a leader in urban sustainability transformed after achieving international recognition and the wider integration of sustainability intiatives within city official plans? How have national and global socio-economic regimes, such as ongoing austerity policies, impacted green realities and green goals? And how have this new identity and new green plans impacted intense and ongoing housing inequalities throughout the city? By exploring these questions in Bristol, through qualitative methodologies, we are able to highlight how not everything that is labelled 'green' is necessarily just. For the first time in the thesis, we being to see the key role played by communities and social movements in both achieving a 'green' status and also in maintaining 'just sustainabilites' (Agyeman et al., 2016) to the best of their ability.

Introduction

The southwestern port city of Bristol (UK) stands as a prime example of the promises and contradictions entwined within the identity of a 'green' or 'sustainable' city. Celebrated for its long history of environmental activism which has now collided with ambitious environmental policies and initiatives, Bristol has crafted an image as a pioneer in urban greening. This was cemented with their winning the title of Europe's 'green capital' in 2015. However, this image is riddled with complexities. While Bristol's green projects are designed to benefit the environment and its inhabitants, the benefits of urban green initiatives are not evenly distributed. Instead, they often amplify existing social inequalities due to low-levels of governance capabilities as an effect of ongoing and continuing austerity policies. In contrast with other (self-)branded green cities, Bristol combines some level of usually seen public investment in urban greening with a unique heavy reliance on community groups and volunteer efforts to maintain green spaces. This paper delves into these contradictions through a core research question of *how do austerity measures influence the implementation and outcomes of green*

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initiatives in cities like Bristol, and what are the broader implications for social equity and sustainability? This inquiry not only seeks to fill a gap in the literature, but by placing contemporary realities within a historical analysis of Bristol's 'green image', aims to better unravel the complex dynamics of urban greening, austerity, and social justice.

Austerity involves government policies aimed at cutting public spending and increasing taxes to reduce national debt, typically implemented in response to economic crises. These measures are rooted in neoliberal economic theory, which advocates for reducing the role of the state in the economy to enhance market efficiency. Austerity policies often result in a significant contraction of public services, with local governments bearing the brunt of budget cuts. This reduction in public spending limits their capacity to manage and fund urban development, maintain public spaces, and support community projects, including those related to green initiatives and environmental sustainability. The impact is particularly severe in marginalized areas where public investment is most needed.

The concept of austerity is closely linked to the broader neoliberal strategies of "roll-back" and "roll-out" policies (Davies and Blanco, 2017). "Roll-back" neoliberalism refers to the state's retreat from its traditional roles and privatization of certain functions, such as welfare provision and public service maintenance, which are seen as (cost) burdens on economic growth. In contrast, "roll-out" neoliberalism involves the active creation of new institutions and policies that promote market-oriented governance, often leading to privatization and deregulation. In the context of urban development, austerity-driven roll-back policies can lead to the municipal neglect of public spaces and green areas (Smith, 2021)while roll-out strategies may prioritize private real estate development over community-oriented publicly-funded projects (Bailey, 2014).This dual process reinforces social inequalities and diminishes the public sphere's role in fostering inclusive urban environments. In Bristol, austerity-driven budget cuts have hindered the fair distribution of the benefits derived from the city's elevation to a green capital status.

Despite the extensive literature on green cities and sustainable development, our understanding of the intersection of austerity measures, urban greening initiatives, and implications for equity and justice remain limited. The paradoxes of green capitalism become apparent in cities striving to maintain their eco-friendly status and claim to deliver a high quality of life – a status that helps municipalities often attract new residents, projects, and developments – amid severe, continuing budget constraints. Budget cuts which place an unfair burden on community groups to maintain green spaces while also necessitating the city council to search for new avenues of funding which are often found in the reduction of new social housing.

Specifically, green branding has emerged as a critical element of urban identity and a tool for enhancing a city's global competitiveness (Zameer, Wang and Yasmeen, 2020; Demaziere 2020; Gulsrud, Gooding and Konijnendijk, 2013; Lyulyov et al., 2024). As cities increasingly seek to position themselves as leaders in sustainability, they employ

various strategies to project a green image. These include pursuing international environmental accolades, such as the European Green Capital award, and undertaking high-profile projects like New York City's High Line, which transforms urban spaces into sustainable, attractive landmarks. Additionally, green branding often involves the promotion of local sustainability initiatives that can spread through 'green diffusion' (Ruiz-Campillo, 2022; Hakjelberg 2014). For example, Barcelona's "superilles" (superblocks) concept, initially a local initiative, has transcended its origins, influencing urban policies and branding efforts across different contexts, from London to New York or Los Angeles. This diffusion illustrates how green interventions can be appropriated by various actors, enhancing the city's green image and creating networks of urban practitioners beyond its borders.

As mentioned above, the motivations behind green branding extend beyond environmental stewardship. Cities engage in these practices not only to address ecological concerns but also to enhance their appeal to global investors, tourists, and residents (Busch and Anderberg, 2015; Moreira, 2023). By showcasing eco-friendly infrastructure, sustainable transport systems, and green public spaces, cities aim to cultivate an image of modernity, innovation, and responsibility. This form of 'green boosterism' is closely tied to neoliberal urban governance, where the focus on economic growth often drives the push for green branding (García-Lamarca et al., 2021).

Yet, green branding is often fraught with significant controversies, particularly around issues of greenwashing and social and housing justice (O'Neill, 2024; Connolly and Anguelovski 2021) Greenwashing occurs when cities present themselves as environmentally progressive and sustainable without making substantial or meaningful changes to their practices. Copenhagen serves as a notable case study in this regard. While the city has heavily marketed itself as a pioneer in urban sustainability and green living, its branding efforts have sometimes been criticized for masking underlying social and environmental issues. Rutt (2022) builds on this critique by examining the broader political and racial dimensions, arguing that Copenhagen's green initiatives are deeply intertwined with neoliberal policies that prioritize market-driven solutions. These policies, she notes, disproportionately benefit wealthier, predominantly white neighborhoods, while sidelining immigrant communities and other marginalized groups.

Bristol further showcases the complex and often dual nature of green branding. On one side, the city earns praise for its environmental efforts, such as renewable energy projects, extensive cycling infrastructure, and lush green spaces. On the other side, ongoing deficiences in providing an affordable and dignified housing stock as well as the negative impacts of city-wide gentrification, which is undoubtedly influenced by the city's newly packaged green status, continue to manifest in a segregated manner throughout the city. In Bristol, the push for green development occurs alongside austerity measures that limit public spending on social services and exacerbate economic disparities by providing loopholes to developers to limit or remove social housing in new developments through the addition of 'green amenities',leaving deprived

wards green spaces undermaintained, or selling advertisement space inside of green spaces. This paper seeks to devle into the specific impacts of austerity policies on the implementation and effectiveness of green projects in Bristol from the point of view of social equity. By doing so, it highlights the need for a more nuanced understanding of the relationship between (national) economic policies and (local) environmental goals.

The primary goal of this paper is to explore the impact of austerity measures on the implementation and outcomes of green initiatives in Bristol, with a particular focus on the broader implications for social equity and sustainability. Through a case study approach, this research seeks to answer the core question: *how do austerity policies influence urban greening efforts, and what are the resulting social impacts and consequences?* The methods employed include semi-structured interviews with key stakeholders, document analysis, and a historical review of Bristol's environmental activism, ensuring a comprehensive understanding of the local context. After exposing the empirical methods of this study, the paper is organized into three main sections: the first examines the socio-economic landscape of bristol and its history of environmentalism, the second analyzes the impact of austerity on specific green projects, and the third discusses the role of grassroots movements in maintaining just sustainabilities (Agyeman et al. 2016) to the best of their abilites. The argument presented here is that while Bristol's green branding has been effective in boosting its global image, the austerity-driven approach to urban greening continues and sometimes worsens the provision of social housing, drives the NGOization of greening and the privitization of green projects which positions new green projects away from working class neighborhoods, all while unfarily placing a burden on community groups, especially in these working-class areas.

Methods

This study employs a case study approach, focusing on Bristol as a representative example of a city navigating the complexities of green urbanism under austerity. Following Yin's (2018) guidelines for case study research, Bristol was selected for its well-documented green initiatives and the clear presence of austerity measures in its policy landscape.

The study incorporates multiple sources of evidence to ensure a comprehensive and valid analysis. Semi-structured interviews were conducted with a diverse group of stakeholders, including city officials, environmental activists, community representatives, and local residents. These interviews provided in-depth insights into individual experiences and perspectives regarding Bristol's green initiatives and their socio-economic impacts. In addition to the interviews, document analysis was performed on key greening plans from the city government. This included a thorough examination of policy documents, strategic plans, and official reports related to urban greening efforts. Complementing this, a historical analysis of Bristol's history of environmental activism was conducted as to understand the changing landscape of environmental activism in the city as well as how radical environmental approaches

have been integrated into city hall policies, as well as how austerity measures have influenced and driven injustices in such a green-focused city.

The qualitative data gathered from the interviews and document analyses were systematically coded using a detailed codebook developed as part of a larger European project aimed at exploring the dynamics between urban greening and gentrification across multiple cities, within which Bristol was one of many case studies. Thematic coding and pattern matching were used to identify key themes and patterns that reflect the complex interplay between environmental sustainability efforts and socio-economic outcomes in Bristol.

All in all, this study aims to contribute to the expanding body of literature on green urbanism by scrutinizing the specific challenges and contradictions that arise when environmental sustainability is pursued under the constraints of austerity. Through a focus on a green capital such as Bristol, we gain critical insights into inequalities in urban greening through the lens of austerity, better understand the intersection of austerity, greening, and housing (in)security, as well as recognizing the key role of grassroots movements in acting as counterpoints to top-down policies. Before delving into interview analysis, the next section presents Bristol's context of a two-city post-industrial divide. The analysis of qualitative data takes a historical lens in order to contextualize the evolution of Bristol's green initiatives within the broader socio-political landscape, tracing how past environmental policies, grassroots activism, and austerity measures have intersected over time to shape current urban greening practices and their socio-economic impacts.

Green, post-industrial transformation in a tale of two cities: Bristol, UK

Once one of England's most important port cities throughout the Atlantic slave trade, Bristol has since aimed to reposition itself as a 'green capital' in both the UK and Europe. Heavy bombing during WWII and the downstream relocation of the city center docks in 1968 provided Bristol with an opportunity to redevelop its physical and natural environments while restructuring its economy. Since then, however, the redevelopment of vacant lots and industrial lands in line with the needs of the growing aerospace, creative media and financial sectors, as well as the proposal of new motorways, have occurred alongside persisting inequalities. Strong land use policies aimed at maintaining over 1,500 hectares of accessible green space within the city's boundaries were joined with goals of becoming a carbon-neutral city, plans for sustainable transport, green infrastructure and school programs such as the One Tree One Child program. While the city's focus on the creation of new green space has since then been eclipsed by a focus on energy efficiency and carbon neutrality, Bristol's greening strategy won the city the EU's European Green Capital Award in 2015.

Access to the progress of the city's green transformation, however, continues to be experienced unequally within a segregated city. Home to over 463,000 people, Bristol is one of the least deprived English Core Cities but contains 41 of the 10% most deprived areas of England, including three among the top 1%, which are often adjacent to some of the country's least deprived areas. As the city's population continues to grow, in large part influenced by the arrival of new residents from London and the retention of university students, a 'tale of two cities' has grown to define Bristol.

This two-city divide becomes clearly evident when crossing the New Cut, a man-made channel, from the city center into South Bristol. According to the 2019 indices of deprivation, the ten most deprived neighborhoods in Bristol are all in South Bristol. These high levels of social deprivation are not new. Following WWII, South Bristol and particularly the areas of Hengrove, Hartcliffe, and Withywood were the site of new council housing estates which significantly increased the population of the area. These new housing developments, however, were not met with the necessary infrastructural developments, leaving South Bristol disconnected from the rest of the city. A lack of public transportation, alongside dwindling employment opportunities, continues to play major roles in the area's socio-economic deprivation. This deprivation is also reflected in the area's green spaces. While home to an abundance of open space, including its border with the Avon Green Belt to the south, a majority of this green space is informal and of low quality. Recently, the city's attempts at bringing formal green space to the area have come into conflict with attempts to provide residents with new and affordable housing and employment opportunities.

The environmental paradox: Sustainability amidst inequality in Bristol

This chapter's historical empirical analysis below reveals how Bristol's development, from a key port city to a green capital, is fraught with contradictions that exacerbate – or at the very least do not resolve – existing broader socio-economic inequalities. The city's efforts to balance environmental sustainability with economic and social needs have often resulted in uneven outcomes, particularly in South Bristol. The analysis underscores the long-standing deprivation in this area, which persists despite various large-scale greening initiatives. To restate, the argument developed in this paper asserts that although Bristol's green branding has effectively bolstered its global stature, the approach to urban greening underpinned by austerity has intensified social inequalities. This reality points to not only to the pressing need for sustainability strategies that prioritize inclusivity and equity but also the need for systematic change if we are to develop cities that are truly green and just.

From grassroots to institutionalized greening

Much of the greening of the city throughout the 1990s and 2000s can be attributed to the continued activism of Bristol's environmental movement. Starting with the movement's

earliest actions in the 1960s, groups such as Bristol Friends of the Earth (BFoE) and Sustrans continue to impact the city and nation to this day. Throughout the late 20th century, activists fought against the construction of new motorways and increasing dependence on private automobiles, created and maintained community green spaces, pushed forward recycling efforts, and demanded housing and energy justice for the most deprived wards. Put differently, Bristol's environmental movement was built upon a foundational understanding of the intimate relationship between socio-economic and environmental issues, with one member of the city hall highlighting how "Bristol has always had [this] mindset…recognizing that environmental and social issues are interconnected…going decades back" (member of Bristol City Hall).

The projects spearheaded by Bristol's environmental movement in the late 20th century illustrate the city's commitment to sustainability and social justice. Between 1979 and 1986, the nonprofit Sustrans, then known as Cyclebag, constructed the 13-mile Bristol and Bath railway path and set in motion Bristol's transition to becoming Britain's first Cycling City in 2008.8 The organization has since grown into a UK-wide charity organization with George Ferguson, the man who led their first demonstration, becoming Bristol's first elected mayor in 2012. When the city halted the collection of wastepaper recycling in 1980, members of BFoE took over and later expanded to collect cans, glass and textiles, all while employing Bristol's youth. This recycling scheme eventually led to the creation of Resources Futures, a waste consultancy organization work- ing with clients ranging from local authorities to the national government and multinational corporations.9 In other words, the work of Bristol's environmental movement had already begun to create a reputation of Bristol as a green and progressive city in the 1980s, a reputation which continues to attract new residents to the city.

As the environmental movement grew, however, it was met with the early years of Thatcherism, marked by significant cuts to public spending on social services and the introduction of policies favoring privatization. This included the reduction of subsidies for public housing, the sale of council homes under the 'Right to Buy' scheme[10], and the dismantling of government support for industries, leading to widespread unemployment. These economic challenges were compounded by an economic recession and growing civil unrest through- out the UK. A police raid of the Black and White Café in Bristol's Inner East in 1980 triggered what is commonly known as the St Paul's Riot. In addition to the racial discrimination the Afro-Caribbean community faced through the Sus Law —a stop and search tactic which unequally targeted youth of color—the riot highlighted longstanding inequalities in housing stock, education, employment, exposure to pollutants and quality green space experienced by neighborhoods of the Inner East (Townsend et al. 1985).

[10] The 'Right to Buy' scheme, introduced in the UK in 1980 under Prime Minister Margaret Thatcher, allowed tenants of council houses (public housing) to purchase their homes at a discounted price. The goal was to encourage homeownership and reduce the role of the state in housing. While the scheme enabled many families to own their homes, it also led to a significant reduction in the stock of public housing, contributing to long-term shortages in affordable housing.

Growing discontent with the progress of the previous decades culminated in the 1990s becoming recognized as a period of environmental direct action (EDA) throughout the UK (Doherty, Plows and Wall 2007). In Bristol, as one respondent notes, "there was quite a lot of stuff happening in the 90s, you know, road protests and things like that. That was a time when we were really starting to see a lot of direct action on environmental issues. It wasn't always organized but it was certainly impactful" (member of Climate Transitions[11]). Despite the environmental movement of the previous decades having fought against the construction of new motorways, they were unsuccessful in halting the construction of the first section of the M32 motorway, which continues to split the neighborhoods of St Paul's and Easton to this day and contribute to the city center's illegal levels of air pollution. While nationwide EDA of the era primarily maintained an anti-road focus, EDA in Bristol expanded to rally against the continued loss of green space throughout the city. Direct action was taken in 1992 against the construction of a new Tesco supermarket on an open green space with activists squatting in a row of lime trees for over 90 days before being removed on live television. Despite this direct action, which was to occur again in 2011 in what came to be known as the Tesco Riots, the supermarkets were built.

As is clear, the roots of Bristol's green reputation in 2021 can be traced back for decades. However, so too can the environmental movement's inability to bring about lasting material change against corporate power in the context of an increasingly neoliberalized state. An institutional rearrangement of the region in 1996, seeing Bristol's transition from being under the administration of the Avon City Council to a unitary authority, offered the environmental movement increasing say in the (re)development of Bristol's physical and natural environments. This institutional rearrangement saw the decades-old struggles of the environmental movement become adopted in 1997 in Bristol's first citywide progressive planning document (*The Bristol Local Plan)* in over 20 years.

A green capital with limited and selective greening

More than fifteen years before the Green Capital Award, after five years of debate and modifications, the 1997 Bristol Local Plan set out to protect green space, to tackle the city's transportation issues related to the lack of public transit, congestion and air pollution, and to deliver new and affordable housing.1The plan placed emphasis on (re)developing the city center and South Bristol, aiming to (re)develop the now derelict city docks into an area of culture, heritage, business, tourism and leisure, while

[11] Climate Transitions in Bristol, founded in 2022, is a community-based initiative focused on ensuring a fair and inclusive transition to a sustainable future. Operating under the Bristol Climate & Nature Partnership, the group is not a government entity but collaborates closely with local communities and NGOs to develop and implement climate action plans. Their efforts are centered on integrating climate action with social justice, particularly supporting disadvantaged communities as Bristol moves towards a low-carbon economy. This grassroots initiative aims to create a more resilient and equitable city by addressing both environmental challenges and social inequalities.

attention to South Bristol noted the historical deprivation of the area and its continued disconnection from the city center and northern wards.



Image 1. A view of the M32 motorway (photo by Galia Shokry)

Over the next decades, the local plan would be supplemented and replaced by numerous planning documents whose focus included access to and maintenance of quality green space (2008 Parks and Green Space Strategy), neighborhood-level supplementary planning documents (SPDs) (e.g., 2006 Planning for a Sustainable Future for St Pauls SPD10), a resilience strategy (Bristol Resilience Strategy 2016) and ending the 'tale of two cities' reputation (One City Plan 2020).

The council's approach to green space management was laid out in the 2008 Parks and Green Space Strategy, which set out quality, quantity, and distance standards aimed at ensuring all Bristolians live within a 15-minute walk of a formal green space and maintaining eight square meters of green space per resident. While nearly 90% of residents already lived within 300 m of parklands and waterways, the 2008 strategy noted a significant amount of this to be poor-quality, informal green space that is underused because it is perceived as less safe and inaccessible. The One City Plan (2020) pushed the city's greening aims further by aspiring to double the city's tree coverage in 25 years. This aspiration, however, would require the planting of nearly 54 hectares of new trees every year throughout this period, as roughly 100 hectares of trees have been removed since the adoption of the 1997 Local Plan.

Central to the One City Plan is not only the ambition for environmental sustainability but also a strong commitment to health and wealth equality. The plan explicitly focuses on ensuring that these green initiatives contribute to reducing health disparities and improving access to quality green spaces for all residents, particularly in deprived areas. This is part of a broader strategy to "ensure Bristol builds a meaningful legacy from its year as European Green Capital," by creating a city where "life chances are not

determined by wealth and background," thus linking environmental goals directly with social justice objectives (Our Bristol Plan, 2020). However, as noted by Marvin Rees, then Mayor of Bristol, in the plan, "the challenge is that while we have a great story to tell, this prosperity is shared by too few people in Bristol," highlighting the ongoing disparities in access to high-quality green spaces despite the city's ambitious environmental and equality goals (Our Bristol Plan, 2020).

Geographically, a city's plans have collectively recognized South Bristol as a key site for regeneration, due to the area's large amount of low-quality open space alongside historic deprivation. Together, these plans aimed to bring employment opportunities, higher density housing and formal green space to the area. For example, the city's largest brownfield site (76 ha) has become the site for a new park. Previously an airfield and a garbage dump, the Hengrove Park Leisure Center opened in 2012 and now hosts open space for dog walkers, children's play equipment, a skatepark, toilet facilities, climbing frames, a sports center, a bingo club, a cinema and 1,450 new homes. The regeneration of South Bristol continued with the arrival of the Fillwood Green Business Park in 2015. Just across the street from the Hengrove site, the new business park brought small and medium-sized businesses to a new environmentally friendly building while also delivering a new bus line, electric car charging ports, and new pedestrian and cycle routes along the main road.

However, the city's plans to tackle broader environmental issues related to congestion and air pollution have fallen short and continue to negatively affect residents of South Bristol. Not only are 8.5% of the deaths in the administrative area attributed to air pollution, disproportionately impacting Black, Asian and minority ethnic (BAME) populations of the Inner East, but South Bristol continues to suffer economic deprivation due to its poor connectivity to the city center. Heartbreakingly, a young girl from Hartcliffe, in the southern tip of South Bristol, who traveled to the center to discuss child-friendly cities and public transportation with the city council, revealed "it was actually the first time she had been into the city center because her parents hadn't had a car, and they couldn't afford the bus fare" (member of Future Proof Parks[12]). Further attempts to connect South Bristol to the city center via pedestrian and cycle ways have been met with disdain as new lanes have cut through both Victoria Park and the Northern Slope Nature Reserve, with the loss of shrubbery and "through traffic" upsetting local residents.

Within South Bristol, the Northern Slopes, a once vibrant area known for its natural beauty and community spaces, began its decline in the late 20th century due to a combination of social, economic, and environmental factors. The area's gradual

[12] Future Proof Parks was founded in 2018 as part of the National Lottery Heritage Fund's "Kick the Dust" initiative, aiming to engage young people in the care and preservation of local parks and green spaces. The project focused on mentoring and training young volunteers, connecting them with Friends of Parks groups to foster long-term stewardship and ensure these green spaces are preserved for future generations.

deterioration was exacerbated by industrial decline, which led to high unemployment rates and reduced investment in the community. As economic opportunities dwindled, the area saw an increase in social issues such as crime and drug use. This, combined with a lack of maintenance and neglect from local authorities, contributed to the area's reputation as unsafe and undesirable.

Urban planning policies in the late 20th century, which prioritized development and housing over green space, further marginalized the Northern Slopes. The community's needs were often overlooked in favor of more economically lucrative projects, leading to a significant reduction in public amenities and services. Over time, this neglect created a cycle of deprivation, where the area's physical environment deteriorated, and social issues became more entrenched.

As one respondent noted, the Northern Slopes has become an area where even "people who live in the area wouldn't even go … [as it is] very unkept … and there's drugs and there's litter." The green strategy has clearly not reached the Northern Slopes. However, members of the Northern Slopes initiative are "trying to [not only] reframe [themselves], but also reframe the local population" (member of Northern Slopes Initiative[13]). The reframing of this discourse has become a priority for the initiative as an attempt to counter the area's negative reputation being mobilized by the city council alongside developers as an argument for reducing the size of green space and to sell of land for real estate and housing developments. We choose to focus on South Bristol for as it is highlighted throughout Bristol City Council's plans, with a consistent reminder to the vast expanse of 'green space' in the area and thus its importance in the city's wider sustainability initiatives, which has led to several large scale 'green' redevelopments being located in the area.

Continued and widespread housing issues

All in all, the new green projects cannot hide that social needs continue to plague much of Bristol, and South Bristol in particular. Influenced by each new mayor wanting to leave their mark with a new plan and the adoption of standardized policy toolkits from international policy consultants, Bristol has seemingly fallen into a loop of changing everything (in writing) so that little changes (in reality). As new developments continue to fall short in meeting the planning requirements for social housing and green spaces become increasingly exclusive and undermaintained, the council continues to fall short in reaching the goals of health and wealth equality central to their numerous plans.

Lofty aspirations for new housing units were set out for the redevelopment of the city center. The 2011 Core Strategy outlined the city center's continued growth, aiming to deliver 7,400 new homes, of which 40% were required to be affordable. Despite this requirement, as of 2017, only 11% of the 2,368 new dwellings across 11 sites were

[13] The Northern Slopes Initiative, founded in 2000, is a community group dedicated to protecting and improving the Nortern Slopes' green areas. The group works on various activities including conservation, community engagement, and advocating for the area's maintenance and safety.

affordable, with developers citing viability and accelerated delivery as key drivers (Thorning, Balch and Essex 2019). Unfortunately, this occurrence is progressively becoming the norm, as one respondent highlights:

> "there's always policies around the number of units that need to be affordable. But then what tends to happen is that the developers … will then negotiate that downwards. They often get planning permission and then start building and say "now that we're underway we've realized we can't afford to do the … the market won't allow this and that" (former candidate for public office and community organizer)

This process is driven by the fact "the British system is very centralized … so most of the decisions about housing … [are] made by the central government. Local government input is quite weak" (ibid).



Image 2. A tightly packed St Marks Road in Easton (photo by Galia Shokry)



Image 3. View of new housing developments in Northern Slopes (South Bristol) (Photo by Carmen Pérez del Pulgar)

Overall, the city has seen an average of 1,341 homes built per year between 2012 and 2017, with only 12.2% being affordable. This dual state of an increasingly expensive city center, alongside an enduring lack of affordable housing throughout the city heavily influenced by the power of the international real estate investment in the UK, has not only pushed gentrification into central neighborhoods, such as Stokes Croft and Montpellier, but has also led to the loss of green space.



Image 3. (a) Waterfront condos near Millennium Square and (b) advertisement for Whapping Wharf regeneration (photos by Galia Shokry)

One such example is found in the council's plan for a new 1,435 working-class and middle-income units of home development at Hengrove Park. While the plan, approved in February 2020, would also additionally bring a new 22-hectare park, the plan clashes with a neighborhood plan put forward by Hengrove and Whitchurch Park Neighborhood Planning Forum. This neighborhood plan called for higher density homes in order to leave room for a 30-hectare park. Despite this alternative plan being backed in a local referendum, the city council has decided to go ahead with their original plan, at odds with the local community who will be left with less green space than desired.

Approximately 50% of the new homes at Hengrove Park are designated as "affordable," which generally means they are priced at up to 80% of the market rent. However, given Bristol's high market rents, this level of affordability may still be out of reach for many lower-income or working-class families. The remaining homes will be sold at market rates, which are more likely to cater to middle-income earners. Therefore, while the development does include provisions for affordable housing, there are concerns that it may not fully address the housing needs of working-class residents in South Bristol, where the demand for genuinely affordable homes is particularly acute. This reflects broader concerns voiced by community members who argue that even these "affordable" homes may not be accessible to those who need them most in the neighborhood, thereby limiting the project's ability to significantly benefit the city's lower-income population (members of Bristol Parks Forum and Future Proof Parks).

Similar to Whitten's (2019) study of the changing landscape of green governance in London, data analysis shows that the recent arrival of higher end residents to Bristol is

impacting the Bristol City Council (BCC)'s ability to deliver services and affordable housing to its residents. Migration factors including the now relatively short train commute to London, the city's claim to two world-class universities, and its reputation as a green capital have led to the arrival of new higher-income residents and stressed the city's already low housing stock and affordability. And while the city council has recently reinvested in council housing and created its own council housing organization, as of January 2020 more than 13,000 families were still waiting to get a secure and affordable home. This reality is particularly felt throughout South Bristol, with areas like Hartcliffe and Withywood being particularly affected, with long-standing issues of poverty, limited access to quality green spaces, and poor connectivity to the city center enduring. The area's housing stock often fails to meet the needs of its residents, with many families enduring poor conditions or lengthy waits for suitable social housing. These challenges are then exacerbated by ongoing gentrification pressures, further marginalizing existing communities.

Austerity and nonprofit stewardship within neoliberalized green planning

Although some may argue that the title of "green capital" is well-deserved, others disagree. Despite 98% of new business development and 94% of new homes occurring on brownfield sites and reaching the lowest carbon footprint of any British city, some say Bristol is a only "self-proclaimed sustainable city," claiming "there is no real credential to support [it]." This type of argumentation not only cites the continued disparities in deprivation, continued loss and informality of green space, illegal levels of air pollution, and an increasingly unaffordable housing stock, but also claims Bristol's current environmental reputation as being a product of neoliberalized environmental politics, whose middle-class, creative and fun approach to greening may be driving gentrification in the city (Harper 2016). And while progress has undoubtedly been made, why do these issues persist? And more importantly, what social impacts could this persistence have as the city continues its green transformation?

As the provision of green space is still not a statutory requirement of local councils, a 66% decrease in the parks budget from 2013 to 2019 forced the BCC to entertain alternatives to funding these spaces. Reversing their position that all parks would have to become self-sustaining after April 2019, the BCC proposed revenue schemes, such as cafes, parking fees, large events, selling off of particular green space and advertising in parks as a means of funding. Public outcry, however, criticized fee-based services for making parks more exclusive while groups such as Adblock Bristol argued that the introduction of advertising in parks is antithetical to the benefits users experience in parks and green spaces. The Bristol Parks Forum, an umbrella organization representing groups directly involved in the city's parks and green spaces, was able to negotiate that the only green space sold off had little to no use for the public. While communities and the public sector were able to limit the extent to which the BCC implemented their private revenue schemes, the council's budget for the maintenance of green space continues to dwindle, further pushing this task onto the public. As one interviewee

highlights, “the standards set in 2008 [referring to the BLANK PLAN] ensured that everyone in Bristol should be within a certain distance of green space. This has become even more crucial now as budget cuts and land disposals threaten these spaces, making community involvement essential in maintaining them” (member of Bristol Parks Forum[14]).

This transfer of responsibility from public to private space management is not merely a result of local austerity running its course but was rather a vision outlined by the national government in their Localism Act of 2011. From a civic participation standpoint, the act is framed as aiming to relieve citizens of a sense of imposition from the central government and to bring a sense of involvement and stewardship alongside new rights and freedoms, which can be interpreted as new duties and burdens. While offering a re-assessment of the role and responsibilities of local governments, this austerity localism (Featherstone et al. 2012) has been argued to offer little in terms of lasting change for marginalized communities as it is unrolled alongside the short-termism of austerity measures (Lowndes and Pratchett 2012). In other words, as austerity has forced the BCC to turn greening into a profitable enterprise, it has also pushed the responsibilization of parks maintenance and stewardship to local community groups.

While this task has been undertaken by the more than 70 community groups throughout the city, it has proven to be far less efficient than when undertaken by the city council. An appropriate transfer of maintenance “would need [a] huge public infrastructure or … a volunteering system that would license people to drive lawnmowers, tractors, and use chainsaws” (member of Bristol Parks Forum) and would begin blurring the line between civic engagement and unpaid labor. This transformation does not come without a financial and human cost to community groups addition- ally tasked with acquiring funding from groups such as the National Lottery Heritage Fund or relying on section 106 or community infrastructure levy (CIL) payments devolved from the city council.14 While section 106 and CIL payments have added more than 40 million pounds to the city’s revenue in the last decade, with portions of this being devolved to communities, community groups feel they have been left to “fight over the crumbs” (former candidate for public office and community organizer) rather than having their green spaces being maintained and affordable housing needs met.

The resulting tasks and burdens of austerity localism have highlighted who is doing and who can do this unpaid labor. Although South Bristol, a majority white yet deprived area, is home to many community groups devoted to the maintenance of green space, the community infrastructure, like the area’s public transportation, suffers from issues of cohesion, which in turn compromises the capacity of residents and/or civic groups to

[14] Bristol Parks Forum is a community-based organization founded in 2000. It serves as an umbrella group for various community organizations and volunteers who are dedicated to the protection, maintenance, and enhancement of parks and green spaces in Bristol. The Forum is not a government entity but rather a grassroots initiative that works closely with the local government and other stakeholders to influence policies and ensure the sustainability of the city's green spaces.

pursue greening work and defend green investments. Inner East neighborhoods, especially St Paul's, continue to see the lowest levels of organizing. This is however being addressed by groups such as the Green and Black Ambassadors, who conduct community research and projects to encourage stronger dialogue and engagement across BAME and environmental sustainability communities.

Put differently, austerity localism has resulted in wealthier areas having better maintained green spaces while poorer neighborhoods are not as resourced and capable of undertaking the required level of volunteer work and stewardship. As one interviewee noted, "South Bristol is missing out because there's nothing there, there's nothing in that area at all," (member of Bristol Parks Forum) —referring specifically to the lack of formal planting, benches, and well-maintained green spaces that are more prevalent in wealthier parts of the city. While far from the city's first experience with austerity in the 1970s and 1980s, decreases in local council budgets since 2010 have been three times greater than the cutbacks of those decades (Whitten 2019).

Beyond green space, neoliberal roll-back and roll-out policies, respectively referring to "the active destruction" of the welfare state and the "purposeful construction and consolidation" of neoliberal modes of governance (Peck and Tickell 2002, 37), have increasingly led to the selling off of social housing while simultaneously prohibiting local authorities from borrowing money to build social housing or invest in maintenance, all while creating beneficial tax schemes for property investors. These negative impacts on affordability have also been met with the growing NGOization of urban maintenance, social support services, and environmental stewardship previously filled by the public sector.

Discussion

In this chapter, we have explored the complexities and contradictions of Bristol's green transformation within the context of austerity and socio-economic inequalities. While the city has made significant strides in promoting environmental sustainability, these efforts have not been uniformly beneficial across all communities. Rather, greening initiatives have often exacerbated existing inequalities, particularly in deprived areas like South Bristol, where access to quality green space and affordable housing remain limited. The compounding impact of austerity measures highlights the challenges of reaching the plans laid out by the BCC, emphasizing not only the impacts of drastic budget cuts but also the difficulties in achieving policies that operate at differing scales—national austerity measures versus city-level greening initiatives. This analysis raises critical questions about the (weak) requirements needed to achieve the status of 'European Green Capital' in what can be seen like a greenwashing scenario and the broader goals of contemporary urban greening initiatives.

Neoliberalism/Austerity in the green city

This study aims to contribute the field of urban green governance by illumnating how

austerity measures intersect with greening efforts to perpetuate and even exacerbate socio-economic and environmental inequalities. In Bristol, austerity has constrained public funding for green initiatives, leading to uneven development and maintenance of these spaces. This has disproportionately affected deprived neighborhoods, where green spaces are often informal and of lower quality and offer less environmental goods than in wealthier areas. By examining these dynamics, the chapter provides a nuanced understanding of how austerity can undermine the inclusive potential of urban greening, emphasizing the need for policies that explicitly address these urban inequalities.

The research highlights the intersection of austerity, urban greening, and housing insecurity, contributing to the early stages of green gentrification discourse. In Bristol, efforts to create new green spaces and improve environmental sustainability have often clashed with the need for affordable housing. This has led to tensions and conflicts, particularly in South Bristol, where development plans for green spaces are at odds with local housing needs. The chapter highlights how austerity-driven policies create a false dichotomy between building affordable housing and pursuing urban greening projects. This "either/or" approach often prioritizes greening over housing, ultimately worsening displacement and housing insecurity in vulnerable communities. This intersection is critical for understanding the broader implications of green gentrification, whereby environmental improvements can increase property values through the removal of social housing and without the sufficient construction of new housing, which eventually and potentially displaces vulnerable populations.

Green boosterism/Urban green branding

The chapter also sheds light on the vital role of grassroots movements in advancing urban greening under the pressures of austerity. In Bristol, grassroots organizations have historically been at the forefront of environmental activism, pushing for sustainable practices and equitable green space distribution. Despite the contemporary challenges posed by austerity, these movements continue to advocate for inclusive and community-driven greening initiatives. The research highlights how grassroots efforts can serve as critical counterpoints to top-down policies, ensuring that the benefits of urban greening are more equitably distributed. This contribution further emphasizes the importance of supporting and empowering local communities to participate in and shape green governance.

However, this relationship underscores a double-edged sword in the context of grassroots involvement in urban sustainability initiatives. As community groups mobilize to maintain their green spaces in response to budget cuts, their success paradoxically provides governments with a rationale to further reduce public spending on green infrastructure. This phenomenon is well-documented in urban studies, where scholars such as Rosol (2012) and Checker (2011) discuss how neoliberal governance strategies co-opt community efforts, turning grassroots activism into a form of unpaid labor that

ultimately supports the retrenchment of the state. These dynamics illustrate how grassroots movements, while crucial in advocating for more equitable urban environments, can inadvertently reinforce the very austerity measures they seek to challenge. To avoid this, there is a need for a more integrated approach that balances community empowerment with sustained public investment, ensuring that grassroots efforts are not exploited to justify continued disinvestment by the state.

The Capitalist Envelopment of Urban Greening and the Need for Systemic Change

Examining austerity through the lens of greening, particularly in the case of Bristol, reveals how dominant forms of urban greening are deeply enmeshed within capitalist urbanization processes. The study shows that the greening strategies adopted during austerity aren't just about the environment; they are influenced by broader capitalist goals that focus more on keeping budgets tight, staying competitive, and making a profit, rather than ensuring fair environmental benefits. In Bristol, the selective application of green branding and the uneven distribution of green space resources reflect how capitalist logics of urban development often overshadow genuine sustainability goals.

The case of Bristol demonstrates that without addressing the underlying capitalist structures that influence urban greening, efforts to create green cities may only perpetuate existing inequalities. The uneven quality and access to green spaces in different neighborhoods illustrate how market-driven approaches can lead to a form of "green elitism," where sustainability benefits are concentrated in more affluent areas while marginalized communities continue to face environmental and socio-economic disadvantages.

Limitations

This study is not without limitations. The case study approach, while providing in-depth insights, may limit the generalizability of the findings to other cities with different socio-economic and political contexts. Furthermore, the reliance on available policy documents and stakeholder interviews may introduce biases, as these sources may not fully capture the experiences and perspectives of all affected residents. Future research may benefit from a comparative approach, examining multiple cities to draw broader conclusions about the intersection of austerity and urban greening.

Conclusion: "Making our prosperity sustainable"

In sum, the political project of austerity pushed to new levels by the Tory government since 2010 has become a roadblock to Bristol parting with its "two city" reputation and fully embracing its place as a green capital for all. Despite and due to being home to a rich infrastructure of community groups and green organizations which have pushed the city council to embrace health and wealth equality in their many plans, Bristol's green transformation continues to be experienced unequally. While those in historically

affluent wards are able to withstand the effects of austerity and maintain community green spaces, and new affluent residents of the city center experience the benefits of green growth, those in historically deprived wards such as South Bristol continue to bear the brunt of the negative side-effects resulting from austerity (localism). Meanwhile, new green projects are targeting the creative classes, from the green jobs at the Fillwood Business Park in South Bristol to the pedestrianization of the Temple Quarter which is increasingly surrounded by luxury flats and a university campus, which may be making Bristol ripe for green gentrification. This is a reality that the city may not escape if the era of austerity—and thus the transfer of urban greening to the private sector—does not come to an end.

To move towards genuinely green and just cities, there is a need for systemic change that transcends the current capitalist framework of urban development. This involves rethinking how urban greening initiatives are funded and implemented, ensuring that they are inclusive and equitable rather than driven by market forces. Policies must be designed to address these disparities directly, balancing the pursuit of environmental sustainability with social justice and equitable access to green spaces (Harvey, 2005; Gibson-Graham, 2006). Only through such comprehensive reform can urban greening contribute to both environmental sustainability and social equity.

Prologue

This chapter has explored and analyzed the unintended consequences of so-called best practice urban greening. Through the lens of Bristol, we have seen how these initiatives, while ostensibly designed to enhance urban environments, often contribute to continued and worsening inequalities in housing, access to quality green space, and overall socio-economic well-being. Bristol's experience reveals the intimate relationship between contemporary urban greening efforts and the broader injustices they can inadvertently perpetuate, particularly in the context of austerity measures that exacerbate these disparities. As we move forward, our focus shifts from a single city's experience to a broader analysis, expanding our scope to understand the relationship between greening and urban inequalities on an international (global north) scale through the lens of green gentrification.

In this next chapter, we 'zoom out'—transitioning from the specific case of Bristol to an examination of 28 'green cities' across Europe and North America. Here, we introduce a novel quantitative methodology to provide a comprehensive and nuanced understanding of how gentrification and new urban green spaces intersect across diverse contexts and histories. We seek to answer critical questions: Is green gentrification a widespread reality? How does it manifest differently across various geographic and temporal landscapes? And, crucially, based on our findings, what practical tools and strategies can decision-makers employ to mitigate the negative outcomes of green gentrification in their respective localities?

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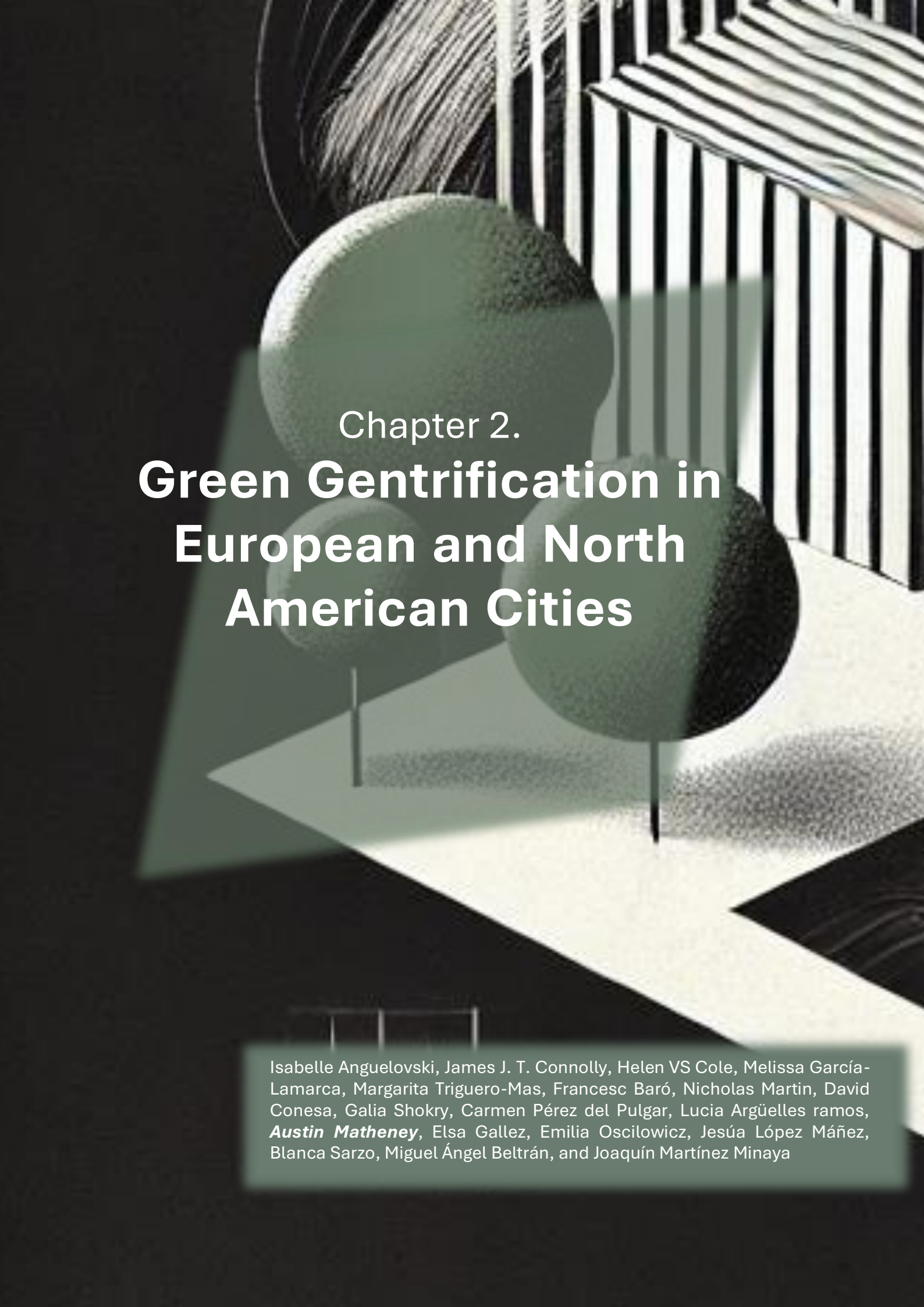
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Chapter 2.

Green Gentrification in European and North American Cities

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Chapter 2. Green gentrification in European and North American cities[15]

Introduction

The value of urban green infrastructure and greenspace in particular is widely recognized for healthier, livable, low- carbon and climate-resilient cities. Some of the benefits include urban cooling and stormwater management (Gaffin, Rosenzweig, and Kong, 2012; Baró et al., 2014; Elmqvist, Gómez-Baggethun and Langemeyer, 2016), climate mitigation through carbon storage or sequestration of urban forests and agriculture projects (De la Sota et al. 2019; Chen 2015), and local environmental benefits that help to manage the health effects of climate change (Huang et al., 2013; Triguero-Mas et al., 2015; Wolch, Byrne and Newell, 2014). Greenspaces and other forms of public places also create or reinforce community ties, civic engagement, and sense of place (Anguelovski 2014; Teig et al., 2009; Fisher, Svendsen and Connolly, 2015; Jennings and Bamkole, 2019).

Yet, large inequalities exist and persist in the distribution of and access to greenspace, especially so by race and income, as the ample literature on urban environmental justice demonstrates. Numerous studies have identified inequities by race and class when it comes to area of accessible parks, park quality, and park maintenance and safety in the Global North, including in the United States (US) (Wolch, Byrne and Newell, 2014; Rigolon, 2016; Boone et al., 2009), France (Liotta et al., 2020), Germany (Wüstemann, Kalisch and Kolbe, 2017), Spain (Baró et al., 2021), and Australia (Mavoa et al., 2015). Empirical research on the topic ranges from an early study of Milwaukee, which pointed at a significant positive correlation between residential tree canopy cover and median household income (Heynen, Perkins and Roy, 2006), to recent research demonstrating that place- based race, ethnicity and poverty factors are important correlates of poor spatial access to parks and other greenspaces (Boone et al., 2010; Baró et al., 2019; Shwarz et al., 2015; Rigolon, Bronwing and Jennings, 2018; Connolly and Anguelovski, 2021; Calderón-Argelich et al., 2021). These inequities in access to green infrastructure and greenspace have been linked with uneven negative ecological and climate impacts in cities (Scholl et al., 2020) and attributed to a historical and social context that produced and entrenched patterns of exclusion, segregation, or unequal urban development more generally (Anguelovski, Connolly and Brand, 2018).

Most recently, scholars have pointed at the so-called green- space paradox (Connolly, 2018; Gould and Lewis, 2017; Haase et al., 2017), by which seemingly laudable

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municipal strategies of restoring degraded urban environments, creating greenspace, or deploying climate-adaptive green infrastructure improve an area's attractiveness while resulting in increased property values, housing prices, and physical displacement of working-class residents and racialized groups and cultures— ultimately serving as a gentrifying force through a process known as green gentrification, environmental gentrification, or climate gentrification (Gould and Lewis, 2017; Gould and Lewis, 2018; Anguelovski et al., 2019; Shokry, Connolly and Anguelovski, 2020; Elmgqvist et al., 2019; Keeler et al., 2019). Urban greening initiatives might thus become "disruptive green landscapes" (Triguero-Mas et al., 2021) or what some have called Green Locally Unwanted Land Uses for historically marginalized groups (Anguelovski, 2016).

Consequently, green gentrification concerns have folded new planning conundrums into already complex environmental and climate justice challenges (Gould and Lewis, 2018; Wrathall et al., 2019; Anguelovski et al., 2020). To the extent that interventions become embedded in processes that contribute to the displacement of the very residents urban greening was often meant to benefit, new green infrastructure can undermine municipal goals of shifting toward climate-responsive cities for all (Ürge-Vorsatz et al., 2018; Cole et al., 2019; Cole et al., 2017; Solecki et al., 2018). They can also compromise calls for transformative, equity-based climate action focusing on vulnerable groups (Rosenzweig and Solecki, 2018; Romero-Lankao et al., 2018). In short, urban greening can become a "wicked" problem for climate and sustainability initiatives, highlighting both the presence of strong competing interests underpinned by unequal power structures (Sovacool, Linnér and Goodsite, 2015) and the need to examine its social impacts beyond climate adaptation or mitigation benefits (Shi et al., 2016). This quality generates the general hypothesis of the green gentrification literature: Urban greening in a neighborhood during a given time period contributes to or accelerates gentrification in that neighborhood during the period immediately following.

Thus far, all quantitative studies of green gentrification in the Global North find substantial support for the green gentrification hypothesis (Cole et al., 2019; Rigolon and Németh, 2020; Pearsall and Eller, 2020; Anguelovski et al., 2018; Kim and Wu, 2021; Donovan et al., 2021; Ali, Haase and Heiland, 2020; Schinasi et al., 2021; Chen et al., 2021; Du and Zhang, 2020; Maantay and maroko, 2018; Immergluck and Balan 2018). However, other than a few exceptions (Shokry, Connolly and Anguelovski, 2020; Rigolon and Németh, 2020; Anguelovski et al., 2018), these analyses do not proceed from multivariate measures of gentrification and thus do not necessarily conceptualize or operationalize the complex nexus of changes happening across social, cultural, and economic arenas within gentrification.

Rather, most quantitative studies examine single characteristics of social change as the outcome, such as changes in the percentage of wealthier residents (or residents' income), racial or ethnic characteristics, housing prices, and, in some cases, residents' occupation. Findings reveal that changes in the percentage of white residents are often revelatory indicators of green gentrification (Pearsall and Eller 2020), while other studies

identify increases in housing prices (Rigolon and Németh, 2020; Kim and Wu, 2021; Donovan et al., 2021; Du and Zhang, 2020; Maantay and Maroko, 2018; Immergluck and Balan, 2018); in median household income (Rigolon and Németh, 2020); in college-educated residents (Rigolon and Németh, 2020; Kim and Wu, 2021); loss of African-American residents (Kim and Wu, 2021); of Hispanic residents (Schinasi et al., 2021); or of residents from the Global South (Anguelovski et al., 2018) as key indicators reflecting gentrification. Meanwhile, gentrification is sometimes removed as a concept in favor of "neighborhood change" with new parks being shown to impact change variables such as residential composition, in- and out-flows of residents, housing costs, housing vacancies, and an area's reputation (Ali, Haase and Heiland, 2020).

Beyond the conceptualization of gentrification, one important tension that remains unresolved within the green gentrification literature is the question of where and when greening plays a primary versus a subsidiary role relative to other factors fueling gentrification. Some studies expose this tension by examining the context of greening through the introduction of control variables at the (a) neighborhood level (e.g., percentage of non-white residents) and at the (b) citywide level (e.g., percentage of vacant housing). These studies, for example, point to the importance of greenspaces linked with gentrification being concentrated near existing gentrifying neighborhoods. In Philadelphia, neighbor- hoods with new public greenspaces located in proximity to other gentrified neighborhoods are found to be more susceptible to gentrification than those located farther away (Shokry, Connolly and Anguelovski, 2020; Pearsall and Eller, 2020). These studies also point to the importance of a critical density of greenspaces. In New York City, the number and percent area of greenspaces in a census tract are identified as having a strong positive impact on property values (Du and Zhang, 2020) and as positively correlated with gentrification (Connolly, 2018) while this trend is not necessarily as clear with per capita income (Maantay and Maroko, 2018). Another recent study (Du and Zhang, 2020) conducted in New York City included area of greenspace within census tracts as a control. Other studies, such as the US-wide study conducted by Rigolon and Németh (2020) found that new parks located close to city centers tend to trigger gentrification regardless of their size and function (function is related to offering infrastructure for active transportation). Interestingly, their finding holds true for small parks, which contrasts with other studies in the US and China in which small parks are not linked with gentrification (Wu and Zhang, 2021; Chen et al., 2021). Last, the effect of new greenspaces has been linked with the quality of housing stock and park design. New parks in Barcelona located in post- industrial neighborhoods with rehabbed or new housing are more associated with gentrification than those located in neighbor- hoods with mass housing built from the 1950s–1970s50, as are greenspaces with more esthetic and recreational value to users (Maia et al., 2020).

In this study, we address several limitations in the existing literature through our test of the green gentrification hypothesis across 28 cities in 9 countries of Western Europe and North America (Fig. 1). Our data allows for a more comprehensive analysis than previous studies on green gentrification because our cities are representative of a diversity of

growth and greening trajectories; we develop a unique internationally comparative multivariate measure of neighborhood gentrification; we identify the role played by greenspaces relative to other drivers of gentrification (previously unstudied controls for other known drivers of gentrification); and we amplify the scope of analysis (citywide and across three decades). Building on this improved data foundation, we use a spatial autoregressive Bayesian model to determine the extent to which variation in new public green- spaces added during a given time period explains gentrification in the period immediately following, in the presence of covariates.

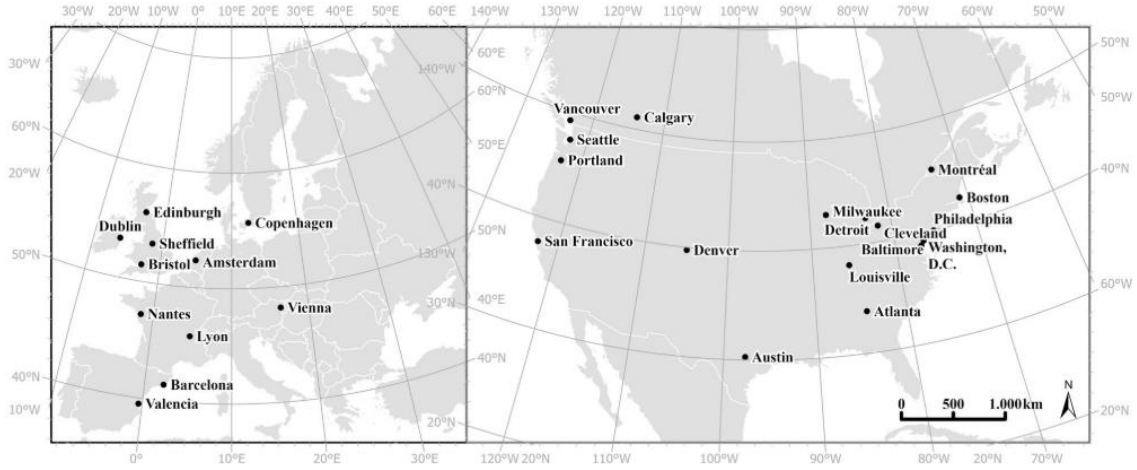


Fig. 1 Locations of the 28 cities included in the analysis. The cities analyzed here (labeled with points) are all mid-sized (500,000 - 1,500,000 population) and are located in 9 countries across Western Europe and North America. Cities were primarily selected to provide a diversity of geographic and growth characteristics.

We employ our model across three time periods (1990s, 2000s, and 2010s) in all neighborhoods of the 28 cities using small-area census geographies as our unit of analysis and accounting for geographic factors not specifically measured within our Bayesian models through the use of a spatial component as a conditional autoregressive term.

Results

Global model.

We employ a Bayesian linear mixed model (in which city and country were considered as random effects) to analyze global relationships across all 28 cities in our dataset. This global model implies that, in general, greenspaces are relevant in the presence of covariates for explaining gentrification across the entire sample during the first two decades of the 2000s (H2 and H3). The results, shown in Table 1, indicate a strong relevant positive relationship between greenspaces inaugurated during Periods 1 and 2 (roughly 1990–2009) and recently emerging gentrification trends during Period 3 (roughly 2010–2016). Results also indicate a positive relevant relationship across all cities considered together between greenspaces inaugurated dur- ing Period 1 (roughly the 1990s) and gentrification that unfolded across Periods 2 and 3 (roughly between 2000

and 2016). Meanwhile, the results indicate a negative, yet weakly relevant relationship between greenspaces inaugurated during Period 1 and gentrification during Period 2. This likely demonstrates that the green gentrification trend overall is a somewhat more recent phenomenon emerging with increased strength over time and some degree of lag as it unfolds, at least in a general sense when considered at the city-level across the many cities we analyze.

The other relationships indicated within the global model include a positive and relevant role for new residential development and city-level Gross Domestic Product (GDP) growth (where included) in explaining gentrification, and a negative and relevant role for closer distance from the city center. While they may have dual roles, we operationalize these variables as drivers, not consequences, of gentrification. For example, regarding GDP growth, we assume that higher economic growth may induce gentrification. It is true that it may also follow from gentrification, but we do not test this potential as we considered it outside our study framework given the hypotheses (Methods section). While these are not standardized covariates, which limits direct comparison, these results point toward a likelihood that gentrification between 1990 and 2016 across all cities studied here was linked with new greenspace and growth initiatives in areas within the city proper and relatively close to, but not usually within, the historic city center. This greening and growth link in gentrifying areas seems to have started to be present in the cities studied here during the 2000s and into the 2010s, while prior to this time the role greening played relative to gentrification was not aligned with growth and development in a general sense.

City-level temporal patterns of green gentrification.

While the global model offers an important overview of the overall relationships between the data in our models, a shift toward city-by- city analysis allows us to deploy a more precise Bayesian model with a spatial weight added as a conditional autoregressive term to understand the potential role of greenspace in explaining gentrification over time. Importantly, this analysis also allows us to identify areas where gentrification took place but greening was not indicated as a relevant variable in explaining it. In all, 17 out of the 28 cities show city-level results that indicate greenspace additions from an earlier time period are relevant for explaining gentrification that occurred during the period immediately following for at least one decade of the 1990s, 2000s, or 2010s. A total of 4 of the 17 cities showing green gentrification trends are European, 2 are Canadian, and 11 are in the US. In all, among the cities studied, we find that green gentrification is more prevalent in North America than Europe, but it is not a solely North American phenomenon, and tests for the effect of region and nation show that the variation is best explained at the city-level. Overall, these results that examine the effect of all new green-spaces within 28 cities show a robust occurrence of likely green gentrification outcomes for at least one decade (i.e., the majority of cities have a citywide effect indicating green gentrification occurred).

Figure 2 demonstrates two main temporal patterns of green gentrification among the 17 cities that display this trend. The first main pattern, which covers 11 of the 17 cities, indicates sustained, or long-term green gentrification across the full time period studied. In these cities, greening predicts gentrification during a period stretching over at least two decades (2000s, 2010s). These sustained temporal patterns are mostly confined to North American cities, especially cities with population and economic growth in the Sunbelt and coastal areas (i.e., Atlanta, Seattle, Vancouver, San Francisco, Washington, Boston, or Denver) or recovering cities (i.e., Louisville, Philadelphia, Milwaukee), with only Barcelona showing this trend in Europe. There are also six green gentrification cities (Austin, Detroit, Nantes, Edinburgh, Copenhagen, Montreal) that indicate a shorter-term temporal pattern wherein the resulting gentrification only took place over one of the three time periods, especially so in most recent years (except for Edinburgh). For these cities, green gentrification is likely present but perhaps more nascent, although limitations in data availability only allow us to draw results for Copenhagen and Edinburgh for the most recent time period, meaning we cannot say for sure in these cities whether there has been a more sustained pattern. Importantly, though, results for all of these 17 cities imply a relevant role for greening in explaining gentrification trends for at least one decade—those "short-term" cases with a more limited temporal extent of the phenomenon should not be seen as cases where there is an absence of green gentrification. For more details on the strength of the associations used to identify these patterns, see supplementary material.

For our remaining 11 cities, the associations we explore show negative or non-relevant relationships between greening and gentrification throughout the study period. Figure 3 shows the temporal pattern and relationships for these eleven cities (see Supplementary Data for the detailed strength of associations). Overall, those cities that present a negative or non-relevant association for citywide green gentrification are mostly European (Amsterdam, Bristol, Lyon, Sheffield, Valencia, Vienna, and Dublin). It is worth noting that in 7 of the 11 cities where greening is indicated as either negative or non-relevant for explaining gentrification (Baltimore, Bristol, Cleveland, Portland, Sheffield, Valencia, Vienna), our models include alternate variables that are potentially relevant for explaining gentrification. In these seven cities, citywide gentrification trends are linked with new development (Baltimore, Bristol, Portland, Valencia, Vienna) or new transit infrastructure instituted as part of widespread urban renewal and development (e.g., Sheffield, Cleveland), but not necessarily with greenspace per se. In other remaining cities (Calgary, Dublin in the earlier period, and Vienna in the earlier periods in particular), our models do not have a good set of relevant variables for explaining gentrification at the citywide level (although some local patterns of gentrification might exist). Last, we also note that data limitations mean we could not run an analysis for all variables/time periods for some of those 11 cities (Bristol, Lyon, Sheffield, Valencia, and Vienna in later periods).

Table 1 Global model results showing strength of effect for each variable in explaining gentrification in the presence of covariates.

	New greenspace from prior period (same as gentrification +2)	Prior green coverage (% of area in 1990)	New residential buildings in prior period (total number)	Population change (city-level)	GDP change (city-level)	City center (distance to)	Tract density (2010)	City size (+/- 1 million)	Time from 1990 (until first time period)
H_1: Composite gentrification score, period 2 (2000s)	−		+ +		++	− −			
H_2: Composite gentrification score, periods 2-3 (2000 + 2010s)	+	− −	+ +			− −		− −	
H_3: Composite gentrification score, period 3 (2010s)	++		+ +	− −	++	− −	− −	+ +	− −

The results were based on a general interpretation as follows: $p > 0.50 \rightarrow$ positive effect on gentrification; $p < 0.50 \rightarrow$ negative effect on gentrification; $p \sim 0.00 \rightarrow$ variable is relevant and negative effect; $p \sim 0.50 \rightarrow$ variable not relevant; $p \sim 1.00 \rightarrow$ variable is relevant and positive effect. Note that new transit data is not included in global results due to a lack of information on variables across all cities.
++ strong positive effect, + positive effect, − negative effect, −− strong negative effect.
Greenspace appears to be an increasing factor in gentrification over time, with relevance shifting from negative 2000s gentrification to positive for 2000-2010s gentrification and strongly positive for 2010s gentrification.

Greening versus other growth-oriented drivers of gentrification

For our final result, we summarize the role played by greening relative to the other potentially relevant covariates in the city-level models. The 17 cities where we find at least one decade of citywide green gentrification can be classified differently according to the extent to which greening is indicated as a stand- alone driver of gentrification or it is enmeshed with other growth- oriented drivers, such as new residential development or new transit infrastructure. In Fig. 4, we identify three types of green gentrification cities based on the degree of relevance (i.e., stronger or weaker) and temporal extent (i.e., longer or shorter in duration) of associations implied by the city-by-city Bayesian model results. We interpret these findings as pointing toward a new typology of the relative roles played by greenspace and other variables in citywide green gentrification processes. The detailed strength and duration of associations of each of the covariates can be found in Supplementary Data (found in the appendice).

In our first type, “Lead Green Gentrification” cities, which include 8 of the 17 identified as experiencing citywide green gentrification, greening is the standout improvement of the built environment playing a relevant and sustained explanatory role over a long period of time in our models. While other qualities of the built environment like density and distance to center might be relevant, other changes to the built environment like new development and new transit are not, and this is the case throughout the entire study period. In short, the green gentrification hypothesis is affirmed most strongly in these cities as it appears that greening, and greening alone, is the main intervention in the built environment that explains gentrification across the city.

In our second type, “Integrated Green Gentrification” cities, which include 6 of the 17 identified as experiencing citywide green gentrification, greenspace is indicated as having an explanatory role that is roughly on par with that of new development and/or new transit in terms of the relevance and temporal extent of association. Here, green gentrification is certainly a real phenomenon, but it is not greening alone that explains gentrification. Rather, greening is mixed up within a set of local interventions working together towards neighborhood redevelopment and, often, broader sustainability initiatives.

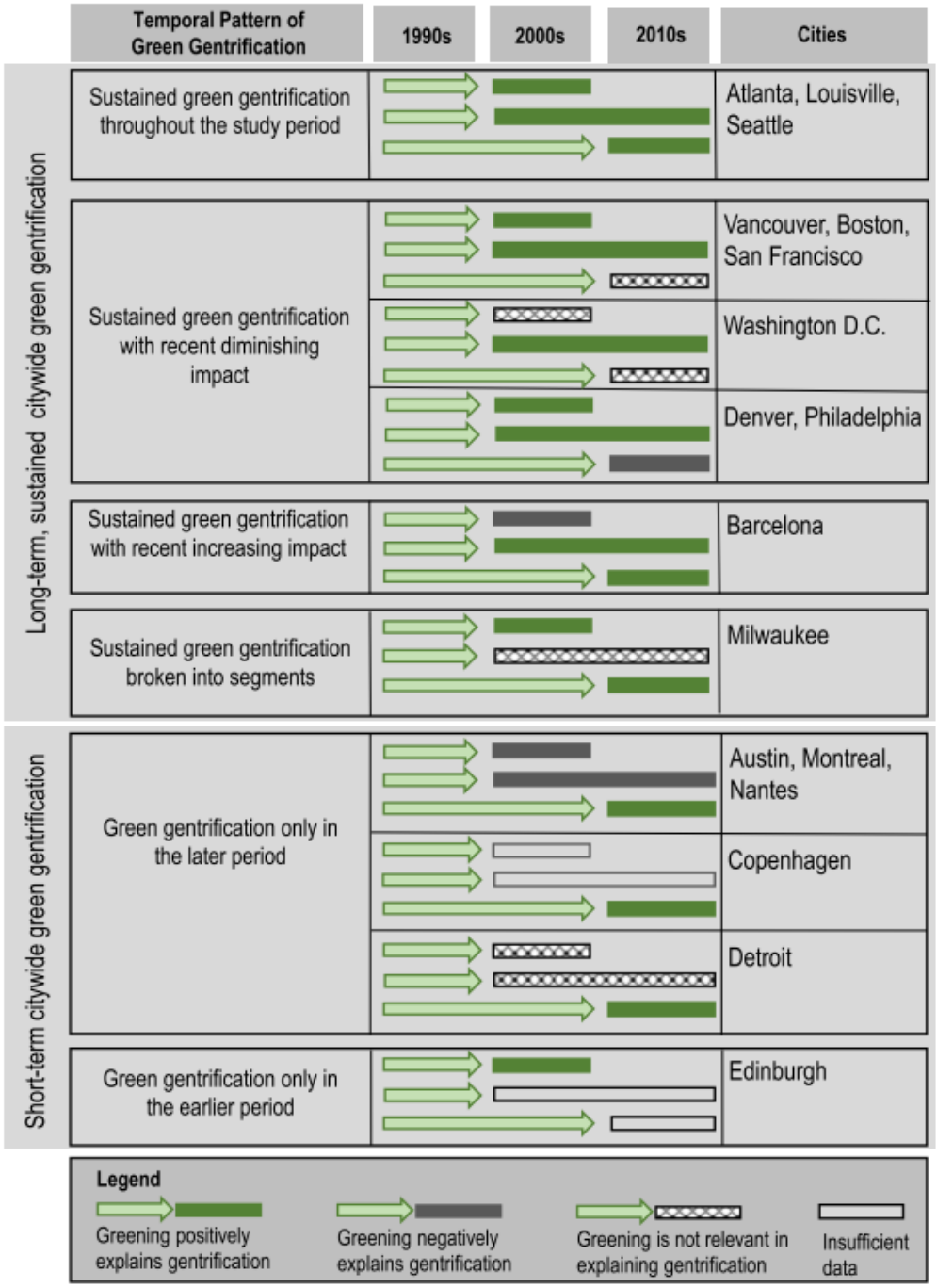


Fig. 2 Cities with patterns of green gentrification. These patterns show green gentrification trends over time in the 17 cities where greening from an earlier period is a likely relevant variable in positively explaining gentrification in the period(s) immediately following at some point between 1990 and 2016. There are two temporal groups: long-term (2 decades) and short-term (1 decade).

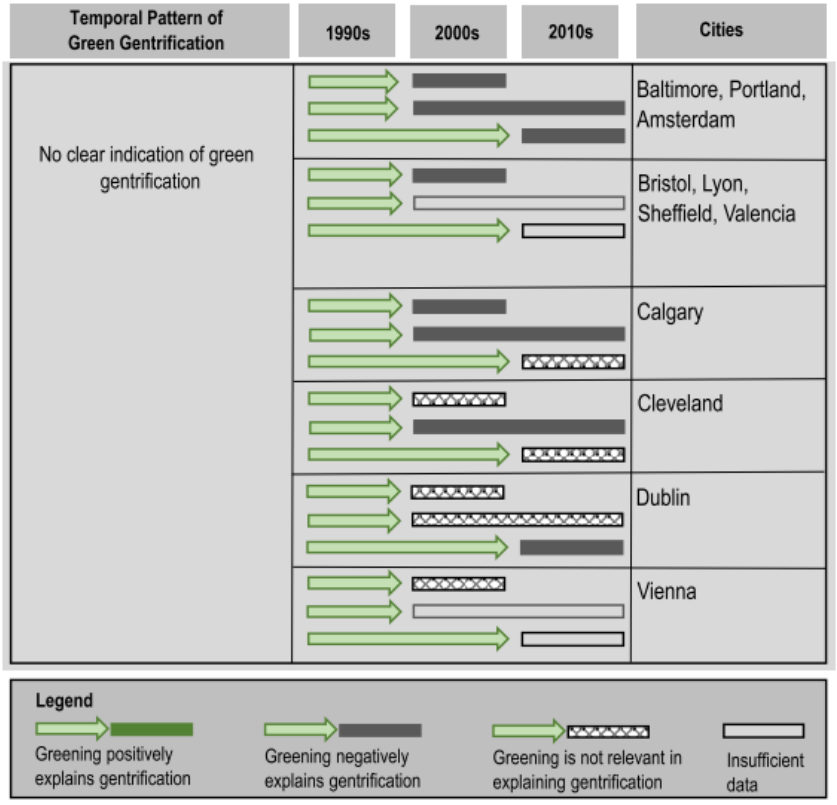


Fig. 3 Cities with no clear patterns of green gentrification. These patterns show cities where greening is likely either a negative or not a relevant predictor of gentrification. For these cities, new development, new transit or spatial location are other likely relevant drivers of gentrification.

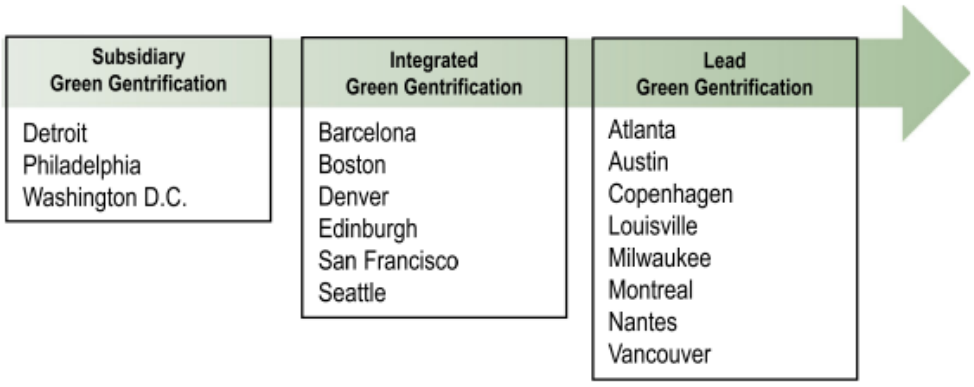


Fig. 4 Green gentrification types. Analysis reveals three types of green gentrification cities. In "lead green gentrification" cities, greenspace is the standout driver of gentrification. In "integrated green gentrification" cities, greenspace demonstrates is likely a relevant driver of gentrification to a degree that is roughly equal to other built environment changes, like new transit and new development. In "subsidiary green gentrification" cities, greenspace is likely a relevant driver of gentrification, but it is less impactful than other built environment changes.
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Finally, in our third type, "Subsidiary Green Gentrification" cities, which include 3 of the 17 identified as experiencing citywide green gentrification, greenspace is indicated as having a relevant role in explaining gentrification, yet it is a more secondary role, with other built environment interventions seemingly more prominent based on strength and duration of association. For example, in Detroit, greening is a relevant positive

explanatory variable for gentrification during the 2010s, but new residential development demonstrates a more relevant and sustained explanatory role throughout the study period. In these cities, we would say that green gentrification is present, but likely plays a subsidiary or nascent role in fueling gentrification processes in the city.

Importantly, these three types of green gentrification all indicate cities where greening plays a likely role in explaining tract-level variation of gentrification results. While one might be tempted to discount integrated and subsidiary forms of green gentrification as less impactful, this interpretation would ignore the relevant role our model indicates for greening across all three types. In other words, it is not the case that because other potential explanatory variables, like transit and new real estate development, are also relevant that green gentrification is not occurring. Rather, it is possible that without greening as part of the mix in these cases, gentrification would not occur at all. Thus, in delineating these three types, we are highlighting the fact that greening drives gentrification in a manner that is not monolithic (and it should be emphasized that it sometimes is not associated with gentrification). However, even subsidiary green gentrification shows a likely relevant role for greening, meaning greening is implicated in the mix of forces that drive gentrification to some degree and needs to be considered on those terms. Thus, all three forms of green gentrification are conceptually important when testing the overall hypothesis.

It is also worth noting that, while the spatial patterns of green gentrification within each city have to be considered relative to the city's local context, there are grounds for assuming that some common spatial patterns exist and that these patterns could inform future development of the typology described in Fig. 4. For example, with the exception of Nantes, distance from center always negatively explains green gentrification (usually with moderate strength) when it is relevant. This means that for the most part, we are observing processes wherein new greening, housing, and transit are sparking gentrification in areas within the city proper, and close to but generally not within the historic downtown of the city. This often points toward post-industrial or underused areas being redeveloped adjacent to city centers. To highlight what this spatial pattern looks like in some of our cities, Fig. 5 displays the spatial pattern of the explanatory power of our model for a selected number of city types and time periods.

Discussion

Our modeling accounting for spatial effects allows us to analyze the role of greening vis-à-vis other built environment changes in explaining citywide gentrification trends; and to assess the different role of greening across time periods. Our global model results indicate that a general association between greening and gentrification is likely a somewhat more recent overall trend in the cities under study, emerging with increased strength over time and with some lag as it unfolds, at least in a general sense when considered citywide across the cities we analyze. Moving to individual city models, in 17 out of 28 cities greening from an earlier time period is relevant for explaining

gentrification for at least one period immediately following (i.e., for at least one decade) given the presence of other covariates. Those results support the overall green gentrification hypothesis within our sample given the high rate (majority of cities) and our conservative citywide analytical approach. This citywide approach offers a more robust indication than a site-level analysis examining specific greenspaces, even though those analyses offer important insights into the pathways through which green gentrification manifests (Anguelovski et al., 2018; Goodling, Green and McClintock, 2015). While one might reasonably focus within our results on what we call "lead" green gentrification cities, the other types of cities wherein greening is indicated as having a less central but still relevant role in explaining the variation in gentrification trends are conceptually as important. All of these three types of green gentrification cities considered together form a heterogeneous affirmation of the overall hypothesis in many cities and point toward important nuances that need to be considered.

Overall, citywide green gentrification is mostly evident across our North American cities, but not only. In European cities with more recent green gentrification, including Copenhagen, Nantes, and Barcelona, an emerging pattern in this direction could be explained by recent context. These cities have seen rounds of investment-oriented greening and climate-responsive livability initiatives (such as the Barcelona Green and Biodiversity Plan or the Nørrebro climate resilience initiative) attract higher-income skilled workers, especially those in recently redeveloped areas. At the same time, those cities have also seen social protection and housing affordability policies—potentially protective tools against gentrification—dismantled to various degrees (e.g., Copenhagen), or such tools were almost absent until nascent efforts by more progressive mayors put housing rights for vulnerable groups at the center of urban policies, as was the case in Barcelona since 2016 (García-Lamarca et al., 2021; Anguelovski and Connolly, 2021). Overall, it seems green gentrification is one possible outgrowth of approaches to urban sustainability that put initiatives ostensibly focused on ecological and public health improvements in service to economic growth agendas through visibly rebranding cities as green and livable areas ripe for investment (e.g., Montreal, Austin) (García-Lamarca et al., 2021; Connolly et al., 2018).

When examining the 11 cities that showed negative or non-relevant relationships between greening and gentrification throughout the study period, an important caveat is that data was not always available to examine all time periods for most of these cities. It should be noted as well that in some of these 11 cities, gentrification is shown in the existing literature to be associated with broader sustainability initiatives, potentially indicating that the citywide analytic approach used here is not capturing some important specific manifestations or that the narrower operationalization of greening as one of five types of greenspace used here may not be capturing all relevant trends (e.g., Portland)60. Often, these 11 cities show in our models that gentrification is mostly explained at the citywide level by new development (D) or transit (T) infrastructure. This

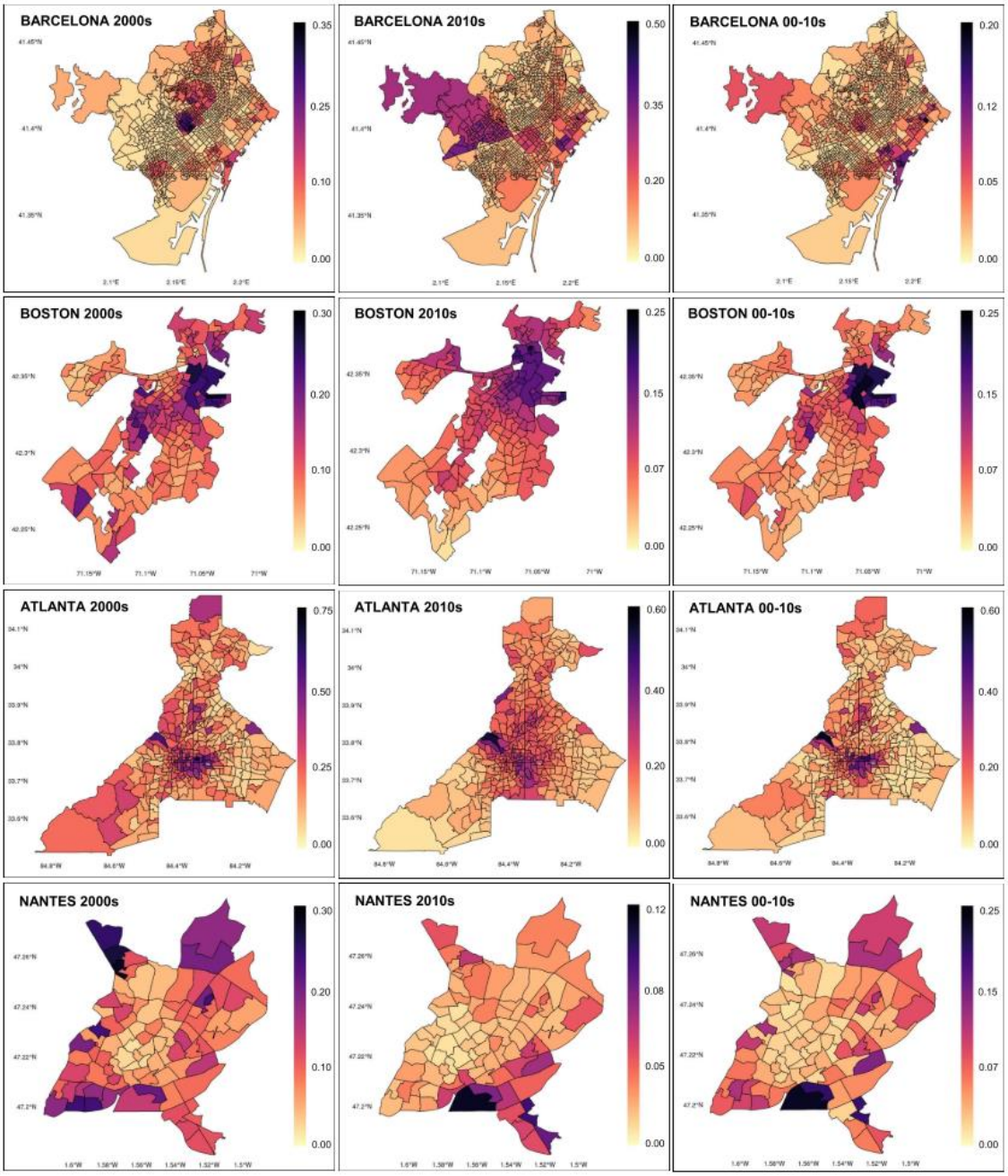


Fig. 5 Mean of posterior predictive distributions in Barcelona, Boston, Atlanta, and Nantes. The Bayesian posterior predictive distributions refer to the distributions of the power in predicting the gentrification index (outcome variable) in each census tract (or equivalent) produced by the final model (model that includes spatial effect and selected independent variables). They are not to be interpreted as traditional p-values (the probability of obtaining the observed results, assuming that the tested null hypothesis is true). Darker (darker pink, purple, and black) polygons show areas of the city where the final spatial effect model best predicts the relationship between greening and gentrification while lighter polygons (from light yellow and orange) show the areas where the final spatial effect least predicts that relationship. Because these are all green gentrification cities, high explanatory values (darker pink, purple, and black polygons) also indicate areas where green gentrification has occurred with higher likelihood. Selected cities include integrated (Barcelona, Boston) and lead (Atlanta, Nantes) green gentrification cities and include cases where the scope of green gentrification differs across time periods. Especially for lead green gentrification cities, the maps are largely indicating the specific geography of green gentrification. For integrated green gentrification cities, the maps are showing the geography of gentrification driven by a mix of factors. For example, in Nantes, for gentrification in the 2010s, the model best predicts high gentrification in the area of the Ile de Nantes (black polygon), and the surrounding areas of Vieux Malakoff, Malakoff, Champ de Mars, and Nantes Sud (darker pink and purple polygons) in the bottom center map.

is the case in Baltimore (D), Bristol (D), Cleveland (DT), Portland (D), Sheffield (DT), and Valencia (D). This finding resonates with events on the ground. For example, in Valencia, an epicenter of grandiose interventions during the Spanish economic bonanza of the 1990s and 2000s, gentrification has been linked to regeneration programs and the arrival of high-speed railway (Arguelles Ramos, 2021). In other cities with negative or non-relevant relationships between greening and gentrification, other factors have been identified as strongly contributing to gentrification on a citywide scale, such as large-scale urban regeneration and high technology investment and related real estate development in places like Dublin (MacLaren, Kelly and MacLaran, 2014). In addition, in other cases, housing affordability and rights policies (e.g., Amsterdam, Lyon), such as 30% or more of the housing stock being allocated to social housing, might be playing an important protective role against green gentrification and its associated displacement (Perez del Pulgar, 2021). Those anti-displacement policies are known to be more absent in North American cities, which exhibit relatively limited housing rights laws and municipal budgets heavily dependent on property taxes—and thus on increased neighborhood economic value and growth (Anguelovski and Connolly, 2021). This policy context could also explain why the majority of sustained citywide green gentrification cities are located in the USA.

Looking more deeply at the types of green gentrification cities identified in Fig. 4, one series of cities (Atlanta, Austin, Copenhagen, Louisville, Milwaukee, Montreal, Nantes, and Vancouver) point toward greening, and greening alone, as the main citywide intervention relevant for explaining gentrification. These cities which we call “lead green gentrification” stand apart from others where greening plays a more integrated or subsidiary role in explaining gentrification. In Atlanta, Nantes, and Vancouver, for example, greening takes place on a large scale, throughout many areas of the city, and with active branding and green rhetoric on the part of developers and city officials (García-Lamarca et al, 2021; García-Lamarca et al., 2022) that draw new large- scale market-price housing and associated higher-income residents. Atlanta is the host of the emblematic 53 km Beltline which will eventually link 45 neighborhoods and is accompanied by new and rejuvenated parks built since the early 2000s (e.g., Old Fourth Ward, D.H. Stanton) (Immergluck and Balan, 2018; Cole and Immergluck, 2021). Nantes with a series of green axes along its two rivers, bordering small and large parks, has since the early 2010s branded itself as “The City in a Garden” (Baró and Anguelovski, 2021), building on its 2013 European Green Capital Award, with some of the most emblematic spaces located within the greened former shipyard site Ile De Nantes in the center-west area of the city, but not only.

In other cities exhibiting green gentrification—Barcelona, Boston, Denver, Edinburgh, San Francisco, and Seattle—greening plays an explanatory role roughly on par with that of new development and/or new transit. Those are “integrated green gentrification”

cases. There, greening has indeed been part of an economic growth-driven redevelopment strategy, rather than a less visible, small-scale, community-oriented approach (Connolly, 2018). For example, Barcelona's more recent green gentrification has taken place in Sant Martí (eastern part of the city), a post-industrial area partially rebranded as the tech- and innovation-oriented 22@ district. Greening and gentrification has also taken place in the 2010s in the regenerated Old Town (Ciutat Vella) (Cocola-Gant and Lopez-Gay, 2020) and further intensified in the upper-income district of Sarrià-Sant Gervasi. In Boston, another integrated green gentrification city, several large- scale so-called resilient development projects alongside greening, which started in the mid-2000s, are located along the self-branded climate-adaptive waterfronts of East Boston, Seaport District, South Boston, and North and South Dorchester.

Much of our study's value lays in its large-scale and international scope across 28 cities in the global North, as well as our ability to assess green gentrification through a composite gentrification score, which includes both demographic and real estate change, over diverse time periods, and at a high spatial resolution. It also lays in the high analytic robustness of the study since it examines citywide, aggregate trends, allowing us to look at whether greening on the whole, as opposed to in specific sites, is relevant for explaining gentrification processes. In that sense, it is a high-bar for attaining a positive relationship between greening and gentrification and represents a conservative approach to testing the gentrification hypothesis.

Our study also presents some limitations. First, the most recent period (2010–2016) was shortened due to data availability at the time of study, which might have affected our ability to assess the extent of gentrification in the most recent time period, thus effectively reducing its scope. While accounted for as much as possible, data availability and variables differed somewhat between the United States and Europe, which might also explain result differences. Further, some of our measures (e.g., GDP for economic growth) can be conceptualized as a consequence of gentrification, as well as a driver, which introduces some complexity to interpretation. However, the temporal structure of the model makes clear the prior position of greening before gentrification, allowing us to at least be certain that greening is wrapped up in the generative processes producing the demographic and real estate changes observed together. Finally, our study analyzes trends within formal city boundaries with the potential for modifiable areal unit problems that may come with such boundary delimitations. Future analyses must also include green gentrification trends and variations by types and size of green- spaces and by operationalizing greening in more expansive ways. Global South cities as well as smaller towns are also worthy of examination, especially so as greening is increasingly used in a variety of contexts and has become a type of global planning orthodoxy across numerous places, including cities such as Medellin or Cape Town (Connolly, 2018; Tozer et al., 2020; Anguelovski et al., 2016).

In sum, our study shows that in most of the mid-sized cities from the Global North we evaluated, while urban greening has diverse climate, health, and socio-economic

benefits, it also contributes to green gentrification processes in a number of circumstances and thus to new social, racial, and health inequalities that eventually undermine climate equity and justice. Our findings call for accompanying anti-displacement and inclusive greening policies (Oscilowicz et al., 2022), which—taken together—would ensure the construction of green and climate-responsive cities starting from an equity lens focused on long-term health equity (Triguero-Mas et al., 2021; Cole et al., 2019), rather than green cities triggering or embedding dynamics of unequal urban development.

Methods.

intense laboratories for urban regeneration,

Table 2 Basic descriptive characteristics of cities included in the analysis.

City	Population	Population change			% GDP growth (yearly average growth)	
	2016	1990–2000	2000–2010	2010–2016	2001–2010	2011–2016
Amsterdam	821,800[a]	+	+	+	1.5	1.7
Atlanta	479,200	+	+	+	0.6	3.7
Austin	939,400	+	+	+	3.5	4.5
Baltimore	616,200	−	−	−	n.a	n.a
Barcelona	1,608,700	−	+	+	1.5	0.2
Boston	679,800	+	+	+	1.5	2.6
Bristol	567,100	+	+	+	1.7	1.6
Calgary	1,239,200	+	+	+	n.a	4.2
Cleveland	387,700	−	−	−	n.a	n.a
Copenhagen	591,500	+	+	+	1.1	2.3
Denver	696,200	+	+	+	0.7	3.7
Detroit	677,100	+	−	−	−1.4	3.0
Dublin	554,500	+	+	+	3.2	4.0
Edinburgh	512,500	+	+	+	2.2	1.6
Louisville	617,600	−	+	+	n.a	n.a
Lyon	513,300	+	+	+	1.6	1.6
Milwaukee	597,000	−	−	+	0.7	1.2
Montreal	1,942,000	+	+	+	n.a	1.9
Nantes	446,500	+	+	+	1.3	2.6
Philadelphia	1,576,000	−	+	+	1.6	1.7
Portland	642,700	+	+	+	1.7	2.9
San Francisco	871,500	+	+	+	1.2	5.7
Seattle	709,600	+	+	+	2.4	4.3
Sheffield	541,800	·	+	+	1.5	1.6
Valencia	790,200	−	+	+	1.7	−0.3
Vancouver	631,500	+	+	+	n.a	3.0
Vienna	1,856,600	+	+	+	1.4	0.0
Washington DC	685,800	−	+	+	3.1	1.3

Sources: United States Census Bureau, Statistics Canada, Organization for Economic Co-operation and Development (OECD), Eurostat.
[a]2015 Population.

Overall research design and comparative framework.

This study was designed around an international, comparative analysis of mid-sized cities (500,000 to 1.5 million residents within city boundaries) in North America and Western Europe with diverse greening trajectories. Our focus on North America and Western Europe derives from a recognition of green planning traditions and trajectories that have recently influenced both regions, even if not always to the same extent, and an interest in comparing similar outcomes across different urban contexts in order to increase generalizability. The relevance of medium-sized cities is linked to the reality that such places compete for visibility in the context of transnational investment that can flow past places lacking a bold urban identity. Neighborhoods in these cities are often

innovation, and green livability initiatives. From the 99 mid-sized cities in North America and Western Europe that we initially identified, we sought to develop a final sample for analysis accounting for important differences between cities that may affect the likelihood and form of green gentrification. Our selection is not necessarily representative of all cities, but it is based on a city-by-city analysis designed to enable us to maximize geographical diversity; diversity in urban development pathways (e.g. growing or shrinking city); and and diversity across various urban forms. We prioritized this diversity approach as it provided the best means of understanding whether the dynamics we observe are simply reflective of a certain city type or region. While this does not guarantee our results apply beyond our sample, it does help to maximize generalizability. We included Northern, Continental, and Southern Europe; Western

and Eastern Canada; West and East Coast US; Southern (i.e., Sunbelt) US; and Midwest (i.e., Rustbelt) US cities. In terms of urban development pathways, we included cities whose economy and population were mostly shrinking since the 1990s (e.g., Cleveland), while others economically and demographically recovered in more recent years (e.g., Philadelphia, Washington D.C.). We also selected cities with a stable, prolonged growth and economic vitality over the last 30 years (e.g., Portland; Nantes). Some cities in our final selection are compact and dense while other cities are sprawling, with important implications for the size and quantity of new greenspace as well as for the density and magnitude of real estate (re) development projects. To finalize the selection of specific cities, we augmented these diversity criteria with a comprehensive qualitative analysis of the greening trajectory since 1990 of the 99 possible cities within our population thresholds, aiming at inclusion of many types of green trajectories so as not to only analyze cities with a strong focus on greening. We used all available public documents relevant to green plans and strategies from each city to identify the variety and diversity of green projects that were undertaken relative to neighborhood redevelopment and revitalization; and real estate changes. This resulted in a classification of cities by intensity and length of their greening agenda, ranging from those seeking to be the "greenest city" or a so-called "green capital" to those for whom greening was a more muted but still highly visible goal. Using this baseline of 99 cities, we then selected a final subset of 28 cities (Fig. 1) with the most even representation across all of our diversity criteria balanced against the extent of available data at the census tract level (or equivalent) on green project creation, demographic change, and real estate values from 1990 to the mid-2010s (Table 2). Our goal in completing an extensive three-decade long (1990s, 2000, 2010s) analysis stemmed from the fact that the 1990s are widely considered as the starting point for formal urban sustainability and later climate planning programs in many cities around the world before their explosion in the 2000s and 2010s. Initiatives such as the 1987 Brundtland Report by the United Nations, the 1992 Rio Declaration on Environment and Development, its complementary Agenda 21 (action plans intended for implementation at various scales), and the 1997 Habitat Agenda rapidly catalyzed the start of sustainability and climate planning in cities. The broad temporal, geographic, and urban typological scope highlights the intent of our study to indicate the general degree to which green gentrification is occurring in the Global North. This intent justified the use of a conservative city- level measure wherein we only report green gentrification when the cumulative effect of all greenspaces across a city has a relevant role overall in explaining gentrification trends, using the census tract as the unit of analysis. Requiring that it be reflected citywide is a high-bar for testing the green gentrification hypothesis because there could easily have been instances of gentrifying tracts around one or a few greenspaces without registering a city-level trend if there were enough sites where green gentrification did not occur in the rest of the city. We deemed it important to maintain this conservative, citywide approach because we sought a fundamental test of the overall green gentrification hypothesis. An alternate approach focused on individual sites would almost certainly expose specific instances of green gentrification within a greater number of cities, would not necessarily test the overall effect of new greenspaces.

Data selection and collection.

In order to build the models for this analysis, for each city we gathered data on greenspaces, gentrification, and covariates (i.e., control) variables. The data on greenspaces includes the spatial boundaries for all parks, greenways, preserves, gardens (formally sanctioned or not), or recreation areas in place as of 2016, and the year of inauguration of the spaces—starting in 1990. Acknowledging that there are multiple definitions and understandings of greenspace across disciplines (Taylor and Hochuli, 2017), for the purpose of this study we define it as the creation of any of our five classifications of urban greenspace—parks, greenways, preserves, gardens, or recreation areas. In some cases, the boundaries and sizes of greenspaces represent a manually augmented version of publicly available files when missing spaces were identified through other sources. To identify the year of inauguration, we used a combination of direct communications with city or non-profit organization staff, city land records, published reports, media reports, historic imagery, and city archival searches. We defined inauguration as the year the space was acquired for public use as a greenspace. If this year was not available, then the year the space was opened to the public was used instead. The gentrification data includes changes in demographics and real estate values reported at the highest spatial resolution possible. These data are derived from national and local statistics offices (see Supplementary Table 1 for a full list of sources and data cleaning approaches). In all cases, the data were reported at the smallest area unit used by that country or city for all variables (e.g., census tract in the United States, IRIS in France, and Secció Censal in Barcelona). For each city, we searched for the most closely aligned demographic variables that corresponded to constructs commonly used to measure the socio-cultural dimensions of gentrification, in addition to rent changes (see Supplementary Note and Supplementary References for a full description of the literature used to develop the variable list). These included relative demographic

changes demonstrated by the (1) change in socially vulnerable population; and relative change in social class as defined by: (2) population with a high level of education, (3) population with relatively high incomes, (4) population with a professional occupation, and (5) population classified as living below poverty level. To operationalize our determination of socially vulnerable, we developed a custom measure of socially vulnerable population variables such as race, ethnicity and migration status. Data on socially vulnerable populations varied relative to the local context. For example, in some cities scholarly research supports race and ethnicity data as a key indicator of social vulnerability, but in others measures of immigration or migration are the key marker of social vulnerability. In response, we developed bespoke measures of socially vulnerable populations by city relative to available data and existing scholarly findings. In Valencia, for example, we included percentage of residents with nationality from countries in Africa, Philippines, Peru, Pakistan, Bolivia, Ecuador, Colombia, or the Dominican Republic (see next section for the general description of gentrification variables and Supplementary Methods, Supplementary Table 2 in particular, for exact variables used in each city). In most cases, the small-area geographies used to report the data changed across years. In order to standardize the boundaries for analysis across time, we used a hierarchically ordered set of techniques designed to minimize error as much as possible (see description of the "CUDA" approach to spatial data standardization in Supplementary Methods, section on Data Processing in particular, for a complete description of the process used to standardize data). The covariate data includes small-area and city-level controls. At the small-area level, we gathered data on the location of all new transit stops added since 1990, the distance from city center, the residential density, and the number of new residential buildings constructed for each time period analyzed. In order to identify the number of new residential buildings constructed in each small-area geography by decade, the number of new buildings was derived from national or state statistics office reports, local building permit datasets, and lot-level tax or cadastral files with "year built" designations in each lot (see Supplementary Table 3). For the transit stops, we used Google maps, Wikipedia and city-level planning documents to identify the location of all new rail and bus stops added since 1990. For distance to the city center and population density, we made these calculations manually from the centroid of each small area using ArcGIS 10.6 desktop software. At the city- level, we gathered data on population change since 1990, city-level GDP change since 2001 (due to data availability), and prior green coverage (in 1990) expressed as percent of city area. For city-level population change since 1990 and city-level GDP change, we used World Population Review and OECD data respectively. For prior green coverage, we calculated this value manually using ArcGIS 10.6 desktop software.

Data processing for greenspace and gentrification measures. In order to calculate the amount of greenspace added over time to a given small-area geography, it was first assumed that every greenspace has a catchment area wherein nearby residents are easily drawn to it. We employed the widely used measure of 400 m as an easily walkable (https://www.healthyactivebydesign.com.au/design-features/ public-open-spaces/evidence/#distancequal) (~5–10 min) estimate of a standard catchment for a greenspace. For this reason, we calculated the number and area of greenspaces in a given small-area geography by first creating a 400-m Euclidean distance buffer around the area. We then used the formal tract boundary plus the 400-m buffer for all greenspace calculations by tract (see ref. Connolly and Anguelovski (2021) for a more detailed discussion of this procedure). Next, we calculated the area of greenspace added during each of three time periods. Owing to data limitations, these periods approximate but do not always exactly align with decadal splits. For example, Time Period 1 in a given city may cover 1992–2001 while it covers 1990–2000 in another city. In order to account for this variation, we customized the allocation of greenspaces to time periods according to the gentrification data coverage. Total area of greenspace added during a time period was calculated as the area of all greenspaces inaugurated during the period covered by the gentrification data plus that added in the two years immediately following that period. The 2-year overlap was added to account for "announcement effects" where spaces announced in the time immediately prior (but presumably built within 2 years after the start of the period) are also included78. For example, if the gentrification data for Time Period 2 in a given city measures changes between 1999–2006, then the Period 2 greenspace data would be the sum of area added between 1999 and 2008. In order to test our main hypothesis—greenspace in a prior period explains gentrification in the period immediately following—we developed a gentrification score for each of three time periods based on a diversity-weighted sum of demographic change plus change in rent values. As change in rent is an indicator of market dynamics and prices, rather than of ability of the population to pay, change in rent and change in income are distinct measures. To develop the score, we used data from each city that coincides with a generalized list of five potential social change indicators chosen to reflect variables of importance that capture some of the complexity in the gentrification literature (for detailed variables used in each city and discussion of the literature supporting

that variable, see Supplementary Note and Supplementary Methods, Supplementary Table 2 in particular). These indicators are:

nvul—percent of residents from a non-vulnerable ethnic group
uni—percent of residents with a university degree or higher prof—percent of residents classified as having a professional occupation
hises—percent of residents classified as having a high income
npov—percent of residents not classified as being below the poverty level Additionally, a single indicator for including the influence of rent values was also incorporated:
hrent—percent of households paying above median value in rent.

Next, we took several steps to combine these measures into a composite gentrification score standardized in a way that makes them comparable across national and city borders. This composite score (Eq. 1) is defined as:

$$G_{\text{tract}} = H_{\text{E}}(Z_{\text{nvul}} + Z_{\text{uni}} + Z_{\text{pro}} + Z_{\text{inc}} + Z_{\text{pov}}) + Z_{\text{rent}}$$

where Gtract is the composite gentrification score for a given small-area census geography; HE is Shannon's diversity index standardized to a score between 0 and 1 as the weight applied to the social change variables; Zx is the standardized score of the given social change variable; and Zrent is the standardized score for the change in rent variable. Our formula calculates Zx as the change in the value over each time period normalized by the citywide change for that same time period. This normalized measure controls for the fact that we would expect relatively high small-area changes in cities with consistently high rates of change and the opposite in cities with consistently low rates of change. In order to make these normalized measures of change for each variable comparable across cities, we calculated their Z-values as the number of standard deviations that an observation is above or below the mean value of observations for the city. The result was a measure of magnitude of change across five socio-cultural (including race, ethnicity and immigration status in nvul) variables and one rent variable suitable for comparison across cities. Having generated the foundation of our gentrification score, we next created a weight for the diversity of change occurring. This weight is meant to respect the complexity of gentrification processes as expressed in the literature wherein we consider it to be most acute and most accurately identified in neighborhoods where there are multiple social, economic, and cultural changes happening at once. Thus, in our view—and as other studies of green gentrification posited—a greater diversity of change across multiple variables is more indicative of gentrification than changes within only one or two variables. We added a weight for this type of diversity in change by calculating Shannon's Equitability Index (HE) for the five social variables—a unique theoretical and methodological contribution of our study in the analysis of gentrification Shannon's Equitability Index (HE) is a variation of Shannon's Index developed in prior studies and typically used to provide a measure of both the abundance and the evenness of a group of observations in species diversity studies. The Shannon Index is calculated by summing the product of the proportional increase in each indicator in relation to the increases in all social change indicators at that location and the negative natural logarithm of that increase for each indicator variable at each location across the city. The "equitability" variation on the original index allows the number of variables measured per indicator to vary, which was necessary for us as not all cities had all five social variables available. Thus, in our case, we used this approach to develop a weight that gives greater importance to small-area units that have change across many variables at once, rather than only having change across one or two, in order to better represent the complexity and diversity of gentrification as a process of urban change. Finally, with the standardized and normalized version of the variables weighted by the Shannon's Equitability Index, we calculated a final gentrification score. For our analysis, the extent to which gentrification is occurring is measured as the sum of the standardized and normalized changes in social variables weighted for the diversity of change occurring plus the standardized and normalized change in our rent indicator (hrent). A higher value from this equation indicates that more demographic and real estate changes are occurring at once in the area, which we use as a proxy measurement for the degree of gentrification. Thus, we use here a unique scale of gentrification activity in small-area geographies that can be compared across national and municipal contexts.

Quantitative models.

Our aim in the study was to examine the relationship between greening and gentrification globally and then city-by-city, through testing our main hypothesis across different time periods. Given the temporal structure of our data, this resulted in three sub-hypotheses:

H1: New greenspaces attributed to time period 1 are relevant in the presence of covariates for explaining gentrification that occurred during time period 2.

H2: New greenspaces attributed to time period 1 are relevant in the presence of covariates for explaining

gentrification that occurred during time periods 2 and 3.

H3: New greenspaces attributed to time periods 1 or 2 (compounded) are relevant in the presence of covariates for explaining gentrification that occurred during time period 3.

With the final aim of incorporating the underlying variability between the different cities and countries, a linear mixed model (in which city and country were considered as random effects) was used for the global analysis. The model also included all covariates previously mentioned. As performing a complete model selection for linear mixed models can be computationally challenging, we used a two-step procedure to identify the (best) final model. First, after removing those variables with substantial missing data, a Bayesian model selection procedure for multiple linear regression models with fixed effects (BayesVarSel) was used to show which covariates were the ones that better explained the response (in presence of the others). Owing to the importance of some variables (such as greenspace), this selection process started from the null model that incorporates them. Second, starting from the selected model for each hypothesis, we selected the best model among those with the covariates already included, plus the two random effects, country and city. Country was found to be not relevant in all the analyses. This non-relevant role for country shows that all the underlying variability was due to differences between cities (a relevant effect in all hypotheses). Inference on the final global model of each hypothesis was performed within the Bayesian framework and so prior elicitation for all the parameters and hyperparameters of the model was required. Inference is performed within the Bayesian statistical approach as it allows us to deal in a natural way with the uncertainty of both the parameters and the models. In particular, we chose vague prior distributions to emphasize our lack of knowledge about them. The complete global model can be expressed as follows (Eq. (2)), where n = 28 cities:

$$
\begin{gathered}
y_i \sim N(\mu_i, \sigma_\epsilon), i = 1, \ldots, n \\
\mu_i = V_i\beta + s_i \\
\beta_1, \beta_2, \ldots, \beta_{p+1} \sim N(0, \sigma^2 = 1000) \\
s_i \sim N(0, \sigma_s^2) \\
\sigma_\epsilon, \sigma_s \sim pc - \text{priori}(2, 0.5)
\end{gathered}
$$

With respect to the city-level analyses for each hypothesis, a three-step procedure was used to check which variables of interest were relevant and whether there was any spatial effect (showing possible hidden geographic drivers resulting from a wide range of possible dynamics within the underlying urbanization process). Again, as a first step, BayesVarSel82 was used to show which covariates were the relevant ones (in presence of the others). Next, we used the Moran index83 to test whether or not the residuals of the model presented spatial autocorrelation. When they did, our third step was to add a spatial random effect that aimed to explain the underlying spatial effect. The spatial component was included as a conditional autoregressive term, reinforcing the idea that the value of an area depends on the values of its neighbors. In order to avoid confounding of the spatial effect and the covariates, the model was expressed as a spatially restricted regression where the spatial random effect is orthogonal to the covariates space. As before, inference was performed within the Bayesian framework and prior
elicitation for all the parameters and hyperparameters of the model was again required. In particular, we chose vague prior distributions to emphasize our lack of knowledge about them. The complete model can be expressed as follows (Eq. (3)):

$$
\begin{gathered}
y_i \sim N(\mu_i, \sigma_\epsilon), i = 1, \ldots, n \\
\mu_i = V_i\beta + s_i \\
\beta_1, \beta_2, \ldots, \beta_{p+1} \sim N(0, \sigma^2 = 1000) \\
s_{i|j} \sim N\left(\frac{1}{k_i}\sum_{i\sim j} s_j, \frac{\sigma_s^2}{k_i}\right), i \neq j \\
\sigma_\epsilon, \sigma_s \sim pc - \text{priori}(2, 0.5)
\end{gathered}
$$

As the posterior distributions of the parameters and hyperparameters do not have an analytical expression, all the resulting models were fitted using the Integrated Nested Laplace Approximation methodology, which is a computationally fast software implementation that provides accurate approximations to posterior distributions84. An important note is that Bayesian probabilities are not traditional p-values and should not be considered as interchangeable.

Data availability

All non-proprietary data generated during the study and analyzed within the study will be available in public repository being developed by the Barcelona Lab for Urban Environmental Justice and Sustainability and scheduled for release in early 2024. This repository will be online and publicly accessible. Until the online repository is fully developed, the national statistics data used is available from the various countries' national statistics offices. The greenspace and other processed data is available upon reasonable request to the corresponding author, Isabelle Anguelovski. The raw Copenhagen and

Vienna demographic and development data are protected and are not available due to data privacy laws. The US demographic data was also purchased. The raw data itself is available free of charge, but the version we used was pre-processed to a standardized geography by a company, GeoLytics, into the 2010 census tracts on which our demographic analysis was base.

Author contributions I.A. and J.C. co-led the study, jointly supervised, co-conceived and designed the study, co-led analysis, interpretation and writing; They are both joint first authors. D.C., J.L.M., B.S., M.A.B., J.M.M. performed Bayesian calculations; H.C., M.G.L., M.T.M., F.B., N.M., G.S., C.P.P., L.A.R., A.M., E.G., E.O. developed the data, analyzed, discussed the results, wrote the paper, and contributed to the revision of the final manuscript.

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Chapter 3.

Exploring green gentrification in 28 global North cities: the role of urban parks and other types of greenspaces

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Chapter 3. Exploring green gentrification in 28 global North cities: the role of urban parks and other types of greenspaces[16]

Introduction

Fostered by global sustainability agendas (e.g. UN SDG 11), cities globally are increasingly mobilizing re-naturing projects towards green, sustainable, and healthy urban environments (Haase *et al* 2017). Those projects create or restore existing greenspaces and other vegetated environments, including parks, greenways or gardens, as well as blue spaces like waterfronts (Haase *et al* 2017, Taylor and Hochuli 2017, de Oliveira and Mell 2019). The adoption of re- naturing projects in cities is often motivated by existing evidence that green and blue spaces can address diverse urban socio-environmental and health challenges, including urban heat island effects, air pollution, water regulation and increased prevalence of non-communicable diseases (Kabisch *et al* 2017, de Oliveira and Mell 2019, Veerkamp *et al* 2021, Yang *et al* 2021).

At the same time, the implementation of re- naturing interventions may contribute to the attraction of new investment and place these areas at higher risk for gentrification—defined as socio-cultural and physical exclusion and displacement of underprivileged residents (i.e. minority racial/ethnic groups, working class individuals, non-white residents and immigrants) from the neighborhood (Glass 1964, Brown-Saracino 2010)—through a process known as green or environmental gentrification (Dooling 2009, Gould and Lewis 2017). The mechanisms by which re-naturing projects induce or accelerate gentrification are material and discursive. Greening contributes to increased property and land values as well as urban green grabbing practices (i.e. developers' appropriation of the financial and social benefits generated by nearby new or planned green amenities) (Safransky 2014, Czembrowski and Kronenberg 2016, García-Lamarca *et al* 2022). Re-naturing projects are further articulated around a green rhetoric that serves to (re-)brand cities (i.e. urban green boosterism) and eventually produce commodified environmental amenities (Garcia-Lamarca *et al* 2019, Triguero-Mas *et al* 2021). These projects may thus produce new types of social injustices (Anguelovski 2016, Rigolon and Németh 2018).

Green gentrification has been clearly documented in a diversity of urban areas, particularly linked with flagship interventions, such as projects in the US (e.g. the High Line Park in New York City or the BeltLine in Atlanta), in Europe (e.g. the Lene-Voigt Park in Ger-

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many, the Noorderpark in Amsterdam or the Limhamn Quarry National Natural Reserve in Sweden) and also in East Asia (e.g. Cheonggyecheon Stream Restoration Project or the Gyeongui Line Forest Park in South Korea) (Loughran 2014, Sandberg 2014, Haase *et al* 2017, Kwon *et al* 2017, Weber *et al* 2017, Immergluck and Balan 2018, Jo Black and Richards 2020, Anguelovski and Connolly 2021).

To implement re-naturing agendas and projects able to address socio-environmental and health challenges while preventing gentrification and displacement, we must first understand how prevalent green gentrification is, the conditions under which it occurs, and the magnitude of its effects (Pearsall and Eller 2020). Yet, empirical quantitative evidence on the relationship between greenspaces and gentrification remains scarce, as much of the literature to date has been dominated by qualitative case study analyses of a specific city and/or of a particular neighborhood (Curran and Hamilton 2012, Loughran 2014, Anguelovski and Connolly 2021). Within this general paucity of quantitative studies investigating the relationships between greenspaces and gentrification at the citywide and cross-city levels, the few studies that do exist show mixed findings (Irwin 2002, Conway *et al* 2010, Kwon *et al* 2017, Anguelovski *et al* 2018, Maantay and Maroko 2018, Connolly 2019, Du and Zhang 2020, Pearsall and Eller 2020, Rigolon and Németh 2020, Shokry *et al* 2020, Chen *et al* 2021, Donovan *et al* 2021, Schinasi *et al* 2021, Kim and Wu 2022, Anguelovski *et al* 2022). Existing quantitative research commonly utilize either single socio- economic attributes to assess gentrification or one socio-economic variable at a time (Conway *et al* 2010, Kwon *et al* 2017, Du and Zhang 2020, Pearsall and Eller 2020, Kim and Wu 2022), the most common of these socio-economic variables being property values (Conway *et al* 2010, Du and Zhang 2020).

Further, few studies consider the heterogeneity of urban greenspace size, vegetation cover, species richness, amenities, legal protection, and other socio- environmental characteristics. A growing body of literature suggests that large-scale urban greening pro- jects such as the BeltLine in Atlanta or the 606 rails-to-trails project in Chicago may induce environmental gentrification as they may be planned—at least partly—to increase property values (Loughran 2014, Kwon *et al* 2017, Immergluck and Balan 2018, Jo Black and Richards 2020, Chen *et al* 2021). How- ever, a study of ten large and medium-size US cities found that park size did not have an impact on gentrification (Rigolon and Németh 2020). Mean- while, smaller greenspaces, are conceptualized as part of a 'just green enough' approach that may not trigger gentrification (Chen *et al* 2021) but may secure environmental and public health benefits of re- naturing interventions (Wolch *et al* 2014).

More specifically, different greenspace characteristics are related to greenspace types (e.g. parks, allotments or biodiversity areas) (Smith *et al* 2017) which may in turn lead to different gentrification pat- terns due to their diverse uses and variety of res- idents' appreciation (Amorim Maia *et al* 2020). For example, parks may be perceived as spaces of daily use for a variety of activities and may be strongly linked to neighborhood identity.

Meanwhile, allotment or community gardens and biodiversity-rich areas such as nature preserves may be used as selling points, marketed as community spaces or valued for their environmental and biological worth. Less than a handful of studies (most of them from the US) have considered the associations between typologies of green spaces and property prices (Lutzenhiser and Netusil 2001, Czembrowski and Kronenberg 2016). However, scholars have clearly stated the importance of understanding how greenspace typologies may be linked to green gentrification (Pearsall and Eller 2020, Stuhlmacher *et al* 2022).

There is only scarce evidence on whether green gentrification is solely or more strongly linked with certain greenspace types and most of this evidence focuses in the US. The study by Rigolon & Németh reported that greenways located within half a mile of census tract centroids increased the odds of the census tract gentrification by over 200% (Rigolon and Németh 2020). A study in Portland showed that each new street tree planted in a census tract was associated with a $265 increase in tract-level median sales price 12 years after tree planting, thus impacting neighbor- hood affordability (Donovan *et al* 2021). Similarly, existing community gardens have been associated with increased gentrification in Brooklyn, New York (Maantay and Maroko 2018) and in St.Louis, Missouri (Braswell 2018). According to another recent study from New York City, passive (not associated with exerting recreational activities), natural (non- manicured, wild) greenspaces contribute to gentrification processes (Kim and Wu 2022). In the specific case of parks, one study in the north-eastern half of Barcelona found that areas around new urban parks experienced gentrification, but not in neighborhoods with housing units difficult to upgrade (Anguelovski *et al* 2018).

Considering this mixed evidence on green gentrification, we hypothesized that each type of greenspace might play a different role in green gentrification processes. Consequently, this study aimed to explore the association between different types of greenspaces and gentrification using quantitative data from a total of 28 cities in the Global North. More specifically, we investigated whether different types of greenspaces (parks, gardens, nature preserves, recreational spaces, and greenways) predict gentrification and whether these effects varied over time, between mid- and long- term gentrification, and between cities representing a variety of geographies and urban development con- texts. Through our analysis, we derive city-level findings from tract-level observations.

Methods

Study design

We designed a multi-city study to assess improved access to different types of greenspace and gentrification processes over 1990–2016 in mid-sized cities in North America and Western Europe (supple- mental material, page 3). With these criteria, we selected those mid-sized cities with strong greening agendas since the 1990s and available and reliable data on the variables of interest for our study, while aiming to include cities that represented different regions and different growth trajectories. This

process led to including 28 cities in this study: 17 in North America (including 14 cities in the US: Atlanta (GA), Austin (TX), Baltimore (MD), Boston (MA), Cleveland (OH), Denver (CO), Detroit (MI), Louisville (KY), Milwaukee (WI), Philadelphia (PA), Port- land (OR), San Francisco (CA), Seattle (WA), Washington DC (DC); and also three cities in Canada: Calgary, Montréal, Vancouver), and 11 in Western Europe (Lyon and Nantes in France; Bristol, Sheffield and Edinburgh in the United Kingdom; Amsterdam in The Netherlands; Barcelona and Valencia in Spain; Copenhagen in Denmark, Dublin in Ireland and Vienna in Austria) (figure 1).

Assessment of gentrification

In the absence of one universally accepted quantitative measure of gentrification, researchers have used a range of methods to assess if places are gentrifying and how rapidly (Freeman 2005, Ding *et al* 2016). In this study we calculated a gentrification score per small geographical unit (SGU) in each city and time period using a unified methodology described previously (Anguelovski *et al* 2022). In brief, our gentrification score is based on several measures of sociodemographic change and change in rent values. To build our gentrification score we calculate diversity in change across several sociodemographic constructs (ethnic/racial vulnerability, higher education, income, poverty, professional occupation) plus change in a real estate indicator (rental housing) by using Shannon's Equitability Index. That is, accord- ing to our composite score, gentrification occurs at the highest degree when several indicators change in a strong direction toward gentrification at the same time (Anguelovski *et al* 2022).

Accordingly, we obtained the most closely aligned variables that corresponded to the sociodemographic and real estate constructs previously stated for 2000, 2010 and 2016 (or the closest date possible to these years) in each SGU and city from national and local statistics offices (see tables S1–S3). Based on these data, we obtained two indicators of mid-term gentrification (gentrification for the 2000s, gentrification for the 2010s) and one indicator for long-term gentrification (gentrification throughout the decades of the 2000s and 2010s) (supplemental material, page 19).



Figure 1. Situation of the cities included in this study.

Assessment of new greenspaces of different typologies

We obtained data for each city on different types of new greenspaces opened for public use between 1990 and 2016 using a combination of direct communications with city and non-profit organizations, city land records, published reports, media reports, historic imagery and city archival comprehensive searches (Connolly and Anguelovski 2021, Anguelovski *et al* 2022). We considered that new greenspaces were all those substantially vegetated publicly accessible spaces that had been inaugurated or publicly acquired (i.e. greenspaces that were formerly private spaces and were transferred to public ownership) during our period of study (i.e. 1990–2016).

Our study included five greenspace categories based on generic cross-city exclusionary definitions that built on common typologies of urban green- space (Cvejic *et al* 2015, Smith *et al* 2017): parks, gardens, nature preserves, recreational areas, and greenways (find a summary of the classification in table 1, for a detailed description see (Connolly and Anguelovski 2021, Anguelovski *et al* 2022) and supplemental material, page 20).

Based on identified data we built the following ten indicators:

Parks pre ~ 2000s, Gardens pre ~ 2000s, Preserves pre ~ 2000s, Recreational pre ~ 2000s, Greenways pre ~ 2000s, Parks pre ~ 2010s, Gar- dens pre ~ 2010s, Preserves pre ~ 2010s, Recreational pre ~ 2010s, Greenways pre ~ 2010s

The first five indicators (*Parks pre ~ 2000s, Gardens pre ~ 2000s, Preserves pre ~ 2000s, Recreational pre ~ 2000s* and *Greenways pre ~ 2000s)* denote the total area of—respectively—parks, gardens, nature preserves, recreational areas or greenways added to each city SGU during the time period before the 2000s (i.e. before the start of the variable 'gentri- fication in the 2000s') plus 2 years (table S4). We included the 2 years overlap to account for the impact that announcing a greenspace creation or improvement may have on gentrification (Immergluck 2009). The last five indicators (*Parks pre ~ 2010s, Gar- dens pre ~ 2010s, Preserves pre ~ 2010s, Recreational pre ~ 2010s, Greenways pre ~ 2010s)* indicate the same as the previous five categories, but for the time period before the 2010s and 2 years during the time-period included in that gentrification variable, following the same logic as for the pre ~ 2000s indicators.

Covariates

Based on previous literature, we selected our study covariates. *Distance from the SGU centroid to the city centre* and SGU *population density per square kilometer in 2010* and *change in population dens- ity between the different time points we studied* was calculated by the research team using ArcGIS 10.6 software. SGU *green coverage prior to 1990* was also estimated using existing databases and ArcGIS 10.6 software. We also assessed the number of *public transit stops added* to the SGU immediately before and dur- ing the first 2 years of the studied decade using Google maps, Wikipedia and city level planning documents to identify the location of all new rail and bus stops. The

number of *new residential buildings* built in the tract during each time period analyzed was derived from national and state statistics office reports, local building permit databases and lot-level tax or cadas- tral files.

Statistical analyses

We developed Bayesian hierarchical spatial models for estimating the relationships between gentrification and our variables of interest (i.e. new greenspaces), while adjusting them for the relevant covariates. More specifically, we developed a model per city and gentrification time period so we had a maximum of three models per city: (a) one model with gentrification in the decade of the 2000s as the outcome variable and *Parks pre ~ 2000s, Gardens pre ~ 2000s, Pre- serves pre ~ 2000s, Recreational pre ~ 2000s,* and *Greenways pre ~ 2000s* as the exposure variables of interest; (b) one model with gentrification in the decade of the 2010s as the outcome variable and *Parks pre ~ 2010s, Gardens pre ~ 2010s, Preserves pre ~ 2010s, Recreational pre ~ 2010s,* and *Green- ways pre ~ 2010s* as the exposure variables of interest; and (c) one model with gentrification considering the decades of the 2000s and 2010s as the outcome variable and *Parks pre ~ 2000s, Gardens pre ~ 2000s, Pre- serves pre ~ 2000s, Recreational pre ~ 2000s, Green- ways pre ~ 2000s* as the exposure variable of interest). We reported the estimates of the associations between gentrification and each independent variable using posterior probability values (postprob- value). These postprob-values indicate the probabil- ity that each estimate that represents the effect of each independent variable on gentrification is greater than zero. Note that this value is a measure of the relevance for each independent variable, so are not to be interpreted in the same way as traditional *p*-values (see supplemental material in appendice).

Table 1. Typology of greenspaces considered in this study, including definition, sub-types and relevant aspects when evaluating green gentrification.

New greenspace type	Definition	Spaces comprised in this type	Relevant aspects when evaluating green gentrification
Parks	• Accessible, high-quality opportunities for informal recreation and community events. These spaces include a variety of features such as formal footpaths, play space, sports areas, trees, planted beds and/or ponds.	• Comprises all urban parks, ornamental gardens, parterres, and green plazas that are designated as vegetated areas.	• They offer a broad range of health promotion and recreational possibilities, including enhancing social networks with neighbors. These spaces are also a prominent space of urban biodiversity (Cvejic *et al* 2015). • We considered that these spaces may increase neighborhood attractiveness as parks may be perceived as spaces to use daily to promote and prevent one's health.
Gardens	• Spaces reserved for a defined set of gardeners to grow food or aromatic plants.	• Includes community and allotment gardens.	• These greenspaces are spaces for social interactions, while being places of food provisioning and physical activity (Cvejic *et al* 2015). • We considered that these spaces may be attractive to the first waves of gentrifiers as spaces to socialize and feel part of the neighborhood community.
Nature preserves	• Areas designated as protected from development and allowed to grow naturally in a relatively undisturbed state. These areas are residual natural habitats, planted or vacant land that has been colonized by vegetation and wildlife. They are often meant to protect biodiversity. • In our study, when there was a doubt about the legal protection status of the greenspace, the space was considered a park instead of a nature preserve.	• Includes urban forests, biodiversity areas, conservation areas, nature reserves and protected areas.	• These spaces are biodiversity hotspots, at the same time as they provide cooling, air pollution, carbon sequestration and water regulation. They may also be important source of certain foods and raw materials (Cvejic *et al* 2015). • We considered that these spaces may increase neighborhood attractiveness for those particularly interested in and those who value wildlife conservation, biodiversity and environmental education or those interested in living in less densely populated areas, surrounded by larger greenery.

(Continued.)

Table 1. (Continued.)

New greenspace type	Definition	Spaces comprised in this type	Relevant aspects when evaluating green gentrification
Recreational spaces	• Natural and artificial playing surfaces. Large and generally flat areas of grassland or specially designed surfaces, used primarily for designated sports i.e. playing fields, tennis courts, bowling greens.	• Sport fields opened for use (e.g. not within an enclosed stadium) and municipal recreation centers largely comprised of attached green areas.	• These spaces are particularly relevant as physical activity promoting amenities (Smith *et al* 2017). • We considered that these spaces may not prominently lead to green gentrification, as other similar grey spaces may provide similar services to residents.
Greenways	• Linear greenspaces designed for people to move through them. They may link different areas within a city as part of a designated and managed network and used for walking or cycling, or linking urban greenspaces and/or or cities to their surrounding cities, towns, countryside or country parks • In this study we considered that greenways did not have the amenities of parks but could be protected spaces (i.e. when a greenspace was both a greenway and a park was considered a park; but when it was both a greenway and a nature preserve it was considered a nature preserve).	• Includes riparian, natural and other vegetated corridors, greenbelts, and linear promenades with substantial vegetation.	• These spaces may have very different impacts according to their vegetation. Certain greenways structures may increase bird and insect richness and abundance or provide cooling, wind-control, air pollution and carbon sequestration (Cvejic *et al* 2015). • We considered that greenways role in green gentrification may be strongly dependent on city characteristics (residents' commuting, city structure).

Results

SGU characteristics

From the 28 cities included in our studies, those with SGUs with higher population density were those in the United Kingdom, Ireland and Nantes, while those that extended more beyond the city center were all US cities (Austin, Detroit and Seattle) (table 2). In all our cities, 50% of the SGU had not had any new public transport stops built before the 2000s or before the 2010s. The cities where a higher number of public transport stops had been built in a SGU before the 2000s were all in Europe (Barcelona, Dublin, Lyon, Nantes and Sheffield) while before the 2010s the cities with a higher number of public transport stops built in a SGU were in Barcelona, Portland, San Francisco and Nantes. The cities where a high number of new residential buildings per SGU was sustained over time were in North America (i.e. Portland and Vancouver). In contrast, the cities with an average higher SGU green coverage before the start of our study period were in Europe (Barcelona, Copenhagen, Edinburgh, Valencia and Vienna).

The average newly inaugurated and acquired greenspaces at the SGU level differed widely among greenspace types (figure 2). Parks were the spaces with the highest area built per SGU from all greenspace types in terms of the 95th percentile (pre ~ 2000s values being 95th percentile = 230.93 and pre ~ 2010s 95th percentile = 25.19, data not shown) and also in terms of the maximum values (pre ~ 2000s maximum is 6042.86, while pre ~ 2010s one is 1424.76). More specifically, when exploring the value of the 95th percentiles, Lyon, Amsterdam and Valencia had the highest values of park area built pre ~ 2000s, while Nantes, Copenhagen and Amsterdam had them for the values pre ~ 2010s. The rest of greenspace types (gardens, nature preserves, recreational and green- ways) had 95% of their values of areas built below five and maximum values below 2000.

SGU average gentrification scores were generally higher in the US, particularly in Baltimore, Detroit and Philadelphia in the 2010s. In contrast, they were generally lower in Europe: Edinburgh in the 2000s, Valencia in the 2000s and Vienna throughout the 2000s and the 2010s (figure 3).

Analyses on gentrification and different types of new greenspaces altogether

Overall, when considering together mid-term gentrification (in the decade of the 2000s, in the decade of the 2010s) and long-term gentrification (through the decade of the 2000s and 2010s), we found associations with several factors, with distance to the city center and new parks being the most relevant ones (figure 4, tables S5 and S6). More specifically, we found that— in the presence of other covariates—new parks were positively associated with gentrification processes in more than half of our models. We also found suggestive evidence that newly designated nature pre- serves were negatively associated with gentrification processes (i.e. negative links in half of our models). Meanwhile, for new gardens, recreational spaces and greenways we did not

find consistent results across cities.

Analyses on gentrification and different types of new greenspaces separately by mid-term and long-term gentrification

Our findings of new parks being positively associated with gentrification processes in more than half of our models remained when considering both mid- (in the decade of the 2000s and particularly in the decade of the 2010s) and long-term gentrification processes (figure 4, tables S5 and S6). For example, in the cities of Atlanta, Boston, Denver, Louisville, Milwaukee, Portland, San Francisco, Seattle, Vancouver, Barcelona and Dublin our data showed links between new parks and both mid-term gentrification and long-term gentrification processes. Moreover, in Austin, Cleveland, Washington D.C., Bristol, Copenhagen, Nantes, and Vienna new parks were associated with mid-term gentrification processes.

However, the negative association between that newly designed nature preserves and gentrification processes were more consistent for long-term gentrification processes (figure 4, table S6) than for mid- term gentrification (table S5). Indeed, we found that more area of newly designated nature preserves was associated with smaller long-term gentrification indexes for all cities for which we had data except for three: Boston (*postprob*-value = 0.70), Calgary (*postprob*-value = 0.65) and Nantes (*postprob*- value =0.79).

We also found that long-term gentrification was positively associated with new gardens and greenways inaugurated between the start of our study period and the 2000s in more than half of our models. Last, our results indicated some positive relationships between long-term gentrification and new recreational spaces (in Atlanta, Baltimore, Denver, Washington D.C: and Barcelona) inaugurated between the start of our study period and the 2000s (i.e. positive associations in half of the relationships we explored). In contrast, we found inconsistent results between new greenways, recreational spaces and gardens and mid-term gentrification indexes.

Table 2. Descriptive statistics of census tract (SGU) characteristics, by city.

		Number of public transit stops added…		New residential building built in the tract …			
	Centre [metres: mean (sd)]	pre2000s (stops/year: median (95th pct))	pre2010s (stops/year: median (95th pct))	pre2000s (buildings/year: median (IQR))	pre2010s (buildings/year: median (IQR))	Green coverage prior to 1990 [ha: mean (sd)]	Inhabitants per square kilometer in 2010 [Inhab./ km2: mean (sd)]
Atlanta	14 940 (9902)	0 (0.06)	0 (0)	0.02 (0.06)	0 (0.01)	0.04 (0.08)	1451 (1057)
Austin	20 019 (14 261)	0 (0)	0 (0.13)	0.50 (5.70)	0.20 (4.60)	0.05 (0.09)	1258 (1285)
Baltimore	4986 (2592)	0 (0.17)	0 (0)	0 (0)	0 (0)	0.25 (0.29)	4686 (3396)
Boston	5615 (3382)	0 (0)	0 (0)	0 (0.01)	0 (0)	0.36 (0.47)	9449 (6744)
Cleveland	12 359 (5858)	0 (0)	0 (0)	0.50 (1.90)	0 (0.20)	0.08 (0.17)	1978 (1193)
Denver	7391 (4651)	0 (0.17)	0 (0.13)	1.40 (5.95)	0.60 (3.20)	0.13 (0.17)	2808 (1,534)
Detroit	16 914 (8953)	0 (0)	0 (0)	0 (0.60)	0 (0)	0.05 (0.11)	1937 (1020)
Louisville	11 763 (6450)	—	—	0 (0.10)	0.20 (0.75)	0.06 (0.12)	1448 (858)
Milwaukee	8094 (4468)	—	—	0 (0.20)	0 (0)	0.01 (0.03)	3081 (2186)
Philadelphia	8236 (5316)	0 (0)	0 (0)	0.30 (2.30)	0.20 (1.00)	0.21 (0.28)	7430 (4188)
Portland	9048 (6448)	0 (0.17)	0 (0.32)	4.25 (7.55)	4.00 (7.55)	0.07 (0.10)	2513 (1479)
San Francisco	4875 (2815)	0 (0.17)	0 (0.38)	1.65 (2.95)	0.20 (0.80)	0.39 (0.47)	11 563 (8915)
Seattle	17 582 (11 196)	0 (0)	0 (0.13)	0 (1.80)	0 (2.70)	0.06 (0.12)	2115 (2177)
Washington DC	5250 (2419)	0 (0.08)	0 (0)	0 (0.01)	0 (0)	0.37 (0.34)	6195 (4398)
Calgary	8553 (3817)	0 (0)	0 (0.14)	0 (1.10)	0.20 (7.05)	0.13 (0.23)	2708 (1579)
Montreal	8710 (6001)	0 (0)	0 (0)	0.10 (0.30)	0 (0)	0.29 (0.28)	7833 (5472)
Vancouver	4958 (2436)	0 (0.08)	0 (0.14)	5.65 (10.98)	5.60 (10.75)	0.18 (0.21)	7103 (5522)
Amsterdam	3950 (2365)	0 (0)	0 (0)	0.33 (1.92)	0.13 (0.69)	0.38 (0.32)	10 468 (7627)
Barcelona	3418 (1614)	0 (1.00)	0 (1.00)	0.10 (0.30)	0 (0)	0.98 (1.16)	43 103 (24 066)
Bristol	3828 (2155)	—	—	2.22 (4.44)	—	0.60 (0.39)	6078 (3496)
Copenhagen	3301 (1652)	—	0 (0)	—	0 (0.17)	0.86 (1.22)	15 353 (11 298)
Dublin	4085 (1885)	0 (0.43)	0 (0)	—	—	0.36 (0.26)	6512 (4273)
Edinburgh	4387 (2861)	0 (0)	—	0.33 (4.17)	—	1.15 (0.99)	7627 (6278)
Lyon	2493 (1249)	0 (0.33)	0 (0.14)	—	2.64 (9.75)	0.58 (0.39)	15 756 (9990)
Nantes	2712 (1331)	0 (0.44)	0 (0.22)	—	11.57 (14.36)	0.16 (0.17)	6867 (3615)
Sheffield	5025 (2817)	0 (0.33)	—	1.11 (4.33)	—	0.51 (0.40)	4833 (510)
Valencia	2387 (1630)	0 (0.25)	—	0.10 (0.30)	—	0.94 (1.01)	31 189 (19 437)
Vienna (central)	4543 (2673)	—	—	—	—	0.83 (0.73)	14 644 (11 051)

Notes: Indicates that no data was available.

Mean (standard deviation (sd)) is reported for continuous parametric variables. Median (interquartile range (IQR) is shown for continuous non-parametric variables, with the exception of those with a high percentage of zeros, for which median (95th percentile (95th pct)) is reported.

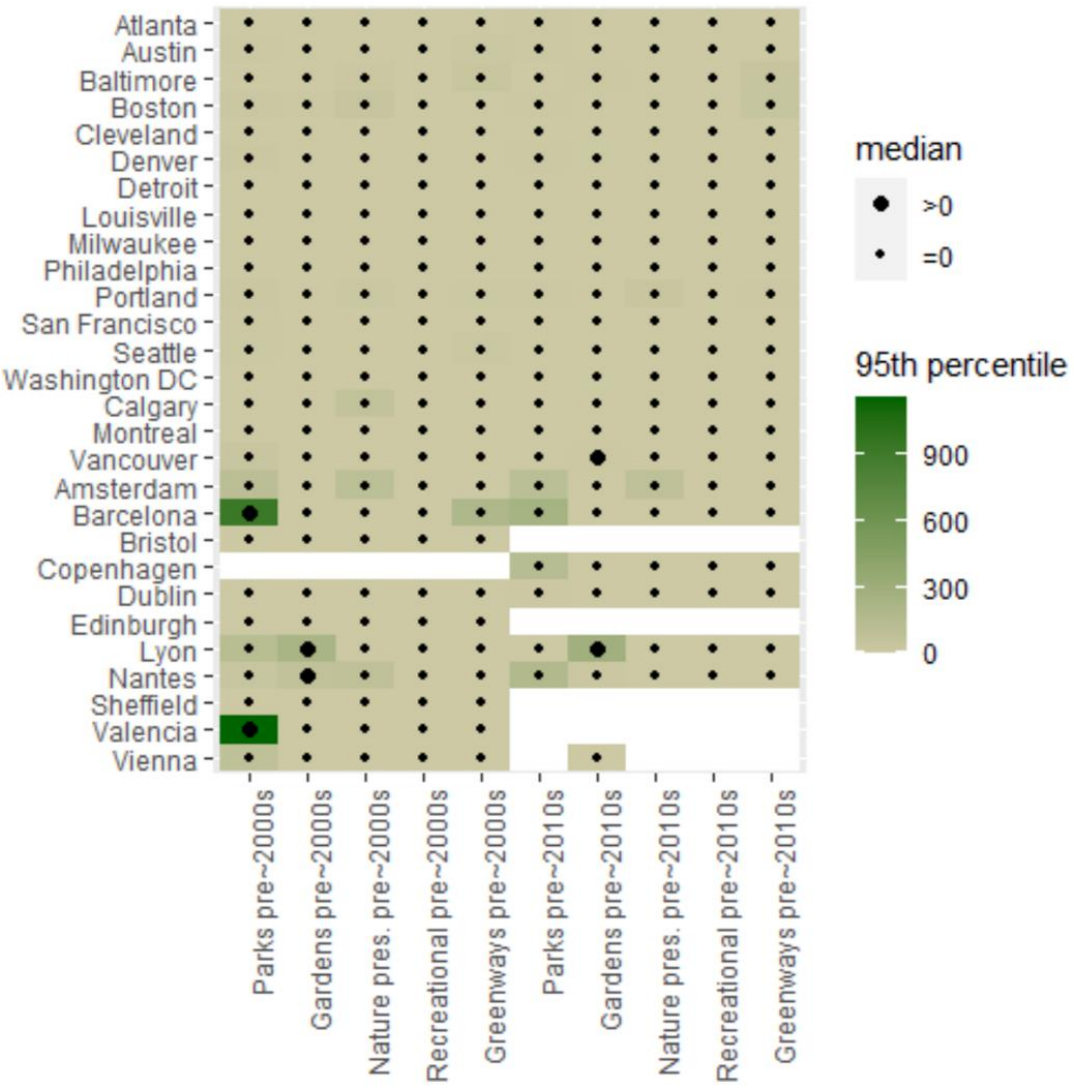


Figure 2. Descriptive statistics (median, 95th percentile) of new greenspace of different typologies before 2000s and also before 2010s, by city. White cells indicate data not available. For Vienna, nature preserves pre ~ 2010s, recreational spaces pre ~ 2010s and greenways pre ~ 2010s only had one value different than zero each, and for that reason they were excluded from analyses, so their descriptives are not included.

Analyses on gentrification and different types of new greenspaces over time periods

When exploring if associations between new green- spaces and gentrification were sustained over different time periods we did not find any clear patterns (tables S5 and S6). Only for parks, gardens and greenways we did find sustained associations over time in some cities. We found that parks pre ~ 2000s were positively linked with gentrification in the 2000s while parks pre ~ 2010s were associated with increased gentrification in the SGU in the 2010s in Atlanta (postprob-value = 0.96 for the association with parks pre ~ 2000s and postprob-value = 0.99 for the association with parks pre ~ 2010s), Cleveland (postprob- value = 0.68 and postprob-value = 0.87), Denver (postprob-value >0.99 and postprob-value = 0.66), Louisville (postprob-value = 0.89 and postprob- value = 0.77), Seattle (postprob-value = 1.00 and postprob-value = 0.75) and Nantes (postprob- value = 0.99 and postprob-value = 0.73). The same

trend was found in Denver for greenways and in Milwaukee, Seattle and Nantes for gardens. Moreover, we found some indications of the relationship between new parks and gentrification increasing over time as—from the cities we included in the study—we found a higher proportion of the associations between parks and gentrification for gentrification in the 2010s than in the decade of the 2000s.

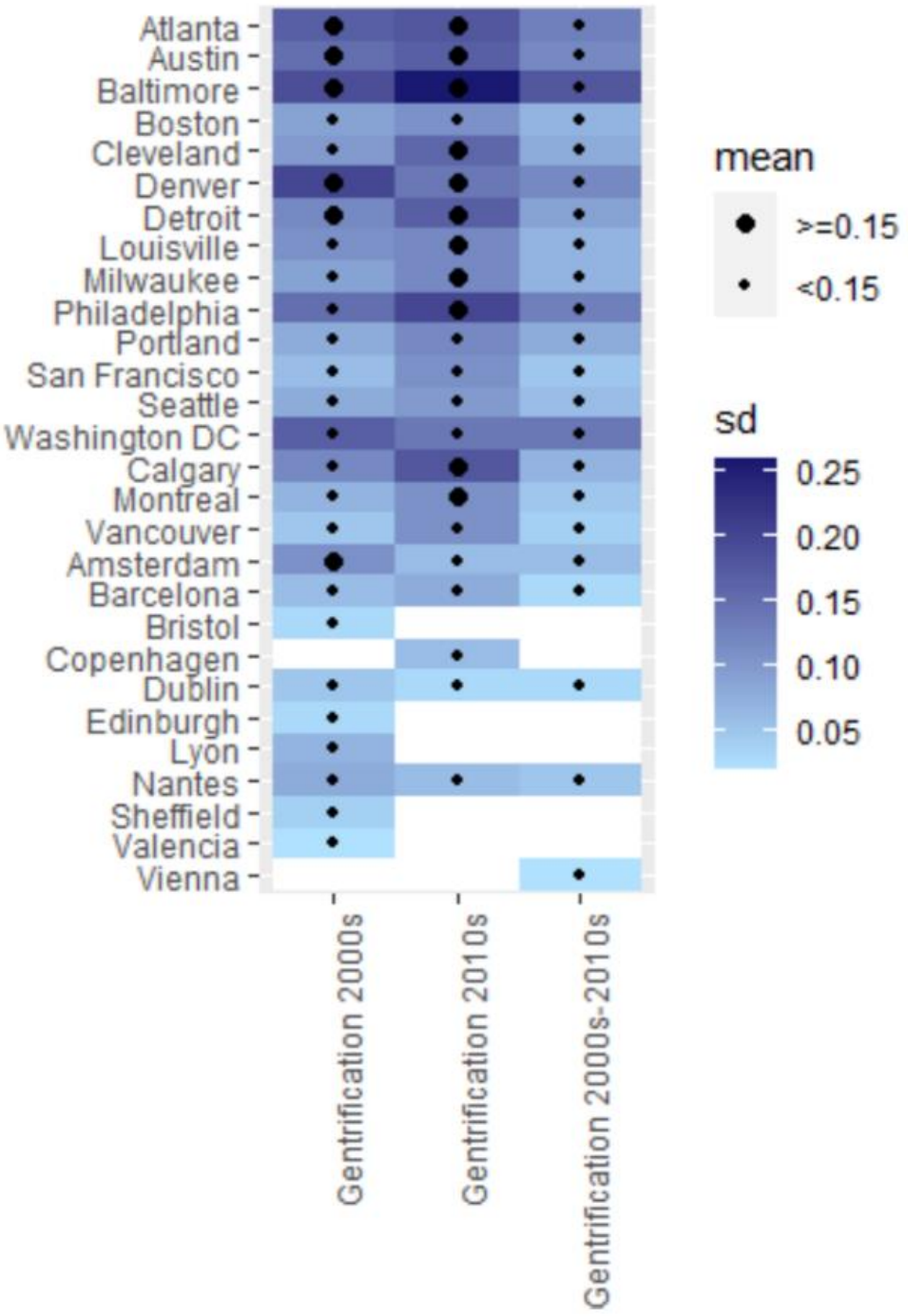


Figure 3. Descriptive statistics (mean and standard deviation (sd)) of gentrification indicators, by city. White cells indicate data not available.

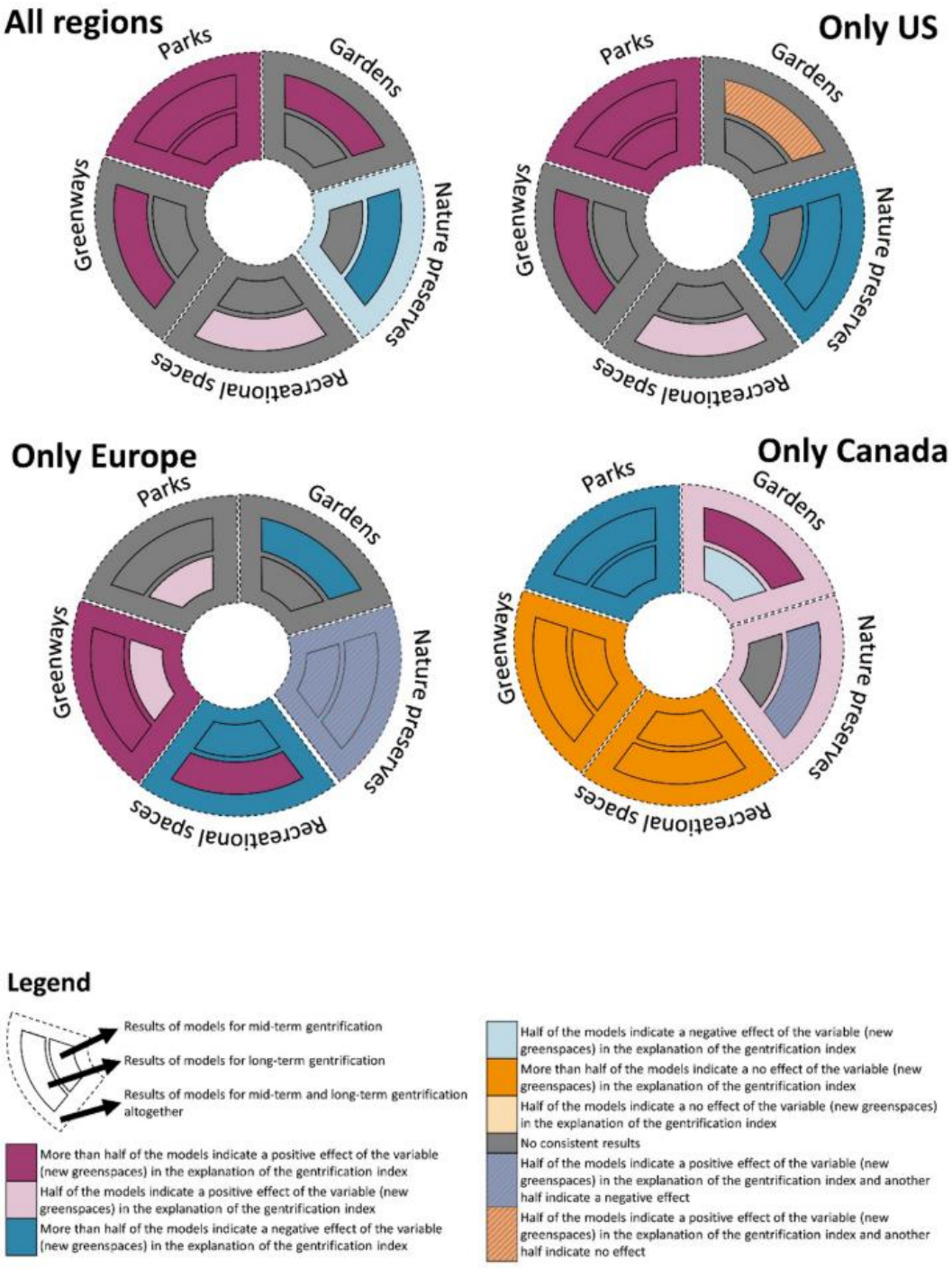


Figure 4. Summary of the associations between different types of greenspaces (parks, gardens, nature preserves, recreational spaces, and greenways) and gentrification indexes (mid-term, long-term and considering mid and long-term gentrification altogether). The summary is presented for all the cities together and also for each geographical context (European, US, Canada).

Analyses on gentrification and different types of new greenspaces by geographical area

Comparisons of our results by geographical area revealed that positive associations between new parks and gentrification were predominantly found in the US, both overall and when looking only at mid- or long-term gentrification processes (figure 4, tables S5

and S6). For example, from all the US cities we included in our study, only in Baltimore, Detroit and Philadelphia our data did not reveal a positive link between parks and gentrification. In contrast, we did not find any clear patterns for parks in Europe, while in Canada we mostly found negative associations between parks and gentrification in most cities. Similarly, our findings on newly designated nature preserves being negatively linked with gentrification, particularly when considering long- term gentrification, were also mostly found in the US, where from all the US cities for which we had data, only in Boston we found links between newly designated nature preserves before the 2000s and gentrification processes in the decades 2000s–2010s. Meanwhile, in Europe and Canada no consistent pat- terns were found for newly designated nature pre- serves and gentrification processes. Last, the positive relationships we found between new gardens and gentrification were predominantly found in Canada and those for greenways were mostly found in Europe and the US.

Discussion

Overall, this unique multi-city study on the relationship between different types of greenspaces and gentrification clearly demonstrates that—apart from other commonly recognized factors such as distance to the city center—different types of newly inaugurated or acquired greenspaces have a different role in the gentrification process. Through an international analysis that reveals trends at the city-level based on SGU data, we find that parks are the type of green- spaces more consistently positively associated with gentrification processes. We also found some indications of newly designated nature preserves being negatively associated with gentrification processes, particularly when considering long-term gentrification processes (i.e. throughout the 2000s and the 2010s) and in the US. Meanwhile, for new gardens, recreational spaces and greenways our research shows mixed results.

Our research indicates that different types of greenspace can be associated with gentrification (solely or together with other factors such as distance to the city center). This finding is aligned with most of the existing evidence (Lutzenhiser and Netusil 2001, Czembrowski and Kronenberg 2016, Kwon *et al* 2017, Maantay and Maroko 2018, Rigolon and Németh 2020, Chen *et al* 2021, Kim and Wu 2022).

Our findings about parks as the greenspace type more consistently positively associated with gentrification processes are partly in line with previous scientific evidence. A study in Barcelona had already found that new parks built in the old town or in traditionally industrialized neighborhoods explained gentrification processes (Anguelovski *et al* 2018). However, Rigolon & Németh did not find a link between acreage of new parks and gentrification in their pooled analyses of data from ten US large and medium-sized cities (Rigolon and Németh 2020). The differences in results with our study could be due to our research design including a more complete and refined set of indicators to calculate gentrification scores, controlling of spatial autocorrelation rather than using multilevel logistic regressions to estimate the associations and also due to our study avoiding

reverse causation (i.e. our investigation estimating the association between greenspace inaugurated or acquired at a time period and gentrification in a later period, while the study by Rigolon & Németh estimated the relationships between greenspace and simultaneously-occurring gentrification).

Our results may indicate that the gentrification effects related to urban greening agendas and associated green branding (Garcia-Lamarca *et al* 2019) may be strongly centered on parks. 'Normative' aesthetics and recreational possibilities may make parks the type of greenspaces that best encompass familiarity, favorability and uniqueness and provide more utility to neighborhood residents. All these factors are linked with green branding and gentrification and may increase willingness to pay for these neighborhoods (Chan 2015, Amorim Maia *et al* 2020). For example, aspects such as ornate landscapes, with manicured garden designs and fences (which might give high feelings of security) could make parks more aestheticized and attractive to gentrifiers and real estate developers (Chen *et al* 2021). They are also those spaces where racialized minorities might find themselves more controlled by police, surveilled, and criminalized (Anguelovski and Connolly 2021, Hoover and Lim 2021).

Moreover, the higher prevalence we found of positive relationships between new parks and gentrification in more recent times (i.e. from the cities we included in the study, we found a higher proportion of associations between new parks and gentrification for gentrification in the 2010s than in the decade of the 2000s) are in line with findings from recent studies identifying the 2010s as the decade in which cities have deployed a more articulated and formal green branding (Gulsrud *et al* 2013, Andersson 2016, Garcia-Lamarca *et al* 2019). This comprehensive green branding may be the result of developers and cities around the world aiming at reproducing the marketing and private profit-making 'success' of New York's High Line and Atlanta's BeltLine (Loughran 2014, Haase *et al* 2017, Weber *et al* 2017, Immergluck and Balan 2018, García-Lamarca *et al* 2022). The opening of both green interventions was linked to an increase in property values (and green gentrific- ation), which cities and developers potentially imported to other contexts (Haase *et al* 2017, Rigolon and Németh 2020).

We are aware of only three previous studies on the impact of other typologies of greenspaces (such as nature preserves, gardens, recreational spaces or greenways) on gentrification. A previous study demonstrated that greenways created between 2008 and 2016 increased the odds of census tract gentrification, but those created between 2000 and 2008 were not linked to gentrification (Rigolon and Németh 2020). Other research found that the availability of community gardens was modestly associated with gentrification (Braswell 2018, Maantay and Maroko 2018). Our findings add to the existing, yet still scarce, evidence. The heterogeneity of associations we found may indicate that gardens, recreational spaces and green- ways are types of greenspaces with very diverse accessibility, uses, aesthetic, and functional characteristics and roles in gentrification processes. It may also be that other factors from which we did not have data (such as presence of vacant land) may influence the role of community gardens,

recreational spaces or greenways in gentrification processes.

Our findings that nature preserves are negatively associated with gentrification processes, particularly when considering long-time gentrification processes or in US cities, are novel and have not been explored before. We hypothesize that most of the nature pre- serves included in our analyses and categorized as new greenspaces are in fact greenspaces that were already present before our period of study (either before the 1990s or before the 2000s), but which became enclosed, formalized as protected areas or whose management changed from private to public during our study period (1990–2016). These legal or administrative changes potentially may not trans- late into new value creation. An alternative explanation could be that preserves may not be perceived nor allowed (like La Petite Amazonie in Nantes) as formal accessible green spaces for daily use or may even be associated with feelings of fear or insecurity for some people due to their wildness (Lyytimäki and Sipilä 2009, Rupprecht and Byrne 2014).

The differences we find between the US and Canada and Europe in the occurrence of green gentrification may also be due to distinct policy and planning contexts, with European cities generally benefiting from the greater presence of anti-displacement tools and equitable greening practices (Oscilowicz *et al* 2022) in comparison with US cities. Last, the importance of spatial effects found in our analyses indicates that new greenspaces located near gentrify- ing neighborhoods are more susceptible to gentrification than those located far away, which is in line with previous evidence (Pearsall and Eller 2020). This may suggest that greenspaces serve as an anchor to support gentrification processes already existing in the vicinity, but do not have an impact alone.

Our original and methodologically robust study explores the associations between a broad range of types of greenspaces and gentrification. To our know- ledge, it is the first to investigate these associations in a broad range of cities in Europe, Canada and the US, across different time periods using rigorous novel methods, namely a Bayesian spatial analysis approach, to do so. More specifically, our control of spatial autocorrelation and a broad range of potential confounders and our gentrification assessment with a score developed to be valid in different geographical contexts and time periods while considering the het- erogeneity of these different cities are strong elements of our study. Our study design also prevents reverse causation, as neighborhood gentrification cannot casually influence new greenspace creation, inauguration, or improvement in previous years.

Our study, however, also faces some limitations. Our aim to compare a broad range of cities in different regions prevented us from using a completely consistent data protocol, so we had to find compromises in the use of time periods and variables across the different cities. We use SGU as the unit of ana- lysis, but SGU limits do not determine gentrification processes, and we had low variability in our green- space variables (i.e. a lot of our census tracts had no new greenspaces). Green gentrification may be better assessed through analyses using greenspaces as the unit of analysis,

despite the high level of data process that developing these measures can need may make them inefficient at large scale. Finally, our study includes a very detailed dataset of types of new green- spaces, but factors such as neighborhood historic significance and characteristics, greenspace size or presence of private greenspaces that may be correlated with both gentrification and public greenspaces, and that previous studies have explored as explanatory variables (Anguelovski *et al* 2018, Chen *et al* 2021, Donovan *et al* 2021, Kim and Wu 2022) were not included.

Conclusions

In summary, our study reveals that parks—together with other factors such as proximity to the city center—may contribute to gentrification processes (i.e. positive associations in more than half of our models), particularly in the US context, except in historically black disinvested postindustrial cities with an abundance of vacant land. In contrast, nature pre- serves, greenways, gardens and recreational spaces are types of greenspaces with diverse roles in gentrification processes (some positive, some negative and some no effect associations). We conclude that the phenomenon of green gentrification in North America in particular, and in Europe to some extent may be reinforced more by parks than other greenspace types.

Both gentrification and an increase in re-naturing projects are well-described in cities around the world (Lees 2012, Haase *et al* 2017, Navarrete Escobedo 2020). Moreover, green gentrification is growingly reported in different locations (Quinton *et al* 2022). Accordingly, although our findings refer to Europe and North America, they should be considered in other contexts and future studies should explore if our results are replicated in other geographical locations such as South America or Asia.

Future studies should further explore the potential impact of different characteristics and other attributes of greenspace on gentrification, build- ing on the attributes already explored to produce comparable evidence. When doing so, it will be important to investigate a combination of types and biophysical characteristics (e.g. parks of different size, parks with different attributes), including socio- cultural traits related to greenspaces attractiveness and perception (van Vliet *et al* 2020, Kim and Wu 2022) and to use greenspace as the unit of analysis (as previously done by (Anguelovski *et al* 2018). The main objective of our study was to investigate whether different types of greenspaces impact gentrification. However, as previous studies have suggested, future lines of research should also explore if the causal link is inversed (i.e. if gentrification processes explain the creation and designation of new greenspaces) (Shokry *et al* 2020, Reibel *et al* 2021).

Considering the environmental and health benefits of urban re-naturing projects, we are calling for cities to keep investing in improving park access and availability in under-privileged neighborhoods while simultaneously implementing anti-displacement and green inclusive policies (Oscilowicz *et al* 2022). With- holding greenspace investment and

associated bene- fits would indeed risk reinforcing the health inequities and environmental injustices that socially underprivileged residents already face.

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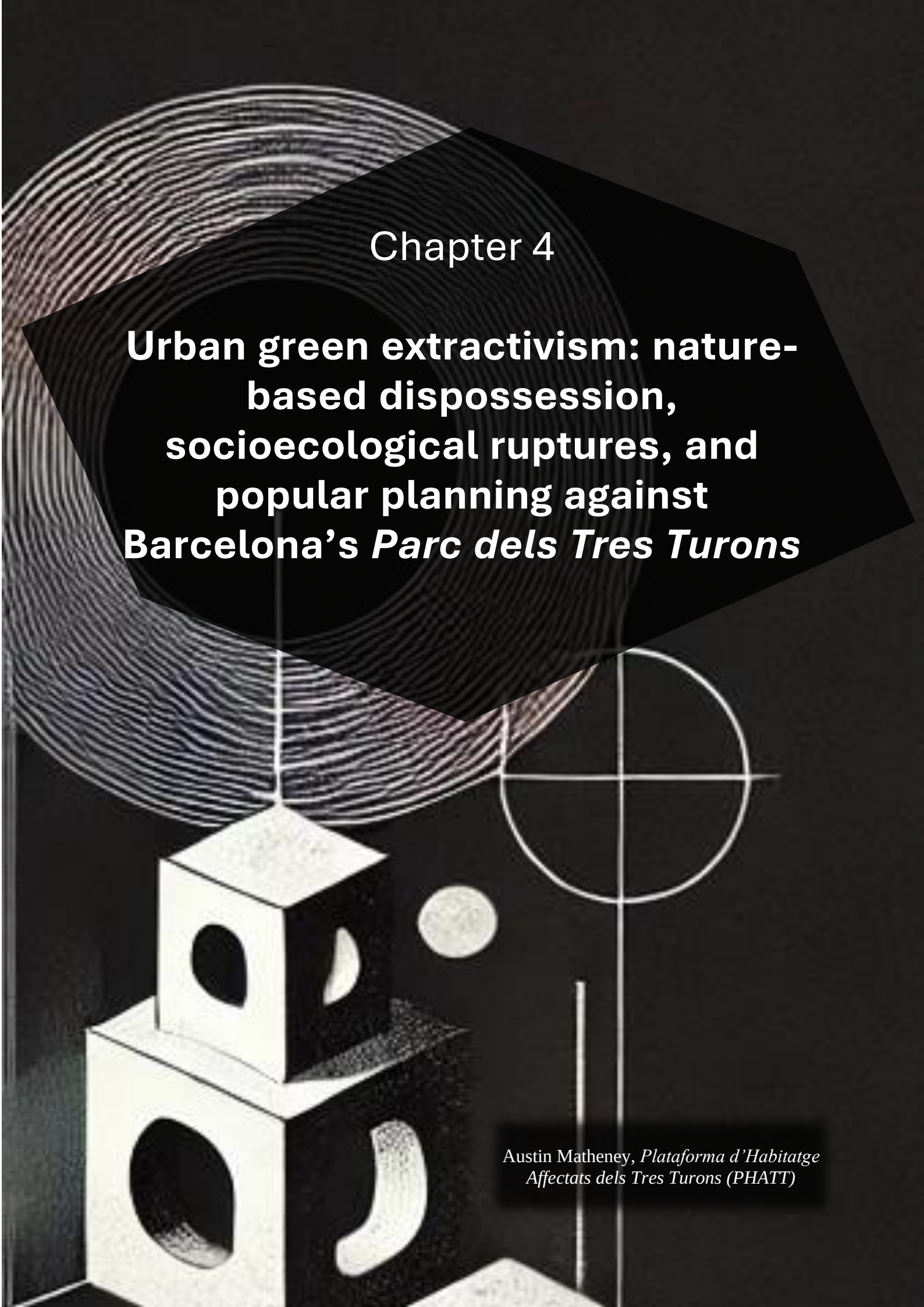
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Chapter 4

Urban green extractivism: nature-based dispossession, socioecological ruptures, and popular planning against Barcelona's *Parc dels Tres Turons*



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Chapter 4. Urban green extractivism: nature-based dispossession, socioecological ruptures, and popular organizing against Barcelona's *Parc dels Tres Turons*[17]

Introduction

In 1902, lawyer Martí Trias i Domènech became the first person to purchase a plot of land in order to build a *villa* and live inside of Park Güell. Inspired by the British garden-city movement, architect Antoni Gaudi was contracted and aimed to design a high-end private residential development which seemlessly existed with the natural landscape of the *Turóde Carmel* (the hill of Carmel in Catalan). Through the use of local materials, harvesting rainwater, and including green spaces, gardens, and ecological corridors throughout the new 'park', Guadi envisioned a harmonious blend of nature and architecture. After declining interest in resettlement to the area, Park Güell was opened as a public park in 1926. Nearly a century later, in 2013, this now UNESCO World Heritage site was privatized and enclosed, with entrance fees rising to 16 euros. Attracting 4.4 million visitors in 2023 (Barcelona de Servies Municipals,2024) —almost three times the population of Barcelona—the area surrounding Park Güell is now slated to become the city's new 'green lung' and 'green balcony'.

Just a few blocks away, in recent municipal efforts to both decentralize tourism and create additional green spaces in an otherwise dense and grey city like Barcelona, a 'new' Parc dels Tres Turons (Park of the Three Hills in Catalan) is planned as an expansion and connection of three existing parks. This 'upgrade' will increase the total park area from just over 30 hectares to 93 hectares. Rather than drawing radical inspiration from Gaudi's original plans which share the same *turo*, the 'new' *Parc dels Tres Turons* will not include new or existing housing in its interior. This decision, however, necessitates the destruction of nearly 300 working-class homes throughout the eight neighborhoods affected by the current plans.

The model of 'green' through which the Ajuntament de Barcelona *(City Hall of Barcelona)* envisions the 'new' *Parc dels Tres Turons* is clearly outlined in the park's plans – drawing inspiration from that of *El Parque de Retiro* in Madrid, *Central Park* in New York, *Regent's Park* in London, *Tiergarten* in Berlin, and *Bois de Bologne* in Paris. These ideal types are referenced as being compact parks 'in central locations in important European cities' (note New York City is not located in Europe nor is the proposed park centrally located in Barcelona) (Ajuntament de Barcelona, 2020: 22.) without housing in their interior and "only" for 'recreation and relaxation for *all* inhabitants of the city'(ibid, emphasis own). The removal of housing from within this "city park" is 'necessary' because it will allow for the new park to meet the standards of these 'best practices'– arguing that housing

[17] This paper has been submitted to Antipode.

within the park "…would hinder its management, services, type of accessibility and *above all* safety and general public use…" (ibid, emphasis own).

The travelling of a specific *type* of green and its blanket insertion onto the socio-material fabric of a neighborhood/city is an aspect much discussed in the literatures on policy mobilities (McCann, 2017), network formation (Goh 2021; Goh 2023), and city boosterism (McCann 2013). The way these literatures conceptualize cities as dynamic processes, rather than static forms, which travel beyond municipal and national borders, highlights their far-reaching impacts in global arenas, illustrating how urban policies and ideas get diffused and adapt through networks of influence and local adaptations (McCann 2013; Goh 2021, 2023). Taken together, this has led scholars to highlight the emergence and existence of a 'green planning orthodoxy' (Connolly 2019), arguing the hegemonic approach to the contemporary '(re)naturing' of cities as driving processes of accumulation by green disposession worldwide (Safransky 2014, 2017; Anguelovski and Corbera, 2023) - leading to common trends of green gentrification internationally (Anguelovski et al. 2020; Quinton, Nesbitt and Sax, 2022; Gould and Lewis, 2018) as well as exposing linkages between 'sustainable cities' and over-tourism (Galvez et al., 2017; Day, 2020). As dispossession becomes a central theme in critical discussions of 'the green city,' the discourse extends to 'greening' discussions of 'urban extractivism'.

Urban scholars have increasingly turned to concepts such as 'green rent gap' (Rigolon and Clooins, 2023; García-Lamarca et al., 2021) 'green grabbing' (García-Lamarca et al., 2022), 'greenwashing,' or 'green gentrification', as mentioned above, to critique the socio-environmental divides created or accelerated by contemporary urban green (re)development. While these frameworks primarily address the material repercussions of urban green extractivism, there is a growing recognition of the discursive power embedded in urban greening narratives through concepts such as the 'social imaginary' and green branding (Angelo, 2021; García-Lamarca et al., 2021; Matheney et al., 2024). The development of these urban-focused frameworks has paralleled efforts to better understand rural green extractivisms and draw connections between rural green extractivism and urban growth, particularly in this era of so-called sustainable urban development. For example, the urban green transition shift is durably linked to the expansion of extractive industries in rural areas (e.g., for sustainable transport, smart cities, etc.) (Zografos, 2022; Andreucci et al., 2024; Dunlap et al 2024). By operationalizing the perspective of green extractivism, we can critically analyze both the accumulation processes associated with urban greening and the discursive power of 'green.'

Importantly, critical studies on (green) extractivism draw attention to the proactive measures taken by those who oppose these developments, highlighting the significant role played by communities and grassroots movements in contesting and transforming these processes (Svampa, 2019). This paper emphasizes the necessity of not only analyzing the extractive strategies within green urban projects but also recognizing and

engaging with resistance efforts. By incorporating these elements, the paper argues for a more complete examination of urban green infrastructure projects—one that considers both the extractive dynamics and the forms of resistance they generate. Not only do these communities have intimate relationships with the natural landscapes in which they live, but also because of this knowledge and bond we may be better placed to construct just futures through already existing realities (Apostolopoulou et al., 2022; Mayer 2020; Temper et al., 2018).

The research is grounded in a year of participatory action research conducted with the *Plataforma d'Habitatge Afectats dels Tres Turons* (PHATT). PHATT, along with other community organizations, continues to organize 'popular planning' events and engage in direct action against the new park and the increasing tourism and commercialization of the *barris de muntanya*. Through informal interviews, ethnographic field notes, participant observation, and document analysis, we juxtapose the visions and goals of the Ajuntament with more place-based socio-natures and idealized futures and ask: ***how does 'green extractivism' manifest in urban (re)devevlopment projects (like in Barcelona's Parc dels Tres Turons), and what are the socio-ecological consequences for existing communities?*** In doing so, the paper aims to deconstruct the plans and situating its specific *type* from its local impacts to its broader global connections.

The paper begins by outlining the conceptual and theoretical lens through which the collected data is analyzed—specifically focusing on 'green extractivisms.' This analysis centers on two of the four key facets of 'green extractivisms': the leveraging of socioecological and climate crises to support existing markets or create new profit-generating opportunities, and the use of ecological sustainability claims to justify extractive practices (Dunlap et al., 2024). Following this theoretical framing, the paper delves into the historical and contemporary contexts surrounding the *Parc dels Tres Turons*, setting the stage for the methodological approach of this study. Through this analysis, I demonstrate how the Ajuntament de Barcelona's planning of the PTT is not only socially and spatially selective but also erases and marginalizes place-based histories and the current uses of already existing green spaces. The project drives unjust housing practices by facilitating green rent extraction—by making spaces more legible to capital—while sacrificing an area already burdened with tourism.

(Urban) Green Extractivism: Expanding Nature in the City and its Critiques

Extractivism, as a concept, has its roots in Latin American structuralism and dependency theory, where scholars like Raúl Prebisch and Andre Gunder Frank critiqued the economic dependency of Latin America on the export of raw materials (Changnon et al., 2022). This early literature highlighted how such dependency

perpetuated underdevelopment and inequality, laying the groundwork for later critiques of neoextractivism. In the 2000s, scholars such as Eduardo Gudynas and Albert Acosta expanded these critiques to address the environmental and social costs of extractivism under leftist governments, advocating for sustainable alternatives like 'post-extractivism' (Gudynas, 2013; Acosta, 2017). More recently, the concept has been broadened to include 'supply chain extractivism,' which examines how global commodity chains extend the impacts of extraction far beyond their origins (Healy et al., 2019; Watts, 2021). This literature traditionally focused on rural settings, but urban scholars, including David Harvey, have extended the concept to the urban realm, linking it to processes of capital accumulation, gentrification, and the commodification of urban spaces. Harvey's work, along with others, set the stage for examining how extractivist logics manifest in cities, particularly through urban redevelopment and greening projects, bridging the rural-urban divide in discussions of extractivism.

Urban scholars have developed a wide range of critiques regarding the environmental and social impacts of greening projects in cities, with one of the most prominent being that of green gentrification (Anguelovski et al., 2022; Gould and Lewis, 2012; Pearsall, 2018). Ecological or green gentrification refers to a process by which urban greening initiatives, such as the creation of parks, greenways, and eco-friendly infrastructure lead to the displacement of lower-residents and the commodification of urban spaces (Anguelovski et al., 2022) . Another significant critique involves 'green grabbing' (García-Lamarca et al., 2022), a term adapted from rural contexts to describe the appropriation of urban land under the guise of environmental protection. In parallel, discussions of green infrastructure and sustainability discourse, led by scholars like Hillary Angelo, critique the moral and political justifications for these projects, revealing how they often serve economic interests rather than genuine ecological goals (Angelo, 2021).

Additionally, the concepts of green rent and green gap, as explored by Maria Kaika and others, illustrate how the economic benefits of urban greening are unevenly distributed, often favoring wealthier residents and investors while marginalizing poorer communities. The work of Andreucci et al. (2017) builds on these critiques, specifically addressing how the accumulation of rents in urban settings is a critical aspect of green gentrification, tying it back to broader discussions of value creation and commodification within political ecology. Andreucci's et al.,'s (2017) extension of accumulation processes to include rent has influenced recent discussions about green extractivism, in both urban and rural contexts. While much of the literature on green extractivism has focused on rural conflicts, the integration of rent dynamics into this framework has opened new avenues for exploring how similar processes occur in cities.

Building on this foundation, Dunlap et al.,'s (2024) work identifies two key facets of green extractivism that are particularly relevant to urban contexts: (i) the leveraging of socioecological and climate crises to bolster existing markets or create new profit-generating opportunities, and (ii) the use of ecological sustainability claims to justify extraction. While Dunlap also identifies a third facet—namely, the deep entanglement

of green extractivism with conventional extractivism[18]—this has been extensively explored in the context of green gentrification and related urban processes. For instance, the work of scholars like Anguelovski et al. (2022) demonstrates how green infrastructure projects in 28 cities across Europe and North America have played varying roles in gentrification, depending on local context and other built environmental changes. This literature underscores that green gentrification is not a binary process but one that operates in tandem with other drivers of urban change, such as new developments and public transportation projects.

Civic resistance to urban greening projects often involves grassroots organizing, where local communities form coalitions to oppose displacement and privatization. These groups use a variety of tactics, including protests, public forums, petitions, and legal action, to challenge projects that threaten their neighborhoods (Oscilowicz et al., 2023; 2010; Cooke et al., 2020; Matheney et al., 2024). Civic resistance to urban greening projects in the U.S. often involves grassroots organizing through community-driven planning initiatives (Oscilowicz et al., 2023). These initiatives focus on empowering local residents to have a direct role in shaping urban development. Communities form coalitions, host public forums, and engage in participatory budgeting, where residents influence how funds are allocated to projects. They also use tools like community land trusts to retain control over land and prevent displacement.

In European contexts, civic resistance to urban greening projects often manifests through stronger municipal collaborations and policy-based approaches. Community-driven planning initiatives here frequently involve citizens' assemblies or participatory urban planning, where local governments actively include residents in decision-making processes (Matheney et al., 2024). European communities also utilize tools like cooperatives and social housing models to maintain control over land and prevent displacement. By organizing in this way, they create alternative visions for urban spaces, advocating for community-led planning and decision-making processes that prioritize social equity alongside environmental goals (ibid).

Dunlap et al.'s (2024) facets, therefore, provide a robust conceptual framework for analyzing urban green extractivism, particularly when viewed through the lens of socioecological crises and sustainability rhetoric. These facets allow for a critical examination of how urban greening projects are not merely benign environmental interventions but are often deeply embedded in the same capitalist logics that drive traditional extractivism in rural areas. By moving beyond a mere analysis of (potential) impacts of green gentrification in the area, we are able to understand "the myriad of systemic processes that enable it" (Sax et al., 2022: 376) – highlighting that green

[18] Extractivism refers to the large-scale extraction and export of natural resources, such as minerals, oil, and agricultural products, often at the expense of local economies and the environment. Latin American thinkers like **Raúl Prebisch** and **André Gunder Frank** argued that this model reinforces global inequalities, keeping peripheral countries in a state of dependency and underdevelopment. According to their theories, extractivism benefits developed nations while hindering industrialization and long-term development in Latin America.

gentrification “is a systemic outcome brought about by adherence to and participation in neoliberal competition and development processes shrouded behind a façade of ecological concern” (ibid).

Socioecological Crises as New Profit-Generating Opportunities	Ecological Sustainability Claims as Justification for Extraction

- **Green gentrification**
  - the influx of green amenities drives up property values, displaces lower-income residents, and benefits developers and investors. The socioecological crisis, in this case, is leveraged to justify redevelopment that primarily serves economic interests rather than addressing the underlying environmental and social issues.
- **Green rent and green gap**
  - green infrastructure projects create opportunities for the accumulation of green rent—profits derived from the increased value of properties near green amenities. This process often exploits the 'green gap' where the benefits of such projects are unevenly distributed, with wealthier residents reaping the rewards while marginalized communities face displacement. The socioecological crisis is used as a pretext to introduce these developments, framing them as necessary for urban resilience while facilitating profit generation for select groups.
- **Green grabbing**
  - Urban green grabbing involves the appropriation of land and resources under the guise of environmental protection and sustainability. Socioecological crises, such as the need for climate adaptation, are exploited to justify the commodification and privatization of urban spaces, often at the expense of existing communities.
	- **Green gentrification**
	  - Projects that introduce green spaces into urban areas are often marketed as essential for combating climate change and improving urban liveability. The sustainability narrative is thus used to obscure the extractive nature of these developments, which prioritize economic gain over social equity.
	- **Green rent and green gap**
	  - Developers and policymakers use the language of ecological sustainability to justify the commodification of urban green spaces, arguing that such projects are necessary for environmental stewardship. This narrative legitimizes the extraction of rent from these spaces, even as it exacerbates socio-spatial inequalities
	- **Political ontology and eco-modernization**
	  - The political ontology of green urbanism, which refers to the fundamental beliefs and assumptions about power and governance that shape our understanding of how the world should operate, is often criticized for using sustainability narratives to justify urban development projects that reinforce existing power dynamics and perpetuate social inequalities. Similarly, in ecological modernization discourses, which are grounded in the same set of underlying assumptions, these narratives are frequently employed to legitimize extractive practices that prioritize economic growth over genuine ecological and social justice, both in urban and rural contexts.

Table 1. Two core facets of analysis with urban sub-lenses

This paper deploys the two key facets identified by Dunlap et al. (2024) as analytical tools to critically examine the proposed Parc dels Tres Turons in Barcelona. This study is novel in its application of the green extractivism lens, traditionally used to critique rural development projects, to an urban context like the "Parc dels Tres Turons." By doing so, it reveals the same processes of accumulation and dispossession at work in both rural and urban settings, connecting these dynamics and demonstrating that the commodification of nature transcends geographic boundaries. This approach also supports arguments that "green" is often used as a social imaginary, legitimizing a wide range of projects—whether in rural or urban areas—that can mask social and environmental injustices (Angelo, 2021; Garía-Lamarca et al., 2021; Neidig et al., 2022; Matheney et al., 2024). By applying these facets, we aim to uncover how the planning and development of the park align with or deviate from critical socioenvironmental standards. Specifically, we will analyze how the discourse surrounding the park’s development leverages the current climate crisis and the urgent need for urban sustainability to justify the project, masking underlying processes of accumulation and displacement.

Furthermore, I balance this analysis by examining the forms of resistance that have emerged in response to the park’s development. Understanding these resistances is crucial, as they provide alternative visions of urban development that challenge the dominant narratives of green urbanism (Apostolopoulou et al., 2022; Temper et al.,

2018). By integrating these perspectives, our study aims to offer a comprehensive critique of the Parc dels Tres Turons, situating it within the broader context of urban green extractivism and contributing to ongoing debates about the future of urban sustainability.

Through this approach, we hope to demonstrate that while urban greening initiatives like the Parc dels Tres Turons are often framed as solutions to socioecological crises, they may also perpetuate the same extractive practices that they purport to address. By critically examining these projects through the lenses of socioecological crises and sustainability rhetoric, we can better understand the complex dynamics at play and advocate for more just and equitable forms of urban (re)development.

Case description and Methods

Case description

We focus our analysis on the development dynamics surrounding the proposed Parc dels Tres Turons (*park of three hills* in Catalan) in Barcelona, Spain. The proposed park (first approved in the 1953 regional plan[19]) aims to convert three hills (Turo del Creuta del Coll, Turo de Carmel, and Turo de la Rovira) into Barcelona's new *'green lung'* and *'green balcony'*. The plan impacts seven (7), mostly working-class and middle-class neighborhoods[20] and faces ongoing and increasing scrutiny from neighbors, social movements, and academics throughout the city due to the 'required' demolition of 295 homes. It is important to note that the plans for the park remain in 'phase 0', meaning no current construction is being undertaken. While the previous city government, under Ada Colau (2015-2023), was *relatively* open to meeting with activists and social movements regarding the future of the park, there has been no communication with the current government, under Jaume Collboni (2023-), about the future plans for the park.

[19] The plan has undergone modification four times through the 1967 Plan Parcial de los tres cerros, the 1976 Pla General Metropolità (PGM), the 2010 Modificació de PGM en l'àmbit dels tres turons and the most recent 2019 concurs de projectes pel parc dels tres turons.
[20] Vallcarca, la Salut, el Coll, la Teixonera, el Carmel, Font d'en Fargues, Can Baró

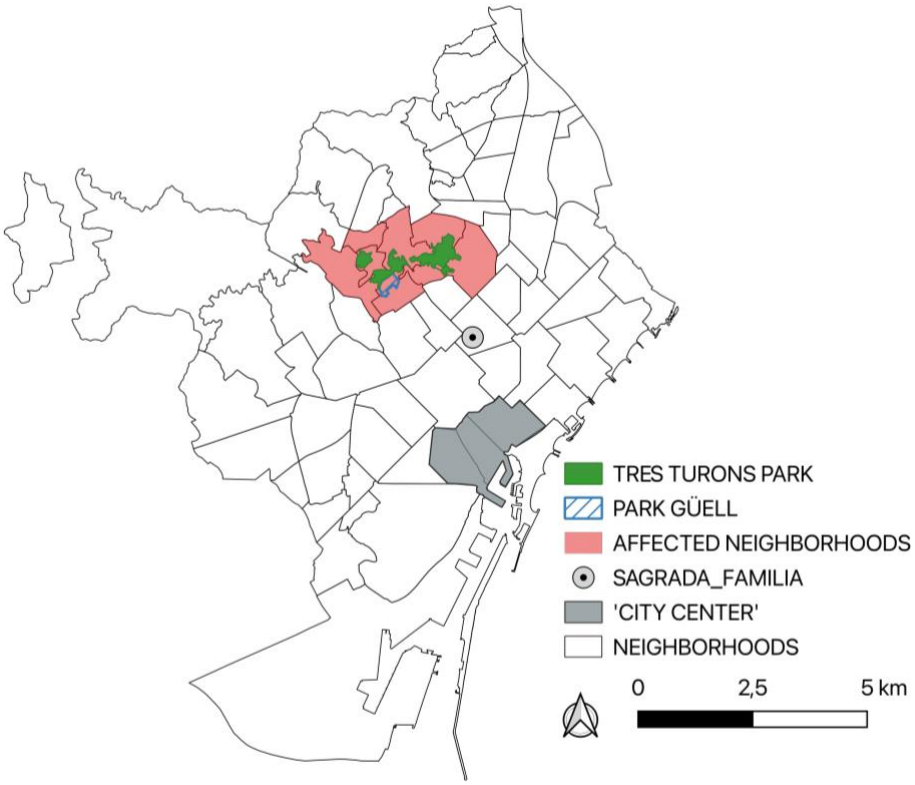


Figure 1. Situating the affected neighborhoods and proposed *Parc dels Tres Turons* within Barcelona. Source: author

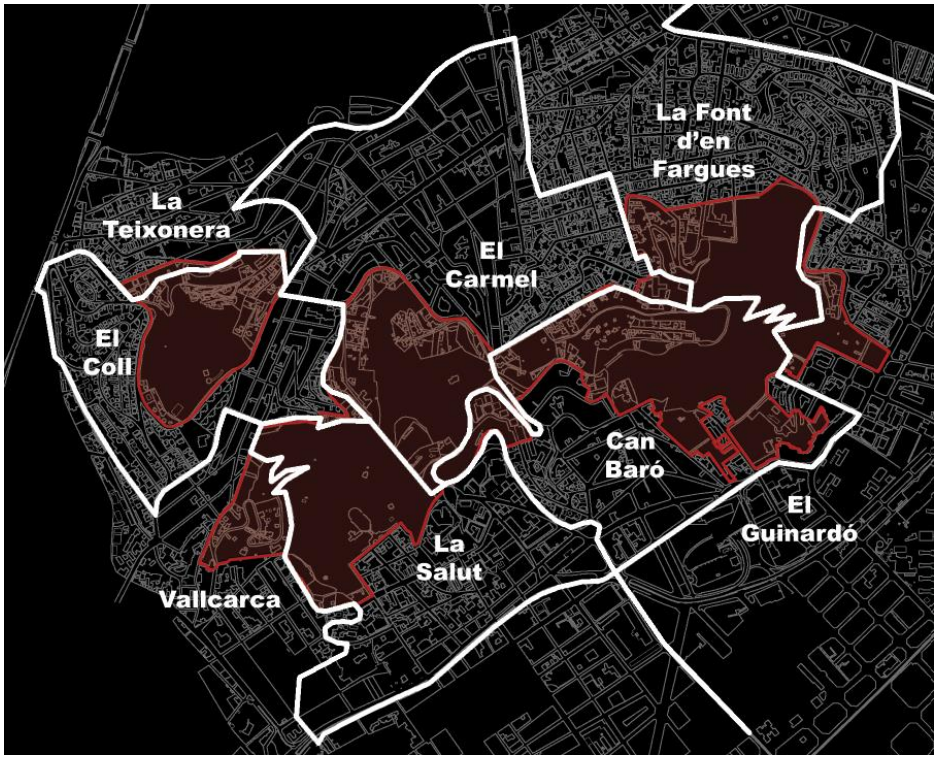


Figure 2. Zooming in on park and affected neighborhoods (source: PHATT)

Despite pressure from social movements and neighborhood associations in the early 2000s, which successfully reduced the number of homes slated for demolition from 776

to 295, these groups continue to advocate for the preservation of every single home. The slogan "ni una casa" (not a single house [demolished]) encapsulates their stance. These homes are regarded as a vital part of Barcelona's cultural and working-class heritage by residents, activists, and academics across the city. However, they are targeted for demolition because they exist within an area designated as an "urban park" under the 1953 Regional Plan (that is, not a residential area), despite many homes being constructed before 1953.

The significance of these homes extends beyond their physical presence; they embody a rich history of barraquismo, a term more broadly used to refer to 'informal' settlements established by waves of Spanish migrants during the 1920s and 1960s. These migrants, primarily from Spain's poorer southern regions, came to Catalonia seeking work during the Franco dictatorship in its burgeoning industrial sector. Although often labeled as "informal" or "illegal" by the city, recent research by scholars like Golda-Pongratz and Urban (2024) challenges this simplistic categorization. They argue that the development of these homes was often a hybrid process, blending informal construction methods with formal agreements, including landowner consent and the involvement of architects and building professionals.



Image 1. Self-built homes on Carrer de Marsans i Rof due to be demolished through the Parc dels Tres Turons. *Source: google earth*



Image 2. Affected home no. 34 Carrer de Marià Labèrnia with sign reading “No a las expropaciones – parque mixto – casas y parque si” (*No to expropiations – mixed park – yes to houses and park* in Spanish). *Source: maps.google.com*

In 1976, after the death of Francisco Franco and during Spain's transition to democracy, Barcelona introduced its first legally binding metropolitan plan, the Pla General Metropolità de 1976 (PGM), which remains in vigor. This plan reclassified the plots, including those of Tres Turons, designated as urban parks in 1953 with three new "affectations" (affected areas/sectors): "existing green area" (key 6a), "newly created green area" (key 6b), and "urban renewal area transforming the existing use into a green area" (key 17/6). These designations have placed affected residents under constant threat of eviction and have led to the deterioration of their homes, as they have been unable to obtain permits for necessary renovations due to their properties' status under these classifications. This situation, which has persisted for decades, raises critical questions about which classes, cultures, and architectural styles are deemed worthy of preservation in Barcelona, and who is entitled to enjoy the benefits of nature in the city’s evolving green landscape.

In recent years, significant developments have occurred, particularly with the launch of the 2019 architectural competition (concurs) for the park’s design, which sought innovative solutions to balance ecological preservation with urban integration. The competition culminated in the selection of three winning proposals, each addressing a specific sector of the Parc dels Tres Turons, with unique yet complementary objectives.

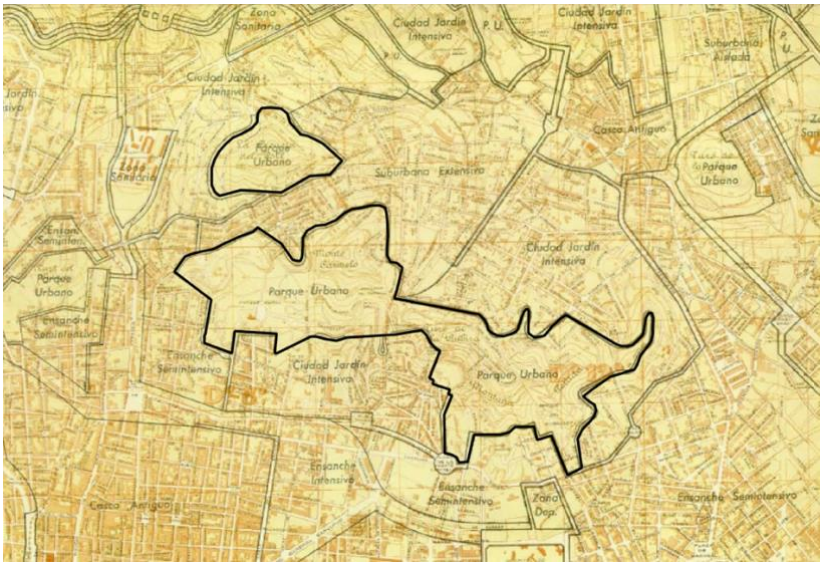


Image 3. Fragment of the Pla Comarcal del 1953 designating the *Tres Turons* as ‘urban parks’. *Source: Ajuntament de Barcelona, modificación del pla general metropolita en l’ambit dels tres Turons (black outline own).*



Figure 2. Changes over time to perimeter of *Parc dels Tres Turons* (1953 (red), 1967 (orange), 1970 (yellow), 1976 (purple)) (source: Voltes cooperative d'arquitecta).

Sector 1: SCOB Arquitectura i Paisatge with IDOM Consulting

The proposal for Sector 1, developed by SCOB Arquitectura i Paisatge in collaboration with IDOM Consulting, focuses on establishing the foundational infrastructure of the park. This sector includes the creation of a comprehensive network of pathways and green corridors that will interconnect the three hills—Turó de la Rovira, Turó del Carmel, and Turó de la Creueta del Coll. The design emphasizes the preservation and enhancement of existing natural landscapes while improving accessibility for pedestrians and cyclists. Key features of this proposal include the development of panoramic viewpoints and the restoration of degraded areas to enhance biodiversity. The integration of these pathways aims to make the park more permeable and accessible from surrounding neighborhoods, creating a continuous and cohesive green space that encourages public use and engagement with nature.

Sector 2: Estudi Martí Franch Arquitectura del Paisatge SL

The winning design for Sector 2, led by Estudi Martí Franch Arquitectura del Paisatge SL, concentrates on the edges of the park, known as "vores," which are critical for the park's interaction with the surrounding urban fabric. This sector's proposal seeks to blur the boundaries between the park and the adjacent neighborhoods, enhancing the park's

"porosity" and creating a more integrated urban-ecological interface. The plan includes the strategic placement of new entrances, or "portals," designed to facilitate access from different parts of the city and to draw residents into the park. These portals are envisioned not only as entry points but also as spaces where the urban and natural environments converge, offering opportunities for public art, community events, and educational programs related to the park's ecological features. Additionally, this sector focuses on improving the urban landscape by incorporating sustainable urban drainage systems (SUDS) and other green infrastructure that supports the park's ecological functions and needs for climate resilience while serving the surrounding urban areas.

Sector 3: Agence Ter, Ana Coello de Llobet SLP, and Audingintraesa SA

The proposal for Sector 3, designed by Agence Ter, Ana Coello de Llobet SLP, and Audingintraesa SA, centers on the Can Baró area, where the project aims to integrate residential areas with the park's natural landscapes. This sector is particularly focused on the revitalization of the old quarries within Can Baró, transforming these historically significant sites into new green areas that serve both ecological and recreational purposes. The design emphasizes ecological restoration, proposing the reforestation of quarry areas and the creation of new habitats to support local biodiversity. Additionally, the plan includes the reorganization of existing residential zones to foster a "better relationship" between homes and the park, ensuring that residents have improved access to green spaces while minimizing the ecological footprint of new developments. The proposal also highlights the importance of community involvement, suggesting that these spaces be used for collective activities such as urban gardening, outdoor education, and cultural events that strengthen the social fabric of the neighborhood while promoting environmental stewardship.

These three proposals collectively (cl)aim to create a park that is not only a recreational and ecological asset for the city but also a space that reflects the social and cultural dynamics of its surrounding neighborhoods. By addressing different aspects of the park's development—core infrastructure, urban-ecological integration, and residential interaction—these designs hope to make the Parc dels Tres Turons a model of sustainable urban planning in Barcelona.

Collectively, the winning plans for the PTT strategically deploy the climate crisis as a core justification for intervention across all three sectors. In response to the urgen need for climate adaptation, the plan focuses on inhancing biodiversity, promoting sustainable water management, and using native-drought resistent vegetation to address the increasing risks posed by rising temperatures, extreme weather and water scarcity. By integrating resilient ecological and infrastructural solutions, the park is designed to mitigate urban heat island effect, manage stormwater and erosion more effectively. The justification for these actions is thus framed around creating a park that not only adapts to the challenges of climate change but also creates an esthetically pleasing and 'modern' form of green – replacing what already exists. Put differently, While the park's

ecological goals are framed as necessary responses to climate change, they may also mask underlying processes of extraction, eviction, and disposession.

Despite these advancements, the project remains in a state of limbo. As of now, there is no clear timeline for when—or if—construction will begin, leaving affected residents and activists in a prolonged state of uncertainty. The lack of communication from the current city government under Jaume Collboni has only deepened these concerns, as the future of the Parc dels Tres Turons continues to hang in the balance.

Social movements have been fighting against the development and management plans for Parc dels Tres Turons in Barcelona since at least the 1980s. The park's transformation, initially conceived as part of broader urban redevelopment projects, has long been met with resistance from local residents and grassroots organizations. These groups have consistently opposed the displacement of families, the expropriation of homes, and the loss of neighborhood identity tied to these redevelopment efforts.

Methodology

This paper builds on a year of *political action research* (PAR) with the *Plataforma d'Habitatges Afectats dels Tres Turons* (PHATT) (*Platform of Affected Homes of the three hills* in Catalan). PAR focuses on participatory methods to bring together diverse groups of participants from communities or neighborhoods where environmental inequalities are particularly stark and researchers are committed to using their resources and projects to bring in those participants to address them in some ways (Noffke, 2009; Kemmis, 2013). Ethnographic and narrative methods like storytelling and autoethnography document experiences, while critical and reflexive methodologies analyze power dynamics (Noffke, 2009). Focus groups and workshops can foster community engagement, provide deep insights, build trust, encourage collaborative problem-solving, and support action-oriented outcomes.

The lead author of the paper followed, accompanied, and supported the civic organizing and struggles of the group, which included documenting, mapping and sharing other green justice struggles and their tactics in Barcelona; co-organizing and/or implementing workshops with planners, activists, and scientists on green gentrification; and supporting the preparation and conduction of meetings between activists and civic officials under the administration of Barcelona's previous mayor, Ada Colau (2015-2023). When encounters and interactions were not confidential and taken place behind closed doors, the authors also disseminated the evolution of struggles and important milestones in social media. Last, together with their research lab, sets of videos were produced on green justice struggles in Barcelona, which included one on the *Parc dels Tres Turons*, to amplify the impact of the civic organizing and diversify the outputs and outlets related to the struggle/conflict.

Regarding data collection, ethnographic field notes were compiled during assembles and sessions of the *Pla Popular de Barris de Muntanya* (PPBM) (*popular plan of the neighborhoods of the mountain* in Catalan). The PPBM is a project launched by the PHATT which aims to propose an alternative to the Parc dels Tres Turons, built from the bottom up through participatory mapping events, while aiming to provide urban technical support to social movements in the territory[21]. In the words of the PPBM's protagonists:

> "The *Pla Popular de Barris de Muntanya* (PPBM) is a project launched by the PHATT (Platforma d'Habitatges Afectats dels Tres Turons) which aims to propose an alternative to the Parc dels Tres Turons, built from the bottom up between the affected neighborhoods for the project. The area of action of the Popular Plan is the set of Mountain Neighborhoods (Vallcarca, la Salut, el Coll, la Teixonera, Carmel, Font d'en Fargues and Can Baró) and its action strategy focuses on a first moment, to weave links between the social movements of the territory and influence the confluence of civic struggles. Three lines of action define the project. First, the construction of a story of common struggle between neighborhoods. Focused on evidencing the shared origin of the problems we suffer from, the affinity between the various current claims and the need to understand that particular struggles are part of a larger area that needs to be addressed. Secondly, work is being done to provide urban technical support to social movements in the territory, all affected by the same urban planning. Finally, the PPBM is open to promoting inter-neighbourhood organized projects that seek to promote cohesion between neighbourhoods. From the celebration of *the Festa Major de Barris de Muntanya* to a Coordinator for the Right to Housing, these proposals seek to build mutual support between neighborhoods, generate territorial affinities and gain strength to decide on daily life in the *Barris de Muntanya*." (manifesto of PPBM, translated by author from Catalan).

As part of the PPBM, the main author participated in activities such as assembles for the planning of sessions of the PPBM, two out of three 'participatory sessions' held at the time of writing, a cine-forum night, direct action/street protests, as well as an 'information event' for residents whose homes are affected by the plan. During this session, activists presented the HOW MANY types of affectations which exist, goals and opportunities moving forward, as well as collected any individual questions or concerns through the collection of questionnaires. In this event, the main author, alongside an activist colleague, presented current green gentrification trends in the city as well as 'positive' experiences from surviving similar affectations in the neighborhoods of *La Satalia* and *Font de la Guattla* on the nearby Montjuic mountain. Additionally, the main author attended two meetings between activists and various members of the Ajuntament de Barcelona (City Hall of Barcelona). These experiences were further enriched by informal discussions and interviews with residents and activists.

[21] The PPBM draws inspiration from the 1970s' *Pla Popular de Santa Coloma*, headed by Xavier Valls (a Catalan architect). *Perifèria*, a 2020 film which discusses the *Pla Popular de Santa Coloma* by following Xavi Valls sons throughout the city and a basement full of old documents and photos belonging to their father, offers a great insight into the radical potential of a *pla popular* and was shown at a cine-forum night on the 20th of October, 2023, as part of the PPBM, with one of Xavier Valls sons in attendance.

The analysis of these notes is supplemented with secondary document analysis (media reports and planning documents related to the park and the overall mission of the *Ajuntament*). A thematic analysis (Braun and Clarke, 2021; Castleberry and Nolan, 2018) was conducted, beginning with an initial round of open coding where data was analyzed line by line to identify emerging themes. A second round of detailed coding was then carried out, applying the codes systematically to the data. This approach ensured that more open and flexible codes and findings could emerge while guaranteeing consistency and depth in the analysis. Finally, thematic connections were drawn between the codes, allowing for a comprehensive understanding of the data and the relationships between key themes. Data was further reflected upon and analysis further refined through interactions and discussions with activists of *PHATT* and residents who attended sessions of the PPBM. In other words, the overall analysis of green extractivism dynamics comes from the words and actions of activists too.

No names or direct quotations are provided in this paper which reflect data collected from residents during sessions of the PPBM. The purpose of collecting this data is for political action and this data belongs to these residents and the social movements involved. Furthermore, as this is an ongoing struggle, my main concern lays with the safety and wellbeing of all activists and residents engaged in this conflict.

Results

We focus on how the proposed park, as envisioned by the city hall, leverages socioecological crises, particularly the climate crisis as well as further issues of housing and disconnection in the affected neighborhoods due to decades of underinvestment and the disallowance of upgrading affected homes, to create new profit generating opportunities. Specifically, we use the language used to describe the park and identify these opportunities. We then explore how the rhetoric of ecological sustainability is employed to justify these profit-generating activities, examining the types of extraction involved – namely direct dispossession through eviction and destruction of non-market houses and the homogenization of (green) public space. Taken together, we can compare our critique to other critiques of green urbanism and highlight how this and all types of urban green extractivism are not deeply rooted in sustainable systems. We then proceed with a discussion of activists' counter-framing on how more engagement with locally and already existing socio-natures would not only be a more sustainable and human approach to the planning process and the park itself, but how in doing so, Barcelona could actually place itself as a leader in urban sustainability. Using the opportunity of pre-existing mix-use parks to lead a change in the style of parks that cities are implementing throughout the world.

Socioecological Crises as New Profit-Generating Opportunities through the rendering and sanitation of urban (green) space

The Parc dels Tres Turons project, which spans over 90 hectares, is presented as a necessary intervention to address ecological concerns such as biodiversity loss, urban heat islands, and the need for more green spaces in densely populated areas. However, this narrative often conceals the underlying economic motivations that drive such large-scale urban transformations. Beneath the surface of this ecological framing, the project creates profit-generating opportunities for real estate speculation and tourism development, positioning green spaces as lucrative assets.

Urban Renewal and Displacement: 'acceptable green' and eco-modernization

One of the most significant aspects of the project is its potential to displace long-standing communities in favor of more economically profitable uses of the land. Historically, the area has been home to working-class residents who have built their lives around the unique combination of natural and urban elements that define the three hills. The project, as outlined in city documents, includes the expropriation and demolition of nearly 300 homes, a reduction from the original 766 but still a substantial number that threatens the stability of the community. This displacement is often justified under the guise of creating a more ecologically sound urban environment, but the true beneficiaries are frequently developers and investors who stand to gain from the increased property values and tourism that such a project would attract, as well as outside tourists and visitors to the area, rather than direct neighbors.

Take, for example, the plans for Sector 3 of the proposed park, which was won by Agence Ter, Ana Coello de Llobet SLP, and AudingIntraesa SA. The concept of creating a "better relationship" between residential spaces and the park is centered around the idea of integrating urban living with natural landscapes in a way that enhances both ecological and social well-being. This approach is detailed in the 'Co-Habitar Natures' proposal, which focuses specifically on the Can Baró area, known for its old quarries and residential zones.

A key aspect of this "better relationship" involves the reorganization of housing developments in and around the park to ensure that they not only coexist with the natural environment but actively contribute to it. The plan includes reconfiguring existing housing and developing new residential units that are designed to be low-impact, both in terms of their physical footprint and their ecological effects. This means prioritizing building materials and designs that are environmentally sustainable, energy-efficient, and that blend seamlessly into the surrounding landscape. Gaudí would be proud.

For example, the proposal suggests reorienting buildings and open spaces in a way that maximizes green views and access to natural areas for residents. This could involve arranging housing clusters so that they face the park or creating shared community

spaces that open directly onto green areas, making nature an integral part of daily life for residents. By doing this, the project aims to foster a sense of ownership and stewardship among the community, encouraging residents to take an active role in maintaining and enjoying the park. However, this narrative does not include the perspective of activists and community members who are facing eviction.

The claim of creating a "better relationship" between residential spaces and the park is indeed complex and somewhat contradictory when considering the planned demolition of 295 homes in the area. These homes, which have been part of the landscape for decades, often embody the very integration of natural and urban environments that the project aims to enhance. The residents of these homes have, over the years, developed their own forms of coexistence with the surrounding nature through gardens, small-scale urban agriculture, and other forms of socio-nature that have organically evolved within this hybrid landscape. However, the city hall deems these homes and private gardens to be ‘unfit’ and ‘in a state of disrepair,’ and thus needing improvement. Importantly, these homes find themselves in this state due to it being illegal to make improvements to the house or the plot of land since 1976. Residents have expressed fear of maintaining their gardens or renovating their homes due to fear of being fined or evicted. These homes were often built by the hands of their parents, and many residents were born in and continue to live in these spaces today.

From the perspective of city planners, removing these homes allows for the creation of a more standardized and controlled environment that better aligns with the overarching ecological and urban planning goals of the project. This is not a new phenomenon, as greening often means the sanitization of space—transforming it in a way that makes it more controlled, orderly, and legible, often at the cost of reducing its accessibility, diversity, or spontaneity. By enabling the design of new residential spaces that conform to contemporary standards of sustainability and landscape integration, the project envisions a more streamlined, marketable version of green space. However, this vision of "green modernity" is not without its critiques.

High eco-modernization, which prioritizes cutting-edge technology and standardized aesthetic forms, often neglects the social and cultural dimensions of sustainability. Critics argue that this approach can lead to the erasure of historical and cultural landscapes in favor of a more sanitized and marketable version of urban nature. The pursuit of a particular vision of "green" urban spaces—characterized by clean lines, uniformity, and an idealized version of nature—can undermine the diversity and richness of urban landscapes that have evolved organically over time. Although the plan promotes enhancing biodiversity, the homogenization of space through standardized interventions often reduces ecological complexity, ultimately making the landscape more "legible" to capital.
By stripping away the irregular, lived-in elements of these spaces, the project sanitizes the area, transforming it into something more easily commodified and exploited by real estate interests. This process, while packaged as environmental improvement, paves

the way for gentrification and extractivist tendencies to move in, as once-diverse land is sterilized and made ripe for investment and speculation. The demolition of unique homes and the loss of their embedded histories reflect this shift, as they are replaced with modern, uniform structures that fit the logic of capital more than the needs of the community. This standardization, while aesthetically and environmentally efficient, erases the authenticity and vibrancy of the existing neighborhoods, as noted in the Nantes study by Isabelle and Francesc, and leaves behind a landscape tailored to economic gain rather than social or ecological resilience.

In essence, the push for high eco-modernization and the associated aesthetic uniformity reflect a narrow understanding of sustainability—one that prioritizes ecological and economic metrics over social and cultural ones. The Parc dels Tres Turons project, as currently envisioned, exemplifies this tension, raising important questions about who gets to decide what "sustainability" looks like and whose visions of the future are prioritized in the process of urban renewal.

Ecological Sustainability Claims as Justification for Extraction in the Parc dels Tres Turons

The rhetoric of ecological sustainability is central to the justification of the Parc dels Tres Turons project. City planners and government officials frequently highlight the project's potential to enhance Barcelona's green infrastructure, improve biodiversity, and create a more sustainable urban environment. However, these claims often obscure the extractive nature of the project, which prioritizes economic gain over genuine ecological benefits.

Framing the Park as an Ecological Necessity

The city's discourse around the Parc dels Tres Turons emphasizes its role as a critical component of Barcelona's green infrastructure. The park is presented as a necessary intervention to address a range of environmental challenges, including the need for more green spaces in densely populated urban areas, the preservation of biodiversity, and the mitigation of climate change impacts. These claims are supported by detailed plans that outline how the park will contribute to the city's ecological health, such as through the creation of habitats for local wildlife, the implementation of sustainable water management practices, and the enhancement of green corridors that connect different parts of the city.

However, these ecological justifications often mask the underlying economic motivations of the project. The emphasis on sustainability and environmental stewardship serves to legitimize the displacement of existing communities and the commodification of the natural landscape. By framing the park as an ecological necessity, city planners can justify the removal of residents and the transformation of

their homes into high-value properties. This approach not only disregards the social and cultural significance of the existing urban landscape but also contributes to the erosion of community bonds and the displacement of vulnerable populations.

The Erasure or Invisibilization of Existing Socio-Natures

The Parc dels Tres Turons project also raises important questions about the impact of urban development on existing socio-natures—the complex interactions between human communities and their natural environment. The area surrounding the Tres Turons is characterized by a unique blend of urban and natural elements, including small homes, gardens, and informal green spaces that have developed organically over time . These socio-natures represent not only important ecological assets but also the cultural and social fabric of the community.

The city's plans for the park, however, often overlook these existing socio-natures in favor of a more controlled and curated version of nature. The destruction of homes and the removal of long-standing gardens and green spaces are justified as necessary steps to create a more cohesive and ecologically sustainable park. However, this approach fails to recognize the value of the existing landscape and the ways in which it contributes to both ecological and social well-being (ANDREU'S MASTERS THESIS). By erasing these socio-natures, the project risks replacing a diverse and resilient ecosystem with a more homogenized and less dynamic version of nature, one that is more conducive to tourism and economic exploitation than to genuine ecological sustainability .

Ecological Claims as a Mask for Economic Motives

The focus on large-scale demolition and reconstruction highlights the tension between ecological sustainability claims and the actual economic motivations behind the project. The destruction of existing homes and the construction of new high-value properties generate significant profits for developers and investors, but these benefits come at the expense of the environment and the local community. The rehabilitation of existing homes and gardens, which could achieve the same ecological goals, is dismissed in favor of more profitable development options.

Moreover, the project's heavy reliance on the tourism economy underscores how economic gains often take precedence over environmental ones. The transformation of the park into a tourist destination prioritizes creating spaces that are aesthetically appealing and profitable rather than ecologically diverse and socially inclusive. By marketing the park as a key element in Barcelona's green infrastructure, the city appeals to tourists seeking environmentally conscious destinations. This, however, often results in further commodification of nature, where public spaces are designed more for the enjoyment of visitors than for the communities that rely on them for everyday life.

In this context, the ecological claims of the Parc dels Tres Turons project act as a mask for economic extraction. The project is framed as a win-win for both the environment and the city's residents, but a closer examination reveals that the primary beneficiaries are those who profit from the increased property values and tourism revenues. The social displacement and ecological erasure caused by the project are portrayed as necessary sacrifices in the name of sustainability, but they ultimately reinforce social and economic inequalities.

The hypocrisy of such green projects is especially evident when considering their resource-intensive nature. The construction of new green spaces often requires significant extraction of materials and energy, undermining the ecological benefits the project claims to offer. Much like Milan's Bosco Verticale, which is celebrated for its vertical forests but requires extensive maintenance and resources, the Parc dels Tres Turons project claims to promote sustainability while destroying existing ecosystems in the process.

Alternatives Proposed by Social Movements: Extra-Actions and Already Existing Socio-Natures in the Barris de Muntanya

In response to the top-down approach of the Parc dels Tres Turons project, social movements and local residents have put forward alternative visions that prioritize social justice, community engagement, and the preservation of existing socio-natures. These alternatives challenge the city's narrative of ecological sustainability and offer a different perspective on how urban development can be achieved in a way that is both socially and environmentally just.

Community-Led Urban Planning

A central theme of the alternative proposals is the emphasis on community-led urban planning. Activists argue that the city's top-down approach, which imposes a singular vision of green space on the area, fails to account for the needs and desires of local residents. Instead, they advocate for a model of urban development driven by the community, integrating the existing built environment with natural spaces. This approach focuses on rehabilitating the current housing stock, improving energy efficiency, and maintaining the hybrid landscape of small homes and gardens that define the Barris de Muntanya. By improving what already exists, this plan is more environmentally sustainable and resource-efficient than demolishing homes and constructing new, sterile green spaces. Such methods avoid the extraction of resources and the high carbon footprint associated with large-scale urban developments—paralleling critiques of iconic but resource-intensive projects like Milan's Bosco Verticale, which, while aesthetically green, rely on massive inputs of materials and energy to maintain.

Community-led planning also highlights the importance of preserving the social and cultural fabric of the area. Activists propose that instead of displacing residents, the city should invest in improving infrastructure and enhancing the quality of life for current residents. This includes developing community-managed green spaces, promoting local food production through urban agriculture, and preserving historical and cultural landmarks. While other neighborhoods in Barcelona have had their unique histories and architectures recognized with cultural heritage protection, the Tres Turons area has been neglected by the city government, which hasn't even initiated a study on the cultural significance of the area. The neglect here echoes broader patterns of stigmatization seen in the portrayal of working-class neighborhoods, as described in literary works like "Últimas tardes con Teresa"—now, the park is being used as a tool to "clean up" the area, reinforcing those stigmas rather than celebrating the community's rich heritage.

The Popular Plan (PPBM) has centered around six key topics: equipment and activities, neighborhood networks, public space, mobility, housing, and others. In session two, participants proposed ideas for public space upgrades. Suggestions ranged from adding more sporting facilities and public bathrooms to organizing cine-forums and creating support networks for older residents. They also envisioned a summer festival celebrating all of the Barris de Muntanya, and historic walking tours highlighting the cultural and historical value of the area. In terms of public space, residents called for reducing the enclosed area of Parc Güell, creating community gardens in unused plots, and repopulating the mountains with native trees. Transportation ideas included extending electric city bikes to higher areas, increasing night bus stops, and analyzing tourist routes to minimize conflicts with local movements. For housing, participants pushed for cooperative housing, ending licenses for tourist flats, and providing financial assistance for the rehabilitation of homes after they are "disaffected" from demolition.

Participants organized their suggestions according to urgency and the community's capacity to implement them. Several initiatives have already been launched, such as a cine-forum night, an informative session, and the Festa Mayor dels Barris de Muntanya. This process has generated a wealth of data and personal connections, which could enrich the Parc dels Tres Turons plans—if the government were willing to engage with the community. Under the previous government of Ada Colau, there were promising avenues for collaboration, but the willingness of the current administration under Jaume Collboni remains to be seen. So far, the only engagement from the city has been visits to affected homes to notify residents of their impending evictions.

If the city were to engage with the community, they would find a well-prepared, organized, and informed group of residents ready to offer place-based proposals for the area's improvement. These proposals reflect decades of lived experience and local knowledge, a valuable resource that has yet to be incorporated into the official plans for the park. Until the Ajuntament embraces more participatory mechanisms, these locally-

rooted desires and experiences will remain excluded from the Parc dels Tres Turons' development plans.

In this way, the community-driven model stands as a more environmentally and socially sustainable alternative to the city's current top-down strategy. By preserving existing housing and integrating it with green spaces, this approach uses fewer resources, avoids unnecessary demolition, and maintains the cultural identity of the neighborhoods. In contrast, the city's plan risks repeating the mistakes of other so-called "sustainable" projects like Bosco Verticale, which, though lauded for their green appearance, are resource-intensive and alienating to local populations. The community's proposals not only ensure a lower environmental impact but also foster a deeper connection between residents and their environment, creating a truly resilient and inclusive green space.

Resisting Green Gentrification and Touristification

One of the key concerns of local activists is the potential for green gentrification, where the creation of new green spaces leads to the displacement of low-income residents. To counter this, activists propose a range of measures designed to protect existing communities from the negative impacts of urban development. These include the implementation of affordable housing policies, the promotion of mixed-use developments that combine residential and commercial spaces, and the protection of informal green spaces that are managed by the community.

Activists also argue that the city's focus on large-scale, high-profile green projects contributes to the gentrification of surrounding neighborhoods. Instead, they advocate for a more decentralized approach to urban green space development, where smaller, community-managed projects are prioritized over large, centrally planned initiatives. This approach not only helps to protect vulnerable populations from displacement but also fosters a sense of ownership and stewardship among residents, who are more likely to take an active role in the management and maintenance of local green spaces.

The first session of the PPBM centered around collectively mapping current and historical use of the area enclosed within the PTT perimeter. First, at three separate tables, neighbors and activists took turns by pointing out their home – leading to many discussions about each persons 'area' of the *barris de muntanya* – and then highlighting, in coded colors, key paths and infrastructures (greenspace, transit, shops, etc.) they frequent. Taking all the maps collectively, we learn were and how neighbors use the park for various purposes – from walking dogs and kids to school, for recreation and relaxation, as shelter when inside their homes, a small level of gardening for nutrition, and for exercise. Participants also marked locations of 'collapse' – such as bus transit lines becoming unaccessible due to high amounts of tourists going to Parc Guëll and the bunkers. Importantly, a *sesio no mixta* (female and non-binary persons only session) was held in partnership with the 'open' session currated by the feminist urban planning

collective *Punt 6*. Only taking the manner in which neighbors came together and were enthusiastically sharing their stories and everyday movements together, reveals an intense connection with the space and a drive to preserve their relationships with it. It is not a space which is used for entrance, enjoyment of the spectacular views, and exiting, but rather an everyday relationship in which caring activities, relaxation, recreation, production, and lodging endure. Their coming together represents a collective fear and rejection of the altering of decades-old socionatures.

Resistance does not only take the form of participatory planning sessions, cine-forum nights, or neighborhood festivals, but also in direct action against the increasing touristifcation of the area. Activists, alongside other locally based and groups from throughout the city as well as other scholar-activists, have engaged in direct action against the touristification of the bunkres, holding a funeral procession for the *Turó de la Rovira* by carrying a cardboard casket, alongside nearly HOW MANY PEOPLE, ending at the top, interupting tourists views. Activists have engaged in direct action inside of public buses, dressing like tourists and holding signs asking neighbrs to go home as they are ruining their vacations, before eventually giving a speech about their lives being impacted by tourism and directly on the bus. Together with other activists groups, a large protest was held against the Louis Vuitton fashion show held in Parc Guëll, which led to the destruction of stairs inside the UNESCO world heritage site and brutal police agression against protesters which gained international attention and critique. While Louis Vuitton was allowed to drive golfcarts and other vehicles throughout the park – normall illegal but allowed, alongside the entire event, by a mayoral decree stating louis vuitton aligns with the city's goals of sustainability etc. – only a week after the event, a parent was fined for riding their bike through the park as to take their child to school. The police officer waited outside for the parent to return to their bike as this was an unacceptable offence.

As is visible in the creation of a PPBM, recognizing the wide reach of the impacts of a park of this nature, activists are actively supporting other organizations throughout the city, and vice-versa, as they aim to collectively resist the integrated green gentrification trends and the increasing levels of touristification across the city.

Discussion

This paper provides an original analysis of urban green extractivism by examining the case of the Parc dels Tres Turons in Barcelona. The results show that, rather than representing a movement towards just green urban (re)development, the park acts as a driver of what can be termed the "sustainability of unsustainability." The proposed redevelopment is framed as a response to socioecological crises like climate change, biodiversity loss, and urban heat islands, but it conceals the underlying processes of dispossession and extraction. While the project emphasizes stormwater management, biodiversity enhancement, and public accessibility, these improvements come at the cost of demolishing homes and erasing long-standing socio-natures, favoring economic

transformation that prioritizes developers and tourists over local communities. In this way, the park shifts from an ecological necessity to a tool for capital accumulation.

One of the more ironic aspects of the project is that many of the sustainability goals—such as integrating green spaces with urban areas, enhancing biodiversity, and improving water management—are already reflected in the existing homes and socio-natures cultivated by residents over the decades. These self-built homes, gardens, and informal green spaces demonstrate a sustainable balance between urban living and nature. Rather than embracing and building upon this existing ecological framework, the city plans to erase it, replacing it with a standardized green infrastructure more conducive to commodification and tourism, homogenizing the landscape and making it legible to capital.

In this way, Barcelona has a unique opportunity to radically rethink urban parks. By recognizing and preserving the already existing socio-natures within the park, the city could forge a new model for sustainable urban development that serves local populations rather than prioritizing external developers and tourists. This would represent a departure from the dominant urban greening paradigms, which tend to be driven by capital accumulation strategies and often result in the commodification of nature. Such a shift would not only strengthen Barcelona's reputation as a leader in urban sustainability but also champion an inclusive, community-centered approach.

Activists have already laid the groundwork for this alternative vision. For years, they have engaged in direct action to protect the homes and communities affected by the park's development. Activist efforts in the early 2000s succeeded in reducing the number of homes slated for demolition from 776 to 295. Today, these activists are organizing across the impacted neighborhoods, developing a Popular Plan (Pla Popular) that proposes a bottom-up vision for the park's future. This plan reflects locally held values and aims for the park to evolve based on community needs, rather than serving the interests of tourists and real estate developers.

Importantly, this struggle is not isolated. The movement surrounding the Parc dels Tres Turons is part of a broader socio-ecological justice movement in Barcelona, which opposes green extractivism and tourism-driven development while advocating for housing rights. Activists and residents resisting the park's redevelopment are aligned with other movements across the city that fight gentrification, housing displacement, and the commodification of public spaces. These movements share a common goal: to reclaim urban spaces for local residents and resist the globalized green orthodoxy that prioritizes capital over community. Just as the logic of green extractivism has gone global, resistance movements have followed a similar expansion, building coalitions that include residents, researchers, and even political entities. These coalitions aim to reshape the narrative around urban sustainability by prioritizing the right to stay and maintaining socio-ecological relationships that have developed over generations.

The green extractivism lens has been instrumental in understanding how the Parc dels Tres Turons project fits into broader urban processes of dispossession and gentrification. While the concept has traditionally been applied to rural settings, this analysis reveals that urban green extractivism operates in much the same way, using the rhetoric of sustainability to justify the extraction of rents and the displacement of local communities. In this case, the project's "green" elements—such as increasing biodiversity and creating public spaces—are primarily tools for capital accumulation, benefitting developers and tourists at the expense of long-standing residents.

Limitations

While this analysis sheds light on the dynamics of green extractivism and green gentrification in Parc dels Tres Turons, there are some limitations. As the park is still in the planning stages, many of the projected impacts are based on plans and trends observed in other urban greening projects. The exact scope of displacement and gentrification will only become clear once construction begins. Additionally, the study relies heavily on activist networks and participatory research, which may lead to bias in how the city's intentions are interpreted versus community concerns. Nonetheless, the analysis provides valuable insight into the processes that make areas like Parc dels Tres Turons vulnerable to green gentrification, and amplifies the voices of those most impacted.

Barcelona has a unique opportunity to transform its approach to urban greening by listening to the residents who have lived in and shaped the area for decades. Rather than pursuing a path that exacerbates green gentrification and displacement, the city could lead the way in developing a community-centered model of urban sustainability. By preserving and enhancing the existing socio-natures within the Parc dels Tres Turons, the city would not only demonstrate a genuine commitment to inclusive, sustainable development but also position itself – as it so clearly desires - as a leader in redefining what it means to build just, resilient, and sustainable cities.

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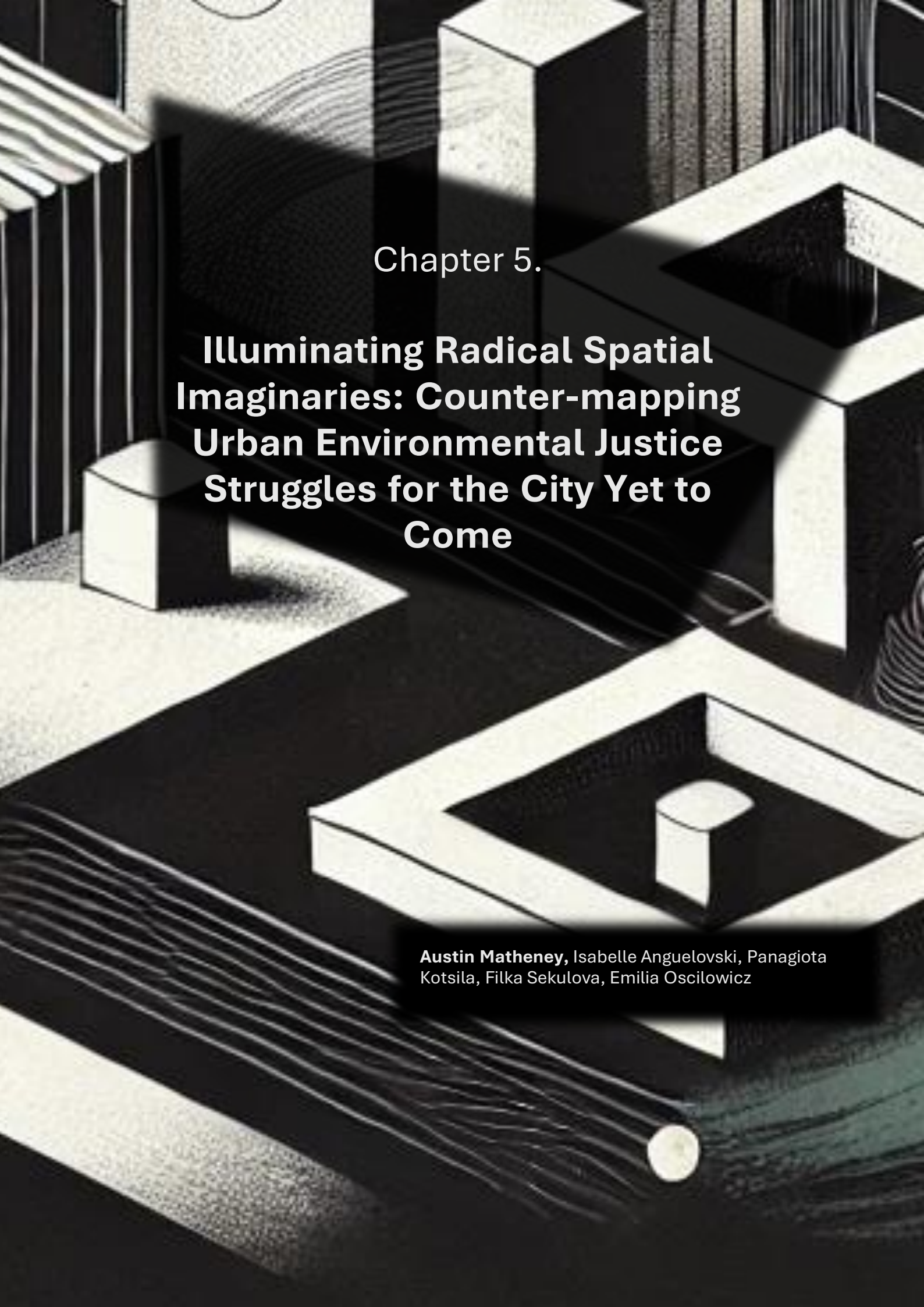
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Chapter 5.

Illuminating Radical Spatial Imaginaries: Counter-mapping Urban Environmental Justice Struggles for the City Yet to Come

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Chapter 5. Illuminating Radical Spatial Imaginaries: Counter-mapping Environmental Justice Struggles for the City Yet to Come[22]

Introduction

It is now a well-established premise that urban greening, or urban green infrastructures[23], are imbued with power relations (Wachsmuth and Angelo, 2018; Anguelovski, Irazábal-Zurita, and Connolly 2019; Finewood, Matsler and Zivkovich 2019; Diep et al., 2022). This stance is reflected, for example, in the growing Urban Environmental Justice (UEJ) literature which outlines and examines processes of 'green gentrification' (Anguelovski et al. 2021; Rigolon and Collins 2023; Quinton et al. 2023; Anguelovski and Connolly 2024), highlighting the uneven geographies of power upon which green infrastructure developments play out. Increasingly so, the discursive power of (urban) greening – its social meanings and imaginaries of the future – is also being examined as deeply defining its power-laden (material/economic) nature. Such studies are outlining, for example, the relationship between 'green branding' of cities or neighborhoods and unjust green urban (re)development (Garcia-Lamarca et al. 2021; Shokry et al. 2022; Lewartoska et al. 2024). The scholarship weaving together the material ramifications and discursive power of urban greening now understands urban greening to be a *social imaginary* – what Angelo conceptualizes as *urbanized nature* (Angelo 2019b) – "of nature as an indirect, moral good that can be mobilized by a range of actors for very different normative visions of society" (Angelo 2019b: 647).

This 'green social imaginary', in its hegemonic imaginative expression, is increasingly deployed within entrepreneurial and economic growth strategies as part and parcel of neoliberal urbanism (While et al. 2004; Matheney, Perez del Pulgar, and Shokry 2021; Neidig et al. 2022) - refering to an urban policy model that prioritizes market-driven approaches, privatization, and deregulation to promote economic growth and competitiveness in cities. A predominately neoliberal logic has been shown to be permeating 'smart city approaches' (March & Ribera-fumaz, 2016), cultural policy (Rius-Ulldemolins, Hernandez I Martí, and Torres, 2016), the introduction of nature-based solutions (Kotsila et al. 2021; Armstrong et al. 2022) and other green and grey infrastructures (Wachsmuth and Angelo, 2018) as well as policies around tourism following COVID-19 lockdowns (Higgins-Desbiolles 2020). In all approaches, designers,

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[23] Urban green infrastructure refers to the network of natural and semi-natural areas, features, and green spaces in urban environments that provide multiple environmental, economic, and social benefits. This infrastructure includes parks, gardens, street trees, green roofs, green walls, wetlands, rivers, urban forests, etc.

planners and policy makers articulate claims highlighting that such ways of urban greening are aiding a transition towards 'sustainability' or the 'green transition' – that is as responses to climate impacts. However, greening is not a neutral intervention on the social fabric and often results in pockets of 'green privilege' (Argüelles, 2021), whereby socially vulnerable residents are excluded from new green amenities they fought for as part of an environmental justice agenda (Anguelovski, Connolly and Brand, 2018: 417).

How then are powerful and increasingly established *urbanized natures*, which lead to a range of social, environmental and climate injustices, being contested and subverted? Despite the increasing scholarship tracing the material ramifications of the discursive power of mainstream ideas around urban greening, counter and subaltern imaginaries to the growing green orthodoxy have been given less attention (see Oscilowicz et al., 2023). If urban greening is indeed a social imaginary which is being operationalized by various actors for different normative visions of society, then focusing on radical manifestations of urbanized nature - or those imaginaries which aspire for a society that continuously builds and evolves its institutions (Castoriadis, 1987)—may offer a way to chart progressive and emancipatory transformations from within existing conditions (Swyngedouw 2023: 38). In other words, shifting our focus away from 'urban greening' in its top-down, large scale, hegemonic manifestations towards the non-hegemonic, radical imaginaries of UEJ movements may help "…to contribute to the realization of [just] sustainable futures" (Temper et al., 2018: 747).

Here, we propose engaging more deeply with the literatures on radical imaginaries. In this endeavor, attention to space is shown to be integral to uncovering alternatives to instituted society (Stoetzler and Yuval-Davis, 2002; Khasnabish, 2008; Asara, 2020). In the proceeding sections, we thus outline a shift from operationalizing the *social imaginary* – a concept increasingly critiqued as having become 'vague and catch all at the cost of clarity' (Delanty 2021; Varvarousis 2019) - to the *spatial imaginary*, centralizing the intimate relationship between imaginaries and their spatiality (Watkins 2015). This paper, then, lays out a framework to uncover and analyze the processes of urbanized/-ing nature in its non-hegemonic, radical forms by uncovering and analyzing how urban environmental justice movements are contesting top-down urban greening initiatives through the performance of spatial imaginaries.

In order to visualize these spatial relationships, we propose 'counter-mapping' urban socio-environmental struggles and alternatives from below. This is done in close collaboration with local activists, as an engaged methodology to make visible radical green imaginaries. In doing so, we ask: what radical imaginaries and intersecting needs does counter-mapping reveal vis-à-vis the green (neoliberal) city orthodoxy? While other forms of 'mapping' have been undertaken related to environmental (in)justices (Temper et al. 2015; Wilson et al. 2015; da Rocha et al. 2018; Pedregal et al. 2020; Keeler et al. 2022), our approach strays in its movement away from the mapping of *hard* infrastructures – be it green infrastructures or environmental pollutants - towards the mapping of radical spatial imaginaries and their performances. Through our mapping

strategy, we aim to bring critical urban environmental justice scholarship in closer contact with not only critical urban sociology (Angelo, 2021) and critical geography (Watkins 2015; Davoudi 2018; Davoudi & Brooks 2021) but also budding research on the transformative potential of radical social movements (Temper *et al.*, 2018; Apostolopoulou *et al.*, 2022).

In the next section we outline the hegemony of the modern 'green social imaginary' and its related and resulting materialities. Following calls for a deep analysis of localized manifestations of the hegemonic green imaginary in urban planning (Angelo 2019a; Long 2016) we then outline the appropriateness of grounding Angelo's (2019b) conceptualization of *urbanized nature* within discussions of spatial imaginaries, paying specific attention to their performativity (Watkins 2015). In this way, we also respond to calls to understand the role of social movements (Angelo 2019a: 9) vis-à-vis the deployment of the green city, looking at the strategies that activists have used overtime and their emergence in view of the spatial and historical characteristics of a neighborhood (Anguelovski 2015: 704).

Moving forward, we outline our operationalization of 'counter-mapping', including a brief overview of 13 case studies of environmental justice struggles within the city of Barcelona which constitute the basis of our methodological approach and analysis. While no singular imaginary exists across a single street, a neighborhood, or the city, we uncover thematic tendencies wherein place imaginaries are strongly linked to the preservation and protection of unique places, how histories of trauma are related to fears of future spatial fixes, and how livable and inclusive neighborhoods are being projected as idealized futures.

The dominance of the green social imaginary and its materialities

In their recent book "Green as Good: Urbanized Nature and the making of Cities and Citizens", Angelo (2021) provides a rich historical analysis of urban greening and reveals how 'nature' has long been communicated as a 'cure' to urban ills – providing a novel lens through which to think through 'nature and the city'. A key facet in the fostering of this paradigm is the transformation of nature from a direct or substantive good to a morally or spiritually beneficial asset, or an indirect good[24]. By transforming nature into an indirect good, or a moral desire, greening becomes wrapped within the language of universality, wherein 'green' becomes beneficial to all and in the same way through a "natural" trickle-down effect process. Lastly, Angelo reveals how 'green' has been and continues to be an 'aspirational' good, which is deployed to communicate visions of

[24] This shift occurs following industrialization. Angelo here follows a Marxian understanding of 'primitive accumulation' and the 'metabolic rift' wherein the landed classes are removed from the land due to its private enclosure, forced to move to urban centers in search for employment in waged labor, and thus no longer turn to the land for subsentence – breaking the metabolism of the soil and alienating humans from both 'nature' and the fruits of their labor.

idealized futures through new conceptions of urban sustainability, often associated with the creation a new bourgeoisie – with its own set of behaviors, tastes, and practices (Baviskar 2020). Importantly, although this 'green as good' narrative may find distinct meanings for different groups, green is always 'good' and the 'winning' imaginary - that which prevails and becomes dominant- is based on power differentials.

With the growing dominance of this idealized green future, Angelo and others have argued for the need to conduct in-depth analyses of localized manifestations of the green imaginary in urban planning (Long, 2016; Angelo, 2019a) as to connect various scales of urban transformation. Neidig et al. (2022), for example, offer a historical outlining of urban greening's role in "building early shared goals in a context of violent political conflict…" and its use in supporting hopes of "becoming a green pioneer internationally…" in the context of the 2012 European Green Capital of Vitoria-Gasteiz (Basque Country, Spain). This before the later depoliticization of green and sustainability discourses in the city. Greening is thus shown to have evolved from merely a political fix to a sustainability fix. By doing so, a once socially useful imaginary has been captured by the logics of neoliberal growth as part of competitive urbanism agendas and may end up endangering democratic participation in decision-making – a participation that was first essential in the rolling out of the green agenda (Neidig et al., 2022). This is not a story unique to the city of Vitoria-Gasteiz, calling for further examination of the injustices arising from local manifestations of an internationally hegemonic (green social) imaginary.

The dominance of this imaginary and its immaterial power is increasingly informing the urban green branding practices of different urban development models – such as the postindustrial green city, the smart green city, or the green resilient city (Burnham et al., 2017). This green branding is then reinforced by 'green awards' such as the European Green Capital and World Green City awards (Rosol, Béal, and Mössner 2017; Matheney, Perez del Pulgar and Shokry 2021; Baró and Anguelovski 2021), creating *idealized* standards to which cities must grow to or fear being 'left behind' (Roy, 2011). The potential of immaterial power has recently been recognized within the (urban) environmental justice literature (Temper et al. 2018; Anguelovski et al. 2020) noting how imaginaries "manifest in specific material, technological, resource, and infrastructure and influence guiding standards for new urban greening interventions" (Anguelovski et al. 2020: 9) Similarly, Angelo (2019b) highlights how the imaginary of 'green as good' "literally made new forms of moral action possible… [which were then] materialized in urban space" (p. 665). As highlighted by (Taylor (2002), "the social imaginary is not a set of ideas; rather it is what it enables, through making sense of the practices of society" (p. 91).

But while the analysis of imaginaries provides a novel and insightful form of analysis for understanding the reach, embodiments, and meanings of green urbanism, the literature maintains a focus on the role of the state and capital while having little interaction with how this or different and alternative, perhaps less dominant, green imaginaries are

performed by urban dwellers and social movements. In this way, making "the tales that people tell of urban greening" visible could "play a central, yet often overlooked role in advancing praxis" (Anguelovski and Connolly 2021: 9). Take for example the relationship between the urban green branding outlined above and processes of 'green gentrification' (GG) - or "the exclusion, marginalization, and displacement of economically marginalized residents" which has been shown to follow "the implementation of environmental or sustainability initiatives" (Pearsall & Anguelovski 2016: 2). While an important and growing literature, less attention is paid to how social movements are utilizing their immaterial power to resist such processes of GG or to create alternatives (see Oscilowicz et al. 2023).

Can resistance to green gentrification be put in the same category as earlier EJ movement's resistance to the unjust situating of environmental toxins in communities of color? Or does resistance to contemporary urban green injustices manifest with a different purpose and vision behind them? While overlaps have been shown to exist, Pearsall & Anguelovski (2016) "also find a number of different strategies, such as leveraging environmental regulations and policies and taking an active role in neighborhood planning processes, collaborating with 'gentrifiers', and advocating for complementary policy schemes" (p. 2). Despite this growing area of research, Anguelovski et al. (2019) point out areas where much attention needs to be placed, such as "risks of cooptation, demotivation over time, and competing goals and conflicts between social organizations and environmental groups" (p. 6). Fostering a frame through which to analyze how resistance to the growing 'green paradox' is enacted and performed within and throughout a *specific location* is thus a necessary endeavor and one we undertake below.

Moving from the 'social imaginary to 'radical spatial imaginaries'

To understand grassroots resistance to neoliberal urban greening, we propose engaging in a deeper conversation with the literatures on social and spatial imaginaries. In this section we contribute to the following three key points: distinguishing between the social and spatial imaginary; distinguishing between the social and the radical imaginary; and comprehending the causality between thoughts, images, texts, and material change. We argue here that the operationalization of 'radical spatial imaginaries', as held by EJ groups, requires a clear distinguishing from the concept's dominant use. Furthermore, we follow Walker (2009) and Leitner et al. (2008) in arguing for refined attention to the role and relationship of multiple spatialities of movements for radical transformation and conceptualizations of justice. This exercise is necessary as there exist growing critiques against the expanding use of the 'social imaginary' in the social sciences – where the term is argued to have become "vague and catch-all…at the cost of clarity" (Delanty 2021: 290) which has "…hindered the formulation of a robust analytical framework to explain diverse empirical case studies" (Varvarousis 2019: 494).

From the social to the spatial imaginary

A *spatial imaginary* differs from a *social imaginary* in that the former's "meanings are directly related to *spatiality*..." – or "...any property relating to or occupying space..." (Wei 2015: 6) - "...while [the latter] may not be" (Watkins 2015: 2015 italics own). In other words, spatial imaginaries are "...cognitive frameworks, both collective and individual, constituted through the lived experiences, perceptions, and conceptions of space itself" (Wolford 2004: p. 410). The scale of a spatial imaginary may vary from the home to the city or region up to the nation state, the supranational level and beyond. Importantly, scholars highlight how spatial imaginaries are strongly connected to processes of 'othering' (Taylor, 2002; Watkins, 2015; Davoudi, 2018) – meaning that "they give us a sense of how one place differs from another, how different places fit together, how to navigate through space and what to expect from the spatiality of our everyday lives" (Davoudi 2018: 101). It also serves to anchor the dominance and inspirational capacity of one urban model over others, and social hierarchies where some groups are privileged or rendered privileged, visible, and accepted parts of spaces over others who become excluded. Crucially, as Massey (2005) highlights, "places do not have single, unique 'identities'; they are full of internal differences and conflicts", or in other words, competing imaginaries may be uncovered within the same place. Crucially, Watkins (2015) highlights the importance of delineating between three types of spatial imaginaries - namely (i) place imaginaries, (ii) idealized space imaginaries, and (iii) spatial transformation imaginaries (see figure 1).

It is our belief that if one is to aptly respond to calls for deeper analysis into the *localized* manifestation of the green imaginary in urban planning (Angelo 2019a; Long, 2016), we must understand how this imaginary is constructed *and* enacted in relation to its spatiality. In doing so, we may move beyond the social imaginary's vagueness towards the construction of a robust analytical framework to explain the diversity, complementarity, and tensions between case studies in place (Delanty 2021; Varvarousis 2019).

From the social to the radical imaginary

Using the words of Castoriadis (1987), a hegemonic social imaginary can be understood as the *institutionalized* imaginary, while the radical imaginary can be seen as an *institutionalizing* imaginary. Attention to space has been shown to be integral to uncovering alternatives to the instituted society. Here, the work of Stoetzler & Yuval-Davis (2002) has been central in elaborating the relationship between space and radical imaginaries (Asara 2020). Building upon Stoetzler and Yuval-Davis's work, Khasnabish (2008) defines the radical imaginary as:

> "the ability to imagine life and social institutions not as they currently exist but as that which might be brought into being, the radical imagination is

> situated in place(s) and emerges from the process of building alternatives and 'acting otherwise' in alternative spaces of social reproduction, spheres of values, and social cooperation" (p. 153-157).

This differentiation resembles Fraser's (1995) distinction between affirmative and transformative change which has been deployed within EJ literature (Temper et al. 2018) but moves beyond in highlighting the importance of *space* in transforming the instituted society.

In the literature bridging the social imaginary and urban greening, Angelo (2021) clearly recognizes that a social imaginary must not only "reaffirm the status quo…" – referring to the existence of 'radical green imaginaries' – however, they aim to "primarily document greening in its top-down, large-scale, and hegemonic moments" (p. 22). Our analysis then aims to uncover and communicate greening in its bottom-up, small-scale, radical manifestations – or in its 'Otherness' – arguing the uncovering of the lines upon which difference is drawn to be essential in unmasking injustice (Stanley 2009; Andreucci & Zografos 2022).

Radical spatial imaginaries as insurgent practices

Lastly, we must understand how imaginaries materialize in urban change. An emerging research area relates to exploring the *performativity* of spatial imaginaries. This approach "criticizes a purely representational view of discourse that essentializes materiality and views actors as outside the field of discursive power" (Watkins 2015: 517)[25] to reveal how "spatial imaginaries not only enable and legitimize material practices through representation… [but] are also enacted and maintained by these practices (Davoudi 2018: 103) (see figure 1). Importantly, embedding imaginaries *within* the social practices of movements, "sets [the concept] apart from other concepts such as frames, values, or ideologies" (Asara 2020: 5) while placing actors within the discourses they produce (Watkins, 2015).

Operationalizing the frame of *performativity* within spatial imaginary research closely resembles García-Lamarca's (2017) conceptualization of 'insurgent practices' - or "collective socio-spatial and political nexus of actions, consisting of both doings and sayings that enact equality and disrupt the dominant production of space, creating possibilities to generate new urban meanings and relations contrary to institutionalized ones and against the interests of dominant powers" (p. 5). In this way, "[t]hinking through insurgent practices can thus help repoliticize space" (García-Lamarca 2017: 7) – a much

[25] · While semiotic discourses too place emphasis on the materiality of imaginaries, the approach differs from a *performative* viewpoint in that it sees materiality emerging through 'stages' which proceed from semiotic existence to selection then translation into specific material practices (Jessop and Oosterlynck 2008: 1156), "limiting empirical verification to linguistic mediums" (Watkins 2015: 518).

needed task as the hegemonic green imaginary has depoliticized public space through the transformation of urban nature into an indirect good which is framed as a universal good for all (Swyngedouw 2011; Rosol et al. 2017).

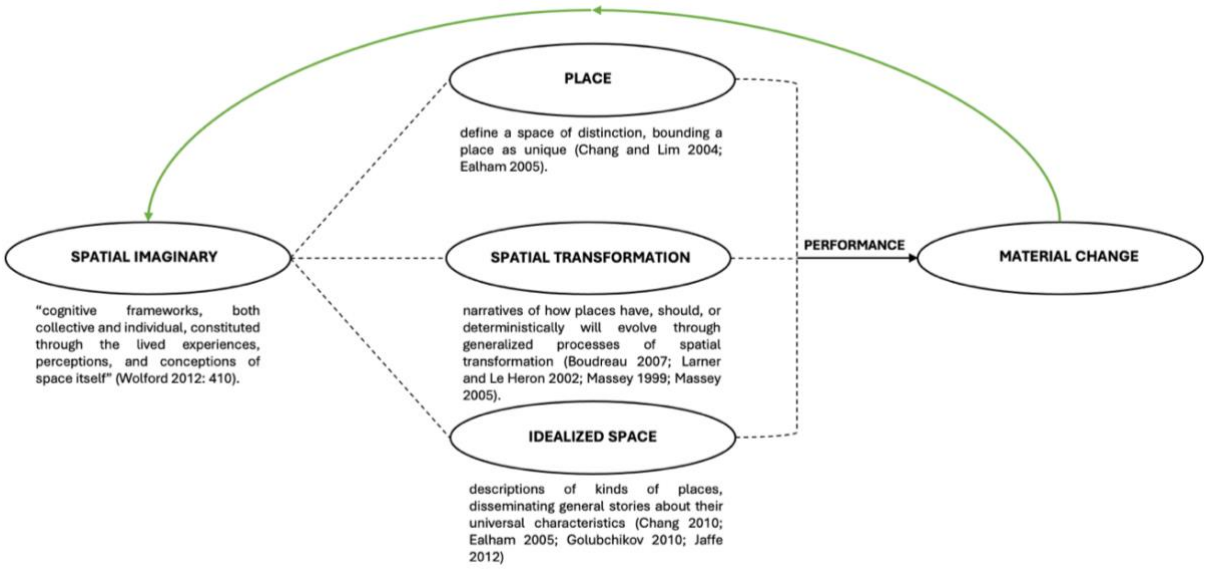


Figure 1. 'Feedback loop' of performative spatial imaginaries (simplified)
The three interrelated types of a spatial imaginary which materialize through their performance, then influencing and molding future spatial imaginaries.

Our point then is to place Angelo's (2019b) conceptualization of urbanized nature within analyses of grassroots resistance to contemporary processes of green urban (re)generation through the lens of 'green radical spatial imaginaries'. To summarize, we position ourselves as part of a shift towards studying the varying forms of spatial imaginaries, as related to urban greening, with specific attention paid to the *insurgent practices* of UEJ movements. This is to say that in order to unpack and explore the tensions between orthodox imaginaries of urban greening and marginalized visions of radical green urban transformation, it is helpful to uncover the discourses, actions, and mobilizations embodied and performed by grassroots social movements and their acts of contestation. In order to ground this discussion, we next outline how counter-mapping is an appropriate methodology to explore these performances and their relationships.

Methodology

Various approaches to 'counter-mapping' have taken hold throughout the years – ranging from critical GIS (Pavlovskaya 2018), community mapping (Parker 2006), participatory mapping (Emmel 2008) public participation GIS (Brown et al. 2020), indigenous mapping (Wainwright et al. 2009), and more. Approaches to counter-mapping maintain several underpinning currents – mainly that counter-mapping is seen as a tool for "upset[ing] power relations" (Harris & Hazen, 2006, p. 115), to provide a voice to marginalized groups in relation to governments (Dalton & Mason-Deese, 2012),

and to proliferate ways of visualizing and realizing new possibilities. Emphasis is placed on the *process* itself of counter mapping – meaning that maps are never "ontologically secure" (Kitchin & Dodge 2007: 333) and continuously reflect the emergence of new conflicts as raised by evolving groups and the evolutions of existing conflicts – among others. We believe the act of counter-mapping – by social movements and/or researchers - to represent *the performance* of a radical spatial imaginary in that it aims for the creation of something new and is at once a product and the producer of spatially bound imaginaries (Cobarrubias, 2009; Davoudi, 2018; Kidd, 2019) throughout (urban) space.

The process of mapping

In this study, the mapping process emerged following an online event co-organized on October 27th, 2020. Following an initial purposeful sampling of well-known EJ struggles in Barcelona led by our team, researchers (10) and activists (17) in Barcelona came together to discuss and build collective strategies in resisting green gentrification and advancing environmental justice in a city like Barcelona. This led to ongoing discussions with social movements and critical media coverage, culminating in the initiative of mapping EJ struggles throughout the city.

From this point, we initiated the mapping process through a snowball sampling of civic mobilizations, resistance, and conflicts linked to urban greening in Barcelona at the time when this project began, in 2020. We attempted to include a wide-range of interventions (citizen-driven tree planting; community gardens; protests against green public space loss due to tourism, commercial, and/or green gentrification; mobilization for new green space/health centers) across socio-economic neighborhood characteristics throughout the city. This paper represents a snapshot of the map at a moment in time when we reached a diversity of cases which allowed for a fair and diverse representation of civic activism around urban nature in Barcelona - that is at the end of 2022. An overview of each case can be found in table 1.

Upon case identification, we contacted the leaders or spokesperson of each case and conducted *oral interviews* with 1-2 additional members or participants in that case. The focus of these semi-structured interviews was on the history of the conflict/struggle, the neighborhood dynamics and overall city politics, the governmental, private and grassroots actors involved more directly, and the claims and demands of the movements as well as how these connect to social and environmental justice. Additional video interviews were conducted to create short web documentaries. These were made publicly accessible to increase the influence of our research in the local community, to offer easily shareable content for social movements, and to establish an online repository of stories from urban socio-environmental struggles narrated by their own protagonists. Interviews were then triangulated with secondary data analysis and visual/video data to write up a case study report and 'conclude' the mapping process for

each case study. Secondary data collection consisted in newspaper clips, social media threads, public videos or other multimedia tools, and websites related to the case and the broader neighborhood change dynamics in which the case is inserted, which included documents from the last 10-15 years. The map is publicly available at (https://storymaps.arcgis.com/collections/008137197bd7411f88e7125018005ac9?item=1) (see figure 2) whereby each case includes a short description in English and Catalan, an accompanying video (when available), and links to the grassroots organizations around it.

Lastly, we build our data collection for this article from an event our research team co-organized and held at the self-managed community and neighborhood space *Can Battló* situated in the neighborhood of Sants-Montjuïc on 30th of November in 2021. At this event, the map was presented to civic associations, researchers, and community members alike – both represented and not represented in the map (with approximately 70 persons in attendance). The goal of the event was to seek expert-driven validation, feedback, and complementary or counter analysis from residents and civic groups themselves regarding case analysis, representation, and mapping, as well as further input on next steps.

Analyzing the cases and their contents

The goal of this comprehensive and systematic round of comparative analysis was to explore the 13 cases included in the map and to find thematic similarities and differences between spatial imaginaries, how they are performed and how these performances influence material change and further spatial imaginaries. The reports embedded within the map were analyzed in two phases – firstly a line by line reading with an open coding process which led to the creation of a codebook and secondly, a thorough coding of the reports using the same codebook for all cases. To analyze the videos embedded in the map, we performed content analysis through which we aimed to uncover patterns in narrative content.

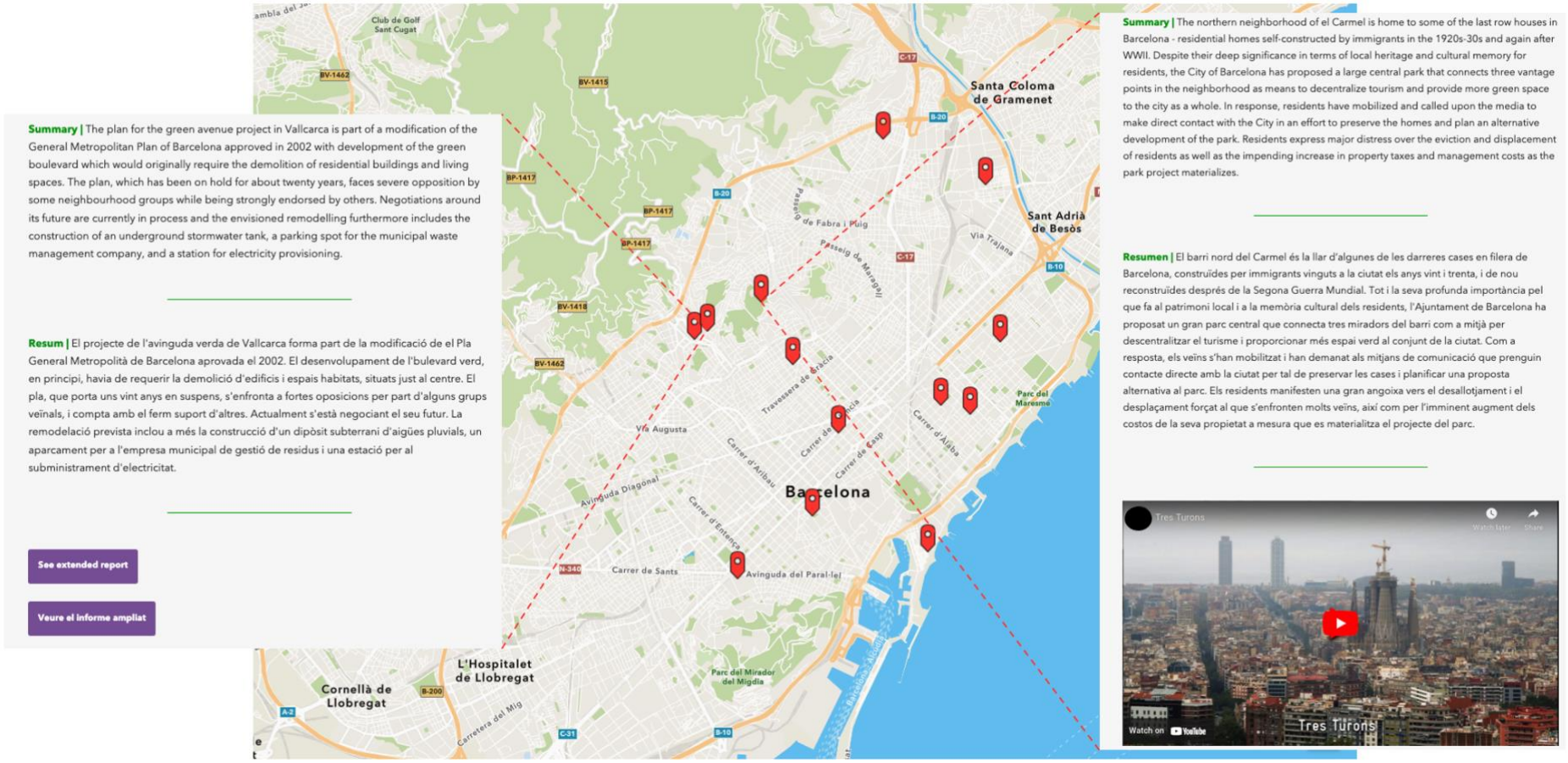


Figure 2. Example of online version of EJ Struggles Map.
Red centroids on the map represent each case study. The left box indicates cases that include a case study report, providing summaries in both English and Catalan, along with links to PDFs of case reports in both languages. The right box represents cases that include a mini-documentary, offering summaries in English and Catalan, and a link to the mini-documentary.

CASE	NEIGHBORHOOD	URBAN FORM	STRUGGLES / DRIVERS OF INJUSTICES	CIVIC ASSOCIATIONS	CHOICE OF STRATEGY	OUTCOMES
Barceloneta touristification	Barceloneta	Low-rise, densely populated coastal neighborhood	Gentrification, touristification, real estate speculation	L'Òstia, Plataforma en Defense de la Barceloneta, Assamblea de Barris per Decreixement Touristic	Awareness raising and public actions to contest mass tourism	'Tame down tourism' measures by city hall; 'micro-alternatives' by residents i.e., Sardineta community garden
Bon Pastor – 'Barcelona of the Future'	Bon Pastor	Working class, peripherally located	Loss of cultural heritage, (green) gentrification, eviction, lack of citizen engagement in decision making	Fem Bon Pastor, Sindicat d'Habitatge de Sant Andreu	Alliance building, direct action	Ongoing struggle against ConrenTramway development plans
Eixample Respira	Eixample	Middle- upper-class, grid style, car dominated, centrally located	Air pollution, noise pollution	Eixample Respira	Mapping air pollution hotspots, demonstrations	Struggle ongoing, Eixample district home to four new 'green axes' (updated supperila plan)
Vallcarca's Avinguda	Vallcarca	Low-middle class, multi-ethnic, community-driven	Gentrification, loss of cultural heritage, destruction of housing	Vallcarca Som Barri, AAVV Gràcia Nord-Vallcarca, Plataforma d'Afectades per l'Eix Verd	Creation of civic platforms, direct action	Plan paused, new plan from city hall coming in future
Vallcarca's social housing struggles	Vallcarca	Low-middle class, multi-ethnic, community-driven	Loss of housing	AAVV Gràcia Nord-Vallcarca, Assemblea de Vallcarca,	Alliance building, direct action, creation of civic platforms, guerrilla gardening	Collectivization and recovery of Farigola Sqaure; creation of community gardens; struggle continues
Gracia's tree project	Gracia	Low rise, densely populated, intense gentrification, lack of green space	Loss of cultural heritage, tree removal, gentrification, real estate speculation	Salvem l'alzina i les casetes del carrer Encarnació	Occupation of property, campaigning for heritage status of space	Heritage status given; space protected under public ownership;
La Fira o la Vida	Sants-Montjuïc	international-fair centered-economy	Housing inequalities, lack of green space, touristification	La Fira o la Vida	Creation of citizens platform, direct action,	Ongoing struggle
La Vanguardia Garden	Poblenou	Post-industrial, working class, intense gentrification, coastal	Touristification, (green) gentrification,	#Hortalavanguardia, Ens Plantem, L'Ateneu de La Flor de Maig, Associació de Veïns i Veïnes de Poblenou	Squatting of municipal area between two major hotels, guerilla gardening	Bulldozed in 2020 to serve as front lawn of the hotel Voraport; neighbors given small plots for gardening
Poblenou Superblock	Poblenou	Post-industrial, working class, intense gentrification, coastal	(Green) gentrification	Ens Plantem, Observatori de Poblenou, Taula Eix Pere IV	Blocking evictions, reporting large scale interventions, modify and promote alternatives to 22@ plan	Struggles continue, rules of 22@ plan continue to be big obstacle
Passatge de Morenes	Poblenou	Post-industrial, working class, intense gentrification, coastal	Loss of cultural heritage, (green) gentrification, housing inequalities	El veïnat del Passatge de Morenes	Creation of neighbor led assembly, hiring of lawyer, media events, holding public events in street	City Council rejected redevelopment plan and houses given 'protection' status
El Raval health center	El Raval	City center, densely populated	Health inequalities, privatization of public space	Plataforma CAP Raval Nord Digne	Occupy abandoned chapel, collection of signatures, street demonstrations	New health center to open in 2025; Ongoing battle to preserve public space amid nearby museum expansion.
Tres Turons Park	El Carmelo	Working class, high immigrant population, dense	Loss of cultural heritage, loss of housing, lack of citizen involvement in decision making, touristification	Dignitat Tres Turons, Plataforma d'habitatges afectats dels Tres Turons (PHATT)	Squatting of homes, guerilla gardening, creation of civic platform, call for study of cultural heritage	As of March 2023, the struggle is ongoing
La Prosperitat	La Prosperitat	Working class, peripherally located, vast social networks	Historical underinvestment in services, public space, and greening	Associació de veïns i veïnes de Prosperitat, Ateneu de Nou Barris, Casal (Joves) de Barri La Prosperitat	Creation of networks fighting for ecological and climate refuge, care, and equipment	Conversion of car park into neighborhood space (hosting Casal de Joves), new public complex for library and auditorium, continued struggle for more green space

Table 1. Overview of (analyzed) environmental justice struggles in Barcelona

Results: radical spatial imaginaries and their performances

Our results are divided into three sections, each representing a type of spatial imaginary based on all data sources used in this study (see figure 3). Each section describes the discursive representation of a spatial imaginary, the performances materializing it, and how these practices influence further imaginaries. We illustrate each theme with relevant EJ neighborhood case studies, showing that case studies can represent multiple spatial imaginaries. By examining these three types, we reveal thematic motivations, tactics, and projections within neighborhoods and the city, providing actionable data for decision-makers and a tool for empowering and building alliances in EJ struggles in Barcelona and beyond.

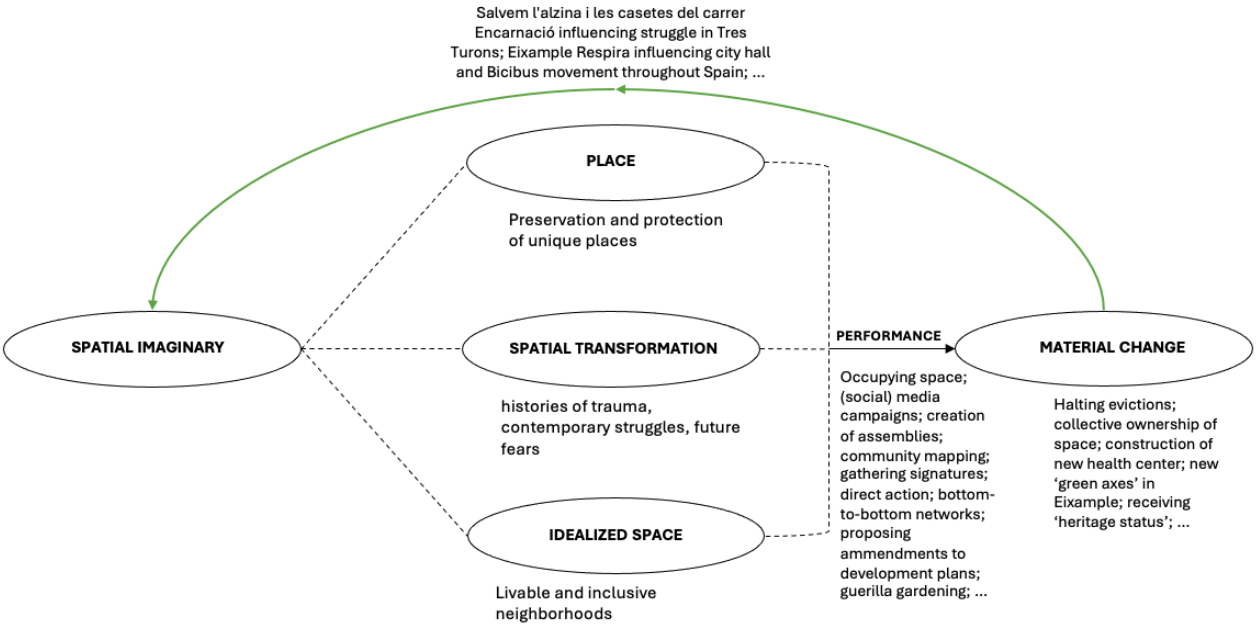


Figure 3. Feedback loop of spatial imaginaries based on Barcelona EJ struggles (own elaboration)

Place imaginaries for preservation and protection

Social movements in Barcelona have historically emerged through neighborhood associations (Calavita & Ferrer, 2004) which have organized around strong connections to place. Analysis of contemporary EJ struggles in the city reveals strong connections to places activists defend as unique in Barcelona's urban fabric. An activist from *Plataforma CAP Raval Nord Digne* states El Raval has unique characteristics, citing its multicultural diversity, history of marginalization, lack of green space, and community organizing challenges due to many undocumented residents. In El Carmel, self-constructed houses within what activists consider a park make it an 'indispensable corner of the city,' suggesting the city should emulate this neighborhood. In a similar

vein, the *cases barates*[26] (cheap houses in English) of the neighborhood of Bonpastor have become a symbolic piece of the neighborhood, its residents' history and pride with "[t]heir specific urban shape and their peculiar history allow[ing] a popular culture distinct from that of the rest of the city to be maintained there" (Portelli 2015: 120).

This last example shows that activists view these places as unique not only due to their built environment, but also because of their demographic makeup and history of place-based struggles. In La Prosperitat, a strong social fabric stems from past community mobilizations that brought new public spaces and services, like *Ateneu Popular 9 Barris* and *Plaça Angel Pestaña*. Contemporary struggles here build on historically intersectional environmental justice activism, often led by women, resulting in almost all neighborhood services and infrastructures being products of past struggles ((Amorim-Maia et al., 2023). These range from late 1970s protests against contaminating factories to current efforts for new green spaces as climate refuges for vulnerable groups. In La Barceloneta, the collective identity is tied to historical demographic, cultural, and economic preservation in view of mass tourism and gentrification in centric districts of Barcelona(Cocola-Gant & Lopez-Gay, 2020). With an economy traditionally based on fishing and harbor jobs, recent anti-touristification efforts focus on protecting the area's distinct socioeconomic and demographic makeup against tourism's negative social and environmental impacts.

Place imaginaries held by civic associations often counter other, non-place-based interpretations. In Bonpastor, the resident-driven 'distinct culture' around self-built houses persists against city hall's view of these homes as 'obsolete' and 'uninhabitable.' The Col·lectiu Repensar Bonpastor notes this stigmatization, mostly by municipal teams in the 2000s and early 2010s, inhibited residents from fully rejecting the "modernization" project, which threatened to evict them rather than lift them from poverty (Lawrence-Zuniga 2015). This place-based imaginary, however, has influenced the recent municipal team (Colau 2016-2023), leading to the rehousing of most families and the creation of a cultural center to preserve Bonpastor's memory and working-class struggles. A similar, unresolved conflict is unfolding in Tres Turons, where self-constructed homes by immigrants in the 1920s and 1960s are seen by activists as a distinct cultural heritage, but the city hall views them as 'illegal settlements.' This clash arises from the 'Pla de Tres Turons' which, since 1953[27], aims to create Barcelona's new 'green lung' involving the destruction of nearly 300 homes and the creation of a new large park connecting various existing green spaces. The preservation of places like Bonpastor, La Prosperitat, Barceloneta, and Tres Turons is rooted in historical memory

[26] The 'cases barates' (Catalan, 'cheap houses' in English) of Bon Pastor were first constructed following *La Llei de les cases barates* (Catalan, 'the cheap house law' in English) of 1929. In total, 784 single-story houses of 40 square meters were constructed for immigrants from other areas of Spain and other marginalized populations, housing up to 3,000 people.

[27] The *Pla del Tres Turons* has undergone modification four times through the 1967 *Plan Parcial de los tres cerros,* the 1976 *Pla General Metropolità* (PGM), the 2010 *Modificació de PGM en l'àmbit dels tres turons* and the most recent 2019 *concurs de projectes pel parc dels tres turons*.

and contests hegemonic views of green spaces as benign, place-improving interventions.

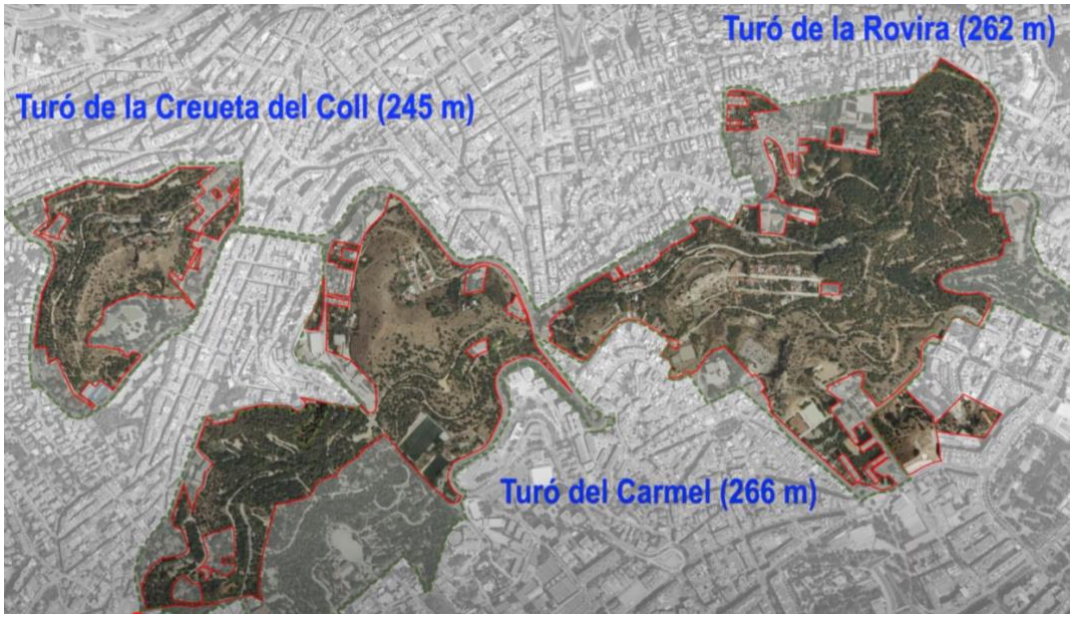


Figure 4. Perimeter of proposed *Parc dels Tres Turons*

These imaginaries of uniqueness and preservation are embodied through the insurgent practices of those involved in the struggles. In Tres Turons, activists have occupied empty homes, reinforcing the area's status as an 'indispensable corner of the city,' claiming to be more sustainable and connected to nature than many affluent areas of Barcelona. Their actions, including street protests, the formation of the *Plataforma d'habitatges afectats dels Tres Turons* (PHATT), and community mapping events, have garnered support from other civic associations and neighborhood members, leading to meetings with Barcelona City Hall in Spring 2023. Activists in *Tres Turons* draw on the successful mobilization by *Salvem l'alzina i les casetes del carrer Encarnació* in Gràcia, where they secured communal ownership and architectural heritage status for two historic houses and a garden with a 200-year-old holm oak tree. Inspired by this, activists in *Tres Turons* seek to have their self-constructed houses included in Barcelona's catalogue of architectural heritage, "com van aconseguir en Gràcia" (as they achieved in Gràcia).

These examples highlight that social movements do not merely express their place imaginaries through textual, vocal, or visual representations but importantly through insurgent practices of occupying space, forming collectives (internal to the neighborhood) and associations (throughout the city), gathering signatures, press campaigns, and meeting with members of the city hall to advocate for their goals. These performances, especially thanks to video and social media materials produced to disseminate struggles, then ripple through the social fabric of Barcelona, amplifying the struggle, garnering further support and debate, as well as influencing struggles in other areas of the city as well as the City Hall. Place imaginaries hence help us uncover the

strong relationship between uniqueness and preservation or protection. The calls to preserve and protect the architectural patrimony, the existing social fabrics and socio-natures in the city emerge in a context of the continuous infrastructural development, touristification and modernization in Barcelona over the last decades, representing a different model of urban being and becoming which is intimately connected to radical and locally grounded visions of nature. A model which promotes a desire to see lasting, meaningful places and reflects a desire to live meaningfully and "to stay put". As an activist from *La Vanguardia Garden*, a previously occupied community garden, puts it:

> "One of our purposes is not only to plant but to make roots in a place because if we're going to change the model where people come and stay at an Airbnb or hotel for just one week then everything will just be very…temporary. It's not just about doing something while you are here, it's also about doing something that lasts, for the neighborhood, something that isn't tourism."



Figure 5. Activist in former *La Vanguardia Garden* with new four star 'Hotel Paxton' in background.



Figure 6. Current state of space as of 24 April 2023 with Hotel Paxton (right) and three-star 'Hotel Voraport' (center-left) (photo by Austin Matheney).

Spatial transformation imaginaries: historical traumas, contemporary struggles, and future fears

While place imaginaries draw upon the uniqueness of place in the struggle for protection and preservation, spatial transformation imaginaries draw upon collective histories of trauma and struggle which influence contemporary struggles against fears of future spatial fixes. Spatial transformation imaginaries are often multiple and competing, as they rest upon various temporal scales which foster emotive responses to histories of spatial change. As we have just seen, the framing of place as unique and its connection to preservation and protection are strongly related to shared stories of past, current, and future *transformations* of space. In a city which "...has undergone profound transformation in the last 30 years" (Blanco 2009: 355) the transformation of urban space is an ever present, embodied experience of the city's residents. Intrinsic to spatial transformation imaginaries are "[i]deas of inevitability, 'othering' different ideas about what has been, is, or may come" (Watkins 2015: 513).

To uncover thematic spatial transformation imaginaries in Barcelona, one need look no further than it's flagship green urban intervention, the *Superilles*. The first Superilla was introduced in Poblenou in 2016, not originally a project of the city hall (Anguelovski et al., 2023). Activists link this intervention to the 22@ development plan, introduced in 2000, which, according an activist of the civic platform *#Observatoris dels barris del Poblenou*, aims to demolish large portions of Poblenou to create a district of offices and hotels, theoretically promoting a new technology-based economic model. However, this plan had a perverse impact on the area. Considered the 'Catalan Manchester' in the 19th century, Poblenou has historically been a working-class neighborhood, with strong anarchist and antifascist movements throughout the dictatorship (1939-1975) and was subjected to significant transformation since the 1992 Olympics While the Superilla is seen as a necessary improvement, activists fear it will lead to gentrification, a growing reality as Poblenou faces strong green gentrification trends (Anguelovski et al., 2018). Activists have also mobilized to save informal greenspaces like La Vanguardia Garden, which was demolished in 2022 for hotel developments.

Similar fears of gentrification are present in Bonpastor, where a new Superilla is planned through a public-private partnership between the city hall and ConrenTramway - a Spanish real estate, investment, and asset manager firm - which bought the 90,641 square meter Bonpastor Mercedes-Benz factory in November 2018. Lifelong residents worry about how this transformation will affect their cost of living, social fabric, and cultural identity (Oscilowicz et al., 2020; Planas-Carbonell et al., 2023). While here we see similarities between two places, we also find competing spatial transformation imaginaries *within* neighborhoods.



Figure 7. Still from mini-documentary of the case *Poblenou Superblock*. Subtitles are from a local activist explaining new green spaces, found at the entrances to new 'call centers', acting more as private, open air space that many residents to not feel comfortable using.

In the neighborhood of Vallcarca, we identify shared visions of how the neighborhood has transformed historically amidst divergent imaginaries of how the *barri* should change moving forward. Since 2002, a plan for a new green avenue, as part of the 1976 General Metropolitan Plan (PGM), was originally set to require the demolition of housing and other living spaces. The *Vallcarca Som Barri* (VSB) civic association labels this plan an 'obsolete form of urbanism,' while the *AAVV Gràcia-Nord Vallcarca* (AAVV) views it as necessary. These competing visions are influenced by the 1976 PGM, which aimed to demolish Vallcarca's historic center and build a rapid transportation road, leading to physical decay, resident exodus, and land devaluation, starting a period of rent gap production in the neighborhood (Antunes, March and Connolly, 2020).

VSB members fear the new green avenue will bring more destruction, speculation, and expulsion. In contrast, AAVV members, often older residents involved in Spain's transition to democracy, see it as a way to bring formal green spaces that 'clean and dignify' the neighborhood and raise property values. Their imaginary of spatial transformation is not only influenced by the history of demolition and decay in the neighborhood but by the squatting of empty and decaying buildings, including the collectivization of unused plots of land for urban gardens, bicycle workshops, and other community infrastructures by other community members, which AAVV frames as 'denigrating' the neighborhood's image and prosperity. The case of Vallcarca then, vividly illustrates how a shared memory of historical spatial transformation can result in and foster diverging imaginaries of the transformation among activists who represent different traditions and generations in the city and experienced different forms of urban negligence and abandonment.

As with place imaginaries, spatial transformation imaginaries are enacted and reproduced through various performances by activists and civic associations in response to city plans and visions. These include forming bottom-up networks (Anguelovski, 2015) space occupation, and direct actions like street protests and art. However, the transformation of space includes additional tactical choices by civic associations and neighborhood members. In Poblenou, many civic associations have united to propose amendments to the 22@ development plan, viewing it as a barrier to fostering a solidarity-based economy rather than one focused on economic growth. Similarly, in Vallcarca, the Assemblea de Vallcarca, formed in 2012 and later uniting with Vallcarca Som Barri, collaborated with local and international architects to reformulate the 2002 plan[28]. This led to the creation of the *Plataforma d'Afectades per l'Eix Verd* (People Affected by the Green Axis). The reformulation, partially approved in 2018, resulted in the recovery and collective ownership of Farigola Square and other buildings, like the community center La Fusteria, around the historically affected Nucli Antic. The opposing spatial transformation imaginary held by the AAVV has been performed similarly, with the group joining seven other associations to appeal the postponement of the 2002 plan. While performances of spatial transformation imaginaries are similar to those of place imaginaries, they often draw on histories of destruction, decay, and rebuilding to oppose specific spatial transformations.

In many of the socio-environmental struggles we analyzed, trauma is also a process activists share and mobilize around. As Gregory (1995) highlights, spatial imaginaries often indeed transmit social anxieties or shared fears of the future. Within struggles for EJ in Barcelona, the emotions expressed by activists are strongly connected to embodied histories of trauma due to past spatial transformations throughout the city. Histories of destruction and decay are giving way to contemporary processes of speculation and gentrification which drive fears of future displacement largely at the hand of 'green urbanism', while also renegotiating spatial transformation imaginaries. As a *veïna* (neighbor) of Passatge de Morenes – a cul-de-sac of small homes due to be bulldozed through the 22@ plan – expresses, trauma is a mobilizing resisting force against green gentrification and displacement:

> "All this started to change about 18 years ago, when they began to tear things down and build hotels and luxury housing…There are no workshops anymore, in the whole block there are only 21 neighbors left. But the situation is the same across all of Poblenou, people are being pushed out and nothing can be done about it…We are fighting to be able to live here and keep the neighborhood's history, the alleys, the small homes…the neighborhoods essence will be completely lost."

[28] *Col·lectiu Volta (based in Vallcarca)*, *Arquitectes Sense Fronteres* and *Unió Internacional d'Arquitectes*.



Figure 8. Activists in Vallcarca protesting to 'save the old core of Vallcarca: Barcelona is not for sale!' Source: https://twitter.com/AVallcarca

Idealized spatial imaginaries for inclusive and livable neighborhoods

How then are activists and civic associations performing their *idealized* visions for their unique yet transforming spaces? Moving forward we last aim to understand how these actors express "how the purported characteristics of [a specific] place are representative of certain *idealized* spaces (Watkins 2015: 512). While closely related to place imaginaries, analyzing *idealized place imaginaries* entails a movement towards analyzing the prescriptive projections "which [suggests] not only how things are and ought to be, but also how they will be" (Davoudi 2018: 9). This form of imaginary is the dominant form of 'green social imaginary' discussed and analyzed within the urban environmental justice literature and critical urban sociological literature at large, albeit in its hegemonic and top-down expression (Angelo 2021; Anguelovski et al. 2020; Neidig et al. 2022). These works have made great strides in outlining how this form of spatial imaginary is manifested and materialized through initiatives like 'green awards', representing top-down and one-size-fits-all projections of what 'urban green' ought to resemble. The idealized place imaginaries of activists, then, run counter to the 'green' and 'global' image of Barcelona in a variety of ways.

Idealized place imaginaries are easily recognized within the manifestos of some EJ movements. Eixample Respira, a neighborhood platform founded in 2019 within the car-centric and heavily polluted Eixample district, highlights the daily impacts of pollution on residents' health, especially children. They emphasize the volume of cars, air contamination, and its tragic impact on human health in discursive materials, graphics, images, and figures shared on social media (see figure 7). This frames the neighborhood's imaginary as dystopian. However, Eixample Respira quickly outlines what a transformed and idealized (utopian) Eixample would look like through images and posters shared on social media, calling for "more clean air, more tranquility, more green,

more space, more community, more neighborhood, more commerce, more equality, more people, less cars!" (see figure 8).

Similar idealized visions of future space are expressed by activists of La Fira o La Vida (The Fair or Life). Founded in 2019 and consisting of diverse social, neighborhood, and environmental groups, La Fira o La Vida proposes that the fairgrounds—27 hectares of land between Plaça de Espanya and Montjuïc—be opened up to the neighborhood rather than amplifying Barcelona's touristic attraction. The initiative calls for creating a green corridor reaching Plaça de Espanya with thousands of public housing units, nurseries, civic centers, and plazas (see figures 9 and 10).

In both cases, civic associations lay out their vision of an ideal spatial configuration with diverse social and green spaces, creating a different form of green neighborhood. One where housing, green spaces, civic centers, and jobs come together to produce a more equitable green city. These proposals echo EJ struggles depicted in traditional EJ studies, where residents fight for a revitalized neighborhood through just sustainabilities (Agyeman et al. 2016; Anguelovski 2014).



Figure 9. Flyer from *Eixample Respira* demanding a stop to contamination with statistics of health impacts and necessary measures for Barcelona to meet European Standards for air pollution levels. Source: https://www.eixamplerespira.com/ca/index.html

Figure 10. Image used by Eixample Respira claiming the daily life at Aragó street. Source: Twitter Eixample respira



Figure 11 and 12. Proposed changes to *La Fira* by activists of *La Fira o La Vida* (left, current urban form, right, proposed changes including green corridor and public housing).

Again, it is important to highlight that these idealized place imaginaries are not merely representational but manifest a spirit of contestation. While Eixample Respira shares images and texts on social media, they also engage in direct action, blocking streets, calling for reduced traffic, organizing actions with residents, schools, and family associations, and launching a map showing air pollution levels throughout the city. These performances have strongly influenced the city hall, which, as of 2023, has implemented three new Eixos Verds (pacified green ways), an updated version of the Superilla, throughout the heavily trafficked and polluted Eixample district. These actions have not only materialized in Barcelona but also inspired movements across Spain, such as the Bicibus movements, where residents collectively cycle to schools with their kids. Similarly, La Fira o La Vida has engaged in direct action, blocking access to the city's fairgrounds (La Fira) and creating a citizen platform proposing alternatives to the city hall's plans, envisioning a socially equitable green district. In this way, activists and civic associations are not merely voicing their discourse but embodying it by re-negotiating their spatial imaginaries with those of others throughout the city and beyond.



Figure 13. *La Fira o La Vida* activists engaging in direct action (upper banner, *that's why we are on strike,* lower banner, *the work continues)*.

Discussion

In this paper, we asked: what radical imaginaries and intersecting needs does counter-mapping reveal vis-à-vis the green (neoliberal) city orthodoxy? First, our analysis contributes to the growing critical literature on the green city and offers an analysis from below, focusing on the contestation of municipal priorities and discourses – highlighting a non-hegemonic imaginary of greening which is collaborative and bottom-up while also being ever-evolving, incomplete and continuously emerging. By incorporating a three-pronged analysis of the insurgent practices of spatial imaginaries, we bring to the forefront the role of space and the processual nature of contentious politics (Leitner et al. 2008; Asara 2020; Stoetzler & Yuval-Davis 2002). Lastly, our analysis adds to an evolving EJ literature which aims to engage in new tools and methodologies, new ways of seeing and communicating at the intersection of research and civic activism which aims to fight against injustices playing out in real time through the creation of supportive tools.

Our analysis shows how and what imaginaries are materializing throughout the urban fabric of Barcelona along with their further repercussions. It reveals thematic tendencies throughout the city of how place imaginaries are strongly linked to preservation and protection of unique places, how histories of trauma are related to fears of future spatial fixes, and how livable and inclusive neighborhoods are projected as idealized futures. We were also able to uniquely understand the interlinking of these three spatial imaginaries in relation to the neoliberal green city through the performative actions of activists and civic associations, which the critical literature on urban green planning is increasingly zooming in (see Oscilowicz et al. 2023). The performances of spatial imaginaries outline the creation of bottom-to-bottom networks (Anguelovski, 2015) – seen as crucial to social movements (Leitner et al. 2008) – as well as the re-negotiation of spatial imaginaries through these performances. As these renegotiation processes ripple throughout Barcelona and beyond, we recognize the multi-scalar nature (both temporal and spatial) of EJ struggles (Pellow 2018) as well as the spatiality of (in)justice(s) (Walker 2009). Fostering a conceptual and methodological toolkit which reflects and responds to this is then integral in moving EJ scholarship forward.

From an epistemological and methodological standpoint, the Barcelona EJ struggles map provides a spatial representation of where green not only "is" but also where and how green is contested, desired, created, and planned for. In this way, it is a map of instances, of expressions, of the tensions that exist around greening. Rather than documenting “a” conflict, the map engages with the history of how and why each of these cases have been and continue to be in conflict – as with any socio-ecological process or process of urban change. It looks at not only “what” happened in each case but analyzes the narratives of the people involved in these struggles aiming to better understand what unites them.

This represents a “counter”-mapping not only because it maps/describes something that has not been mapped before (how people imagine, perceive, desire, value different forms and aspects of urban greening) but also because it specifically engages with the imaginaries of those on the front line of struggles surrounding urban justice. Importantly, by doing this analytical exercise, we might help make clearer the axes of common/divergent imaginaries and thus forge alliances, dialogue, and reflection among the local movements, activists, and decision makers in Barcelona and beyond. Furthermore, by incorporating Watkins (2015) call for a three-pronged analyses of performative spatial imaginaries, we are able to provide a diverse, comprehensive, and comprehensible conceptual toolkit through which analyses and discussions may revolve.

To be certain, our study is not without its limitations. For this paper, the map only consists of 13 EJ struggles, which is in no way a full picture of Barcelona’s EJ activism. As this paper is being written, further EJ struggles are unfolding throughout the city. Furthermore, 12 of the 13 cases are still ongoing. In this way, this paper only reflects a tiny snapshot in time of a broader map of EJ struggles which we cannot cover in its entirety and is constantly evolving. Additionally, the map we selected to produce does not capture the opposing imaginaries within neighborhoods (as seen in Vallcarca). However, we believe that these 13 struggles are representative of the variety of counter-discourses and imaginaries against the green city in Barcelona and include civic mobilizations that are both more isolated and in conversation with one another.

While we recognize the uniqueness of Barcelona and its history of strong, neighborhood-based social movements, we believe this framework to be transferable to a wide range of urban settings worldwide. The primary goal of this conceptual framework is to understand residents' relationships to place in both its discursive and material manifestations, emphasizing the direct relationship between the two. By focusing on this interplay, we assert that the framework can be applied across various urban contexts. This assertion is grounded in the fact that the framework does not introduce novel concepts but rather responds to scholarly calls to integrate all three types of spatial imaginaries into a single analysis, in contrast to most studies that focus on just one. Therefore, analyzing spatial imaginaries is not unique to Barcelona's urban fabric. Additionally, as demonstrated in the case of Eixample Respira, examining the performativity of spatial imaginaries in one location can reveal connections between different geographies and scales of the green transition.

Furthermore, we believe this framework is not limited to analyzing 'acts of contestation' from environmental justice movements but can also be a powerful tool for uncovering competing imaginaries within a space, as seen in the case of Vallcarca. In the current context of an emancipatory paradox, where right-wing, populist, and reactionary ideals are gaining traction (Blühdorn, Butzlaff and Haderer, 2022), it is crucial to examine the spatial imaginaries of those who oppose concepts like the 15-minute city through conspiratorial narratives or harbor anti-immigrant sentiments regarding the use of green

spaces (Stanfield and van Riemsdijk 2019). By understanding both sides and revealing the lines along which differences are drawn, we will be better equipped to identify and address injustices in the green city.

Final thoughts

If cities can indeed play a central role in combatting the climate crisis (Castán Broto & Robin 2020) and urban greening is indeed a vehicle for larger social change, then better understanding and highlighting "the systemic, multi-dimensional and intersectional approach inherent in EJ activism is uniquely placed to contribute to the realization of equitable sustainable futures" (Temper *et al.*, 2018, p. 747). In Barcelona, we discover how place imaginaries are strongly linked to preservation and protection of unique places, how histories of trauma are related to fears of future spatial fixes, and how livable and inclusive neighborhoods are projected as idealized futures. Collectively, these acts of contestation aim to visualize and defend a non-hegemonic imaginary of urban greening. While contemporary urban greening in Barcelona continues down the hegemonic, neoliberal/growth-oriented path, the performed radical imaginaries of social movements for EJ in Barcelona aim to build upon a divergent and collective path of bottom-up organizing around care for human and more-than human worlds through democratic means. While being in dialogue with existing institutions, these movements call for non-reformist reforms and are in contestation to hegemonic growth-laden forms of inhibiting, mercantilizing and touristifying space.

In this way, we join comrades both near and far – EJ Atlas (Temper et al. 2015), CREATE Initiative (Keeler et al. 2022), The Anti-Eviction Mapping Project (Maharawal and McElroy, 2018) - in calling for the continued counter-mapping of EJ struggles and illuminating radical imaginaries through emerging tools and methodologies. Our emphasis here has been placed on not only the counter-mapping of EJ struggles but also the fostering of a frame through which to analyze diverse struggles for just environmental futures through the lens of performative spatial imaginaries from below. Creating databases of these spatially bound imaginaries, with both intense localism and wide-spreading global reach, registers these realities while leaving little excuse for decision makers not to act. Several of Barcelona's key urban greening projects have indeed responded to the claims of civic activists, including those in the heavily contaminated and trafficked Eixample district – although this area is also one of the wealthiest districts in the city.

With the recent ousting of Barcelona's progressive city hall in the May 2023 elections, the city faces the potential reversal of its urban greening interventions, an increase in privatization, speculation, car, port, and air traffic, and decreases in public participation in decision making procedures (as seen in recent decisions from local tribunals in September 2023 requiring the municipality to dismantle some of the city's recent urban greening initiative (e.g., the Eix Verd Consell de Cent)). It is ever more pressing, then, for

academics to build coalitions with EJ movements throughout the city and to use our privileged positions to fight against the injustices playing out in real time. As the climate crisis accelerates and conservative and right-wing governments are increasingly elected throughout the world, it is imperative for academics to produce radical and novel science to support the fight for cities which are truly green *and* just.

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Chapter 6.

A Space of Possibilities: Situated Research from/with *La Casa dels Futurs*

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Chapter 6. A Space of Possibilities: Situated Research from/with *La Casa dels Futurs*[29]

Introduction

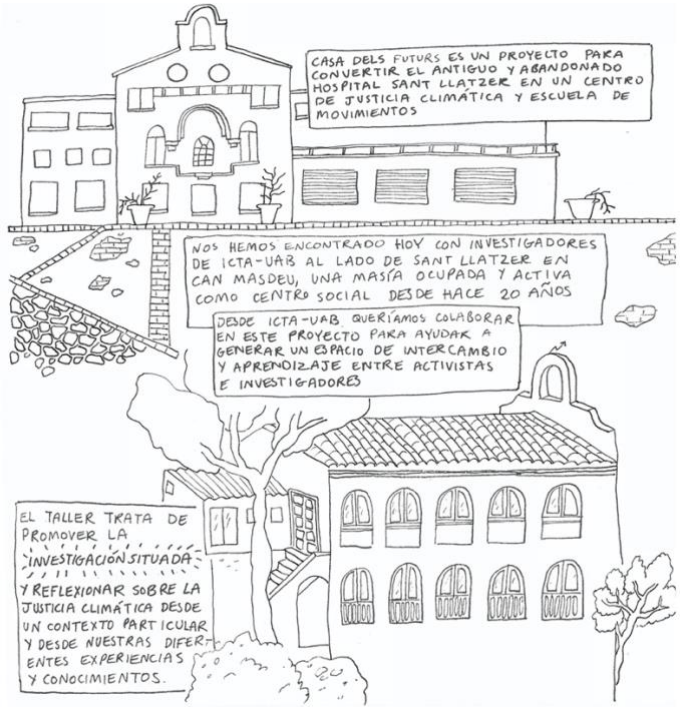


Image 1: Hospital Sant Llàtzer (above) and Can Masdeu (below) (source: Cristina Fraser)

Quote 1: "Casa dels Futurs is a project to convert the old and abandoned Sant Llàtzer Hospital into a climate justice centre and a school of social movements."

Quote 2: "We find ourselves today with researchers from ICTA-UAB next to the Sant Llàtzer in Can Masdeu, a large occupied and activist social centre which is over 20 years old."

Quote 3: "From ICTA-UAB, we wanted to collaborate in this project to help to create an exchange and learning between activists and researchers."

Quote 4: "The workshop is centred around situated research and aims to reflect on climate justice from a particular context as well as from our different experiences and knowledges."

Margit Mayer (2020: 37) recently proclaimed that "radical urban research may need to take a leap" due to "three interrelated tipping points" emerging from the climate crisis—of biophysical systems, of the economy, and of the social fabric. While mainstream discussions of "the city" are ripe with repetitions about urban population increase and the "integral" role cities "may" play in combating the climate crisis (Andersen and König Jerlmyr 2022), Mayer (2020) is joined by an increasing body of literature which draws specific attention to the key role of situated knowledges and radical social transformations, particularly those surfacing through environmental and climate justice movements (Apostolopoulou et al. 2022; Goh 2020; Temper et al. 2018). Rather than highlighting cities as the spearhead of sustainability policy discourses (Angelo and Wachsmuth 2020), the embodied knowledges (Derickson 2018) of urban environmental and climate justice movements offer tangible possibilities of transformative transitions towards sustainable and just (urban) futures.

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We situate this intervention precisely in the creation of such spaces of tangible possibilities for just urban futures. We offer here a critical reflection of a one-day event organised with La Casa dels Futurs (https://www.casafuturs.org/)—an activist-led initiative aiming to convert an abandoned hospital in Barcelona's periphery into a climate justice centre seeking to support social and ecological movements—where researchers and activists joined together to co-create situated research guidelines with and for La Casa dels Futurs. Through this reflection we explore two questions. First, *how to set up just processes for scholar-activist/situated research with and within social movements?* And second, *what role can/do researchers/activists play in the other extending legitimacy?* We draw upon both the embodied experiences and struggles in and of situated research of activists and researchers involved in climate/social justice-oriented research and action while imagining La Casa dels Futurs as a space for exploring those possibilities. We share our reflections from the event supported by illustrations done in situ by the artist Cristina Fraser during the day of the event.

We find that while much of our discussion around situated research is echoed in scholarly literature, the *process* of co-creating research guidelines with researchers and activists fostered in itself a more *just* process which may foster *just* situated research approaches. Furthermore, co-creation brought to the surface how research–activism alliances can create mutual-aid dynamics, as well as its challenges and limitations. For instance, the (potential) legitimacy gained with certain institutions through scholar-activist bonds. On the one hand, the privileged position of researchers and their greater potential access to decision makers may give legitimacy to social movements in their negotiations with official institutions. On the other hand, working with social movements in such a process can open up caring and intimate spaces outside of the machine of neoliberal academia through which more just research practices can be (co)imagined and (co)enacted.

The Event: Situated Research towards Climate Justice

On a November morning in 2022, over a dozen largely early career researchers from ICTA-UAB (the Institute of Environmental Science and Technology at the Universitat Autònoma de Barcelona) and activists from La Casa dels Futurs met at Can Masdeu (https://canmasdeu.net/), an emblematic building occupied for 21 years that operates as both social centre and housing in the periphery of Barcelona. The day began with a short round of introductions and a presentation of La Casa dels Futurs projects and activists. Just a five-minute walk above Can Masdeu lies the former Hospital Sant Llàtzer, a building abandoned and empty of social use since the mid-1970s, where activists aim to physically locate La Casa dels Futurs projects and create a Climate Justice Center and Movement School. The project is organised along three axes: climate resilience (working on *local* climate change challenges); global solidarity (working internationally with land defenders, focusing on the Global Souths); and knowledges (the building of a permanent Movement School which cultivates social solutions through

and with popular education). The workshop was organised as part of the "knowledges" axis. One of La Casa dels Futurs' key arguments for placing the Climate Justice Centre in the abandoned hospital is its location on the margins of the urban and the rural. Situated in Nou Barris, one of Barcelona's poorest neighbourhoods, and at the foot of the Collserola mountains, it fosters an engagement of thinking through these worlds together. La Casa dels Futurs activists guided a brief tour of the building. From the terrace of the abandoned hospital, a *vecina* (neighbour) outlined how Can Masdeu's community gardens function, outlining the empowering and emancipatory potential of community food stewardship. Sharing and observing such practices underscored the importance of conducting the event and situating the project in this *particular* space. A space on the periphery of the city, navigating the urban–rural boundaries in both place and thought.

Upon returning to the terrace of Can Masdeu, two short presentations were given by ICTA-UAB researchers around the themes of "situated research" as well as the challenges facing the Collserola mountain range and neighbourhood. After lunch, a world café event was facilitated to explore our first question: *How to set up just processes for scholar-activist/situated research with and within social movements?*



Image 2: "From the terrace of Sant Llàtzer, Dan and Nelly explain to us the history and the current state of the building. From here we can see the community gardens of Can Masdeu and Isi tells us how they work." (source: Cristina Fraser)

Image 3: "The sweet potato, or el camote, as we call it in Mexico, is used by indigenous peoples to relieve the symptoms of menopause." (source: Cristina Fraser)
Image 4: "Situated research is about generating knowledge from a place, a context, and a history—from social relations. It means there are other ways of understanding the world—that there exist other ways of knowing outside of a western framework!" (source: Cristina Fraser)
Image 5: "Lack of water—Fire risk—Land privatisation—Lack of transparency of the management of the area—The benefits both for nature and for the quality of life of the residents of Barcelona is evident, but there are many conflicting interests—The natural park of Collserola extends for 8,400 ha in the mountainous zone and semi-forest area situated next to Barcelona. Together the neighbourhood of Nou Barris and its history of activism, these all form a part of the importance of the context in which the project is situated. Austin explains to us the challenges which are facing the area." (source: Cristina Fraser)

Reflections on the Event I: Just Processes for Situated Research

Through the world café, we discussed what research experiences have (and have not) worked, and what we consider to be the most important methods and tools for a situated research approach. Three major themes emerged: research as a process; the importance of agendas, frameworks, and language(s); and the importance of (connections to) place.

Research as a Process

Building relationships for the long term was emphasised by many participants as fundamental for just and transformative situated research, as extended engagement is required to generate trust, establishing meaningful relationships, processes, and outcomes. Activist-researchers have underlined specific elements of what this looks like in practice: mutual aid, accountability, embeddedness, reciprocity (Graziani and Shi 2020; Pulido 2008). While long-term commitments can at times be "mundane and painstaking", "[t]his is often the timescale and reality of winning social struggles" (Autonomous Geographies Collective 2010: 265). Research as a process means that the outcomes of research processes should reflect a co-creation dynamic, with research findings disseminated in accessible, public-facing formats as much as possible. We also discussed a tension between the different dynamics and rhythms of universities and activist movements. Research approaches and outcomes often clash with metrics like publications in high impact factor journals, measures used to assess academic progression and ensure the viability of research projects (see ORCID Unauthenticated 2014). We further problematised the imbalanced temporalities that affect the longevity of these relationships, comparing local activists' often long-term engagement in a field with early career researchers' precarious contracts and established institutions, particularly in the Southern European context. The research process also underlines the need for establishing ontological and epistemological positions to mutually unfold in dialogue with the territory and communities, its spatial position, and its temporalities. This echoes what Wolch (2003: 646) points to as *radical openness* as method, which is also "a discipline of humility and courage" in the sense of trusting and following through on what allies and places need. Thus, the definition of research objectives and questions should play a key role in the process of engaging with movements/communities.



Image 6: From our experience with situated research, what has worked well? (source: Cristina Fraser)
Quote 1: "When we arrive with our own frames it's problematic."
Quote 2: "And agendas and language and time frames."
Quote 3: "I was in Cantabria to study the reintroduction of wolves into rural zones. We collaborated with the agricultural community only at the end of the process and we couldn't take their experiences and critiques into account because the project had ended. In this way, we should have done things differently."
Quote 4: "We had funding to develop an agro-forest but the community had other needs which were more urgent.

Agendas, Frameworks, and Language(s)

One of the unexpected beauties of our encounter was creating a space where early career researchers shared, in open honesty, their pitfalls with research interventions and funding that (eventually) were not situated and thus did not meet local community needs, and the lessons learnt in this process. Experiences that, indeed, do not find space within competitive, excellence-driven scenarios of the university. For example, closed research protocols that don't allow for "reality" in its complexity to emerge, and thus the need to open them up from the get-go. The enormous importance of allied agendas and frameworks between researchers and social movements for transformative situated research that emerged in our discussions is echoed in reflections by the Autonomous Geographies Collective (2010). Language was a major point that arose, on two fronts. First, the need to translate academic concepts and jargon into context-relevant and understandable terms for movement comrades. And yet, in turn, the importance of acknowledging social movements as knowledge producers and situated sources of knowledge, where relevant new theoretical concepts are in fact generated (Casas-Cortés et al. 2008; Choudry 2014). Second, the need to make valiant efforts to communicate in the local language in order to foster the profound relational ties and meaningful research outcomes that situated research seeks. In general, we felt that creating a space for early career researchers and activists to be frank about when we "fail" as situated researchers and how to better align research

frameworks and objectives with the needs of social movements was a valuable experience.



Image 7: What methodologies are the most important for situated research? (source: Cristina Fraser)
Quote 1: "To be conscious of your own cultural baggage and how this influences your perspective..."
Quote 2: "My Western glasses!"
Quote 3: "...for that I decided to do my research in a place where I feel a connection and I can be involved for a longer duration."
Quote 4: "Building confidence and creating a common understanding is the methodology."

(Connections to) Place

Both these previous points highlight the need to connect to place, an issue that arose time and again in our conversations. Place is key in questions of transformative scholarship and activism (Pulido 2008). Many feminist scholars underline the importance of relationality (Askins 2018; Parker 2016) and a politics of location and belonging (Carrillo Rowe 2005), referring to the connected nature of place, practices, and power and how the human and non-human are interrelated, as well as holding ourselves accountable in/to a collective belonging. Activist scholars have similarly underlined the need for "relation-centered, materially-grounded understandings of constructing knowledge" (Choudry 2014: 86). At the same time, a relationship with place is key in the organising of La Casa dels Futurs. The project is centred around place-based pedagogy (Boggs and Kurashige 2012; Gruenewald 2003), placing the social, historical, and ecological aspects of the location and its surroundings at the heart of its organising. Throughout our conversations it became increasingly clear that situated research processes underlying the role of place, building relations, and aligning agendas, frameworks and languages are fundamental for more just research processes, which are critical to lead to more just and meaningful research outcomes. In this respect, such an approach is fundamental to manifest the intention of La Casa dels Futurs: to create a model of large-scale physical infrastructure for social and ecological transformation, with a material climate resilience dimension, a knowledge and movement school-

oriented dimension, and an international, networked-organising dimension for broader transformative movements.



Image 8: What practical tips can we give to ensure that climate justice-oriented research leads to action? (source: Cristina Fraser)
Quote 1: "I'm not saying I'm an example but I think we researchers need to get involved in direct action … get out of our comfort zone! The time is now!"
Quote 2: "In academia you have to accompany processes and get involved with the movements."

Reflections on the Event II: Researcher/Activist Legitimacy as a Two-Way Street

After the event, we reflected on our second question: *What role can/do researchers/activists play in the other extending/achieving legitimacy?*

Legitimacy to social movements closely relates to Derickson and Routledge's (2015) first notion of resourcefulness which might inform scholar-activism—namely, directing the resources and privileges of academics to non-academic colleagues. During the event, these resources were reflected in potential connections to other nodes of people/infrastructures throughout the city, such as architects to conduct assessments of the abandoned building, connections to decision makers, and other social movements and researchers inside and outside Barcelona. As La Casa dels Futurs is still negotiating the rights-of-use to and conversion of the abandoned Hospital Sant Llàtzer—which must come from Barcelona City Hall, the regional government, the church, *and* the Hospital Sant Pau (all united through representatives in one independent body called MIA [Molt Illustre Administració])—conducting an event with an internationally recognised research institute may offer legitimacy in the eyes of these players. This is to say that while Barcelona has been internationally recognised for participatory approaches to green urban (re)development—although not without critique (Oscilowicz 2020)—and whose climate emergency declaration mentions climate justice throughout, the approach of the city hall remains one of placing "formal"

knowledge and projects coming from international institutions (like the academy) above those emerging from the grassroots. We have no desire to subsume La Casa dels Futurs' project *into* the academy, but the *apparent* "formalisation"—through collaboration with researchers like the event described here—may have the potential to influence La Casa dels Futurs' struggle to convert the abandoned hospital. Our point here is that by recognising the power dynamics that scholar-activist relationships exist *within*, and the privileges that are awarded to those operating within "formal" institutions, scholars may extend legitimacy to social movements through collaboration, and, that this collaboration may play a role in at least destabilising these power imbalances moving forward.

The extension of legitimacy, as experienced in this event, not only travels from researcher to activist but is also provided to researchers through their engagement with activists. Far from being the simple fact that the empirics and theories contained within academic publications largely emerge through participation with activists and social movements—and thus fulfil the requirements of grants and contracts—we understand an *intimate* legitimacy gained by engaging both with activists and within the spaces provided by activists. Similar to our reflection above, the process of co-creating situated research guidelines outside the four walls of neoliberal academia—in both physical location and outside the constraints of precarious grant requirements—offered a caring and stimulating space for researchers to collectively reflect on their previous experiences and future desires. While we are not arguing that these types of conversations cannot exist within the university, the concreteness of social movements—referring to their close ties to place, historical legacies, and active and continuous struggles—offers a distinct framing and legitimacy to the thoughts, experiences, and desires of researchers by involving them in tangible outcomes. Furthermore, the welcoming of researchers by social movements creates inter-personal ties within a physical space which some researchers may lack due to the increasing precarity, internationalisation, and (un)desired mobility of academics in the contemporary era. This caring space, we believe, opens up the possibility for more *just* research practices to be (co)imagined and (co)enacted.

Conclusion

If indeed radical research "may need to take a leap" and "[w]e can and should contribute to building a collective sense of agency" (Mayer 2020: 37, 47), we believe engaging in the building and enacting of situated research practices with and within social movements for climate justice to be a critical starting point. For all involved, the organising and partaking in the one-day event was seen in itself as an act of research-activism aiming for mutual support. In our case, this event revolved around supporting the creation of a physical location of a climate justice centre for, amongst other things, further researcher-activist engagement and the cultivation of social solutions which address the root causes of climate change, although we believe this type of engagement can absolutely be fruitful in various fields and social movements. Not only may this form of engagement provide legitimacy to social movements—to gain control of an abandoned

building or gain recognition from decision-making bodies—but, in our experience, extend an intimate legitimacy through the creation of a space of caring in which researchers are welcomed to critically reflect on their research experience and goals outside the pressures of neoliberal academia.

To be certain, this intervention is a textual representation of our support of La Casa dels Futurs movement. We call on the Barcelona City Council, the regional government, the church, and Hospital Sant Pau to open dialogue with La Casa dels Futurs and to grant right-of-use to the former Hospital Sant Llàtzer that has sat abandoned for nearly 50 years. Our reflections highlight both the value and need for the engaged, situated research on climate justice that can emerge from such a place, at the city of Barcelona's urban–rural interface. A climate justice centre which aims to cross-pollinate social and local solutions for movements to thrive on a fossil urbanised (Simpson 2022) and damaged planet, which acknowledges the historic responsibility of the Global North and prioritises directly impacted communities, all while empowering organisers and activist-researchers with skills to build power and knowledge from below. As our reflections highlight, this can only be done through the creation of a physical infrastructure. In the words of an activist at the event:

> "Without access to spaces to organise and share resources and educate in all of the areas which are affecting our communities, we won't have access to justice, be it climate or of another type. Climate justice is not something that already exists, or that we will have if we put the right label; it must be created in real time."

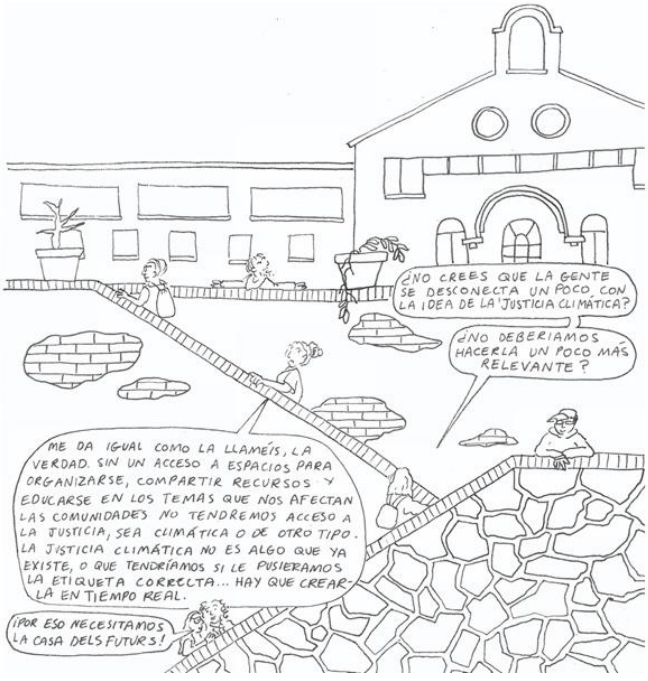


Image 9.
Quote 1: "You don't think that people disconnect a little bit with the idea of 'climate justice'? Maybe we should make it a little more relevant?"

Quote 2: "I don't care what you call it, honestly. Without access to spaces to organise and share resources and educate in all of the areas which are affecting our communities we won't have access to justice, be it climate or of another type. Climate justice is not something that already exists, or that we will have if we put the right label … it must be created in real time."
Quote 3: "That is why we need La Casa dels Futurs!" (source: Cristina Fraser)

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Conclusion

Conclusion

My journey into the field of urban environmental justice, which began in the Spring of 2019, has been a gradual process of discovery, shaped by a desire to move beyond more abstract discussions of decolonization and instead explore how it can be meaningfully implemented in my work and myself. I've found myself focused on uncovering the ways in which green urbanism can unintentionally contribute to injustices within cities. My personal interest and academic toolkit is rooted in the critical literature on capitalism's relationships with nature, particularly by the early works of Marx, such as his "Debates on the Theft of Wood," and his later collaboration with soil chemist Justus von Liebig, which examined the impacts of urbanization on soil fertility. My first attempts to better understand the processes of accumulation by disposession, the homogenizing of land and plant species, and the inherent colonialities of power behind these processes were submitted as my term paper for a course at Jawaharlal Nehru University (New Delhi) in early 2018.

Written during a time of exploring debates between Vivek Chibber and scholars associated with Subaltern Studies – namely Guha, Chatterjeem and Chakrabarty – I began to question the application of marxist categories of class, capital, and universality throughout the Global Souths. Taking these critiques, I then explored a history of urbanization in Kenya through the lens of the metabolic rift, highlighting the broader implications of metabolic rift theory in the context of postcolonial urbanization and ecological degradation. My analysis of urbanization in Kenya through this lens emphasized the deep-seated, systemic issues that continue to affect the socio-ecological fabric of the country due to the continuation of colonial systems of opression and extraction. By examining the disconnection between urban centers and rural areas, particularly in relation to the nutrient cycle and agroecological knowledge, I demonstrated how colonial legacies of land alienation, labor exploitation, and ecological degradation persist in contemporary urban planning and (re)development. Albeit with intense, local particularities. This exploration underscored the ongoing relevance of Marxist ecological critiques in understanding the complexities of urbanization processes. In those early writings I recognized that without addressing the underlying capitalist structures that perpetuate inequality and environmental degradation, efforts to create sustainable and just cities may inadvertently reproduce the very injustices they seek to remedy.

The exploration of these themes gained momentum during an internship in 2019 with the Barcelona Laboratory for Urban Environmental Justice and Sustainability (BCNUEJ). Surrounded by a group of scholars deeply engaged in these issues, I found myself drawn into the world of urban environmental justice and green gentrification. This internship sparked my curiosity in merging my background in decolonial (environmental) sociology and red-green ecosocialist thought with the world of urban environmental justice – of which I had little understanding. Once my doctoral studies began and the chance arose to contribute to a study on the social tensions and inequalities linked to winning a

European Green Capital award and to the growing field of urban green inequalities (of which green gentrification is a subset), working alongside esteemed colleagues who had conducted fieldwork, I saw an opportunity to apply the methodological and theoretical tools I had gained during my master's program on a 'best practice' scenario. The experience of expanding that work for this thesis, particularly during a research stay at the University of Bristol in early 2024, was both challenging and enriching – again both personally and academically. It provided me with a deeper understanding of the subject and helped shape the direction of this thesis, bringing together the insights and experiences I've gathered along the way.

A key facet of the second half of this thesis has to do with my connections with social movements in Barcelona. My first connections emerged at an event our research lab co-organized and held at the self-managed community and neighborhood space of *Can Battlo* in late november of 2021. At this event, the results of our groups counter-mapping exercise was presented to civic associations, researchers, and community members alike – both presented and not presnted in the map. In this meeting, I first met members of PHATT. After an event held by my research lab on October 22, 2022, which brought together academics, decision makers, and activists in Barcelona to discuss findings on green gentrification in the city and more widely[30], I found myself having a vermut with two activists of PHATT. As we have questioned many times, my relationship with their community emerged naturally, with none being sure of its exact process. I quickly found myself in protests, assembles, sessions of the PPBM, dinners, and celebrations with the members of PHATT and other community members in the *barris de muntanya*. Meeting locations would vary from a bodega in Vallcarca, *casetes* in Carmel, *okupas* in La Teixonera, las jardines de Juan Ponce in Carmel, the civic center in Carmel or various buildings of the city government. As a doctoral student from the United States, I felt extremely welcomed in an environment wherein personal relationships were fostered while a political component continously took center stage and shape both my personal and intellectual journey around green justice struggles.

All in all, this thesis is a personal and academic journey in aiming to better understand processes of 'green urbanization' and its social implications. This aim to 'better' understand refers not only to an attempt to gain more knowledge about urban socio-natures but also to do so through novel and participatory methodologies. To analyze various scales – from the very local (chapter 5), to the city (chapters 1 and 4), to international comparisons (chapters 2 and 3) – and to engage in politically motivated research which places myself in a variety of places and spaces (from direct action in the streets to civic centers, the halls of universities, and inside of city halls).

[30] For a deeper reflection on this event, see the blog post *3 must-do's for urban researchers looking to bridge research, activism, and policy* published on the website of the Barcelona Lab for Urban Environmental Justice and Sustainability *(https://www.bcnuej.org/2023/01/11/3-must-dos-for-urban-researchers-looking-to-bridge-research-activism-and-policy/)*

Below, a highlighting of the key results of all individual empirical chapters is offered before outlining five key, crosscutting contributions which emerge from the thesis as a collective piece. The conclusion then continues with a discussion of strengths and limitations before outlining possible and desirable avenues for future research. A reflection on the role of policy implications/recommendations in academia is offered before outlining several key policy implications emerging from this dissertation. Finally, a few short concluding remarks are offered to end the thesis.

Key results of individual chapters

Chapter 1. A Green capital for All? Austerity, inequalities, and green space in Bristol

The first chapter of this thesis examined, through qualitative methods, the green trajectory of Bristol (UK). Semi-structured interviews with key stakeholders, including community groups, city council officials, and real estate developers, were analyzed alongside planning documents, media reports, and local histories of environmental activism in the city. The chapter asks: *how do austerity measures influence the implementation and outcomes of green initiatives in cities like Bristol, and what are the broader implications for social equity and sustainability?*

All in all, this study aims to contribute to the expanding body of literature on green urbanism by scrutinizing the specific challenges and contradictions that arise when environmental sustainability is pursued under the constraints of austerity and neoliberalism deployed at the local and national levels in the UK. Through a focus on a green capital such as Bristol, I gained critical insights into inequalities in urban greening through the lens of austerity, better understand the intersection of austerity, greening, and housing (in)security, as well as recognizing the key role of grassroots movements in acting as counterpoints to government led policies.

My analysis revealed how dominant forms of urban greening are deeply enmeshed within capitalist urbanization processes, albeit with austerity and budget cuts affecting green planning and projects. The study shows that those greening strategies are influenced by keeping municipal expenses tight, staying competitive, and making a profit, rather than ensuring fair environmental benefits – not unsimilar to greening during moments of growth. In Bristol, the selective application of green branding and the uneven distribution of green space resources reflect how capitalist logics of urban development often overshadow genuine sustainability goals drawing focus rather towards a 'green economy' and urban growth, and a widely recognized status of 'green capital'. This analysis further revealed that the task of green space maintenance, due to continued slashing of public budgets, is forced upon community members – otherwise known as 'austerity localism' (Jupp, 2021; Whitten, 2019) – which is undertaken unevenly throughout the city due to more privileged wards being more able to undertake more caring tasks as opposed to residents of more deprived wards. This transfer of responsbility, a typical instance of roll-out neoliberalism, then, acts as a double edged

sword in that it may act as an excuse for governments to justify further budget cuts affecting environmental projects, further embedding these uneven and splintered relationship within the dynamics of a poster child of urban greening.

This localized example highlights a broader trend seen in many cities: namely the rise of "green gentrification," albeit in a more unique context of austerity – most studies of gentrification take place in so-called growing cities (Anguelovski et al., 2022) – where environmental initiatives, though well-intentioned, can drive up property values and displace long-standing communities. Understanding these dynamics in Bristol sets the stage for a wider exploration of how similar patterns play out across different urban contexts, while noting the uniqueness of Bristol in terms of its history of environmental activism and the city council's constraints due to continued austerity policies. By examining green gentrification in a diversity of urban development contexts, we can gain deeper insights into the complex relationship between urban greening, social equity, and economic pressures. All in all, this chapter foregrounds the themes explored throughout the rest of the thesis which collectively aim to better understand how contemporary green urbanisms are driving new forms of inequalities and injustices as well as the key role local social movements play in the maintenance of green spaces as well as in fighting against and for more green and just futures.

Chapter 2. Exploring green gentrification in Europe and North America

In the second chapter, we delve into the complex relationship between urban greening and gentrification through a quantitative analysis across 28 cities in the Global North. By employing advanced statistical methods, specifically a spatial autoregressive Bayesian model, this study explores how new green spaces contribute to gentrification in mid-sized cities in Western Europe and North America over three decades. This chapter seeks to answer a critical question: *to what extent does the introduction of new public green spaces contribute to gentrification, and how does this vary across different urban contexts and time periods?*

The study aims to extend the existing literature on green gentrification by providing a comprehensive quantitative and spatial analysis that spans multiple cities, time periods, and variables that could explain gentrification. By focusing on the broader implications of urban greening, the chapter offers insights into the multifaceted dynamics that arise when green spaces are implemented in diverse urban environments. It examines the intersection of environmental improvements with socio-economic changes, revealing the potential for green spaces to exacerbate social inequities under certain conditions.

The findings reveal that green gentrification is a prevalent trend in many cities, particularly in North America, where the creation of new green spaces often correlates with rising property values and demographic shifts indicative of gentrification. However,

this phenomenon is not uniform. The analysis identifies three distinct types of cities based on the role of greening in gentrification processes: "Lead Green Gentrification" cities, where greening is the primary driver; "Integrated Green Gentrification" cities, where greening plays a significant but not exclusive role; and "Subsidiary Green Gentrification" cities, where greening contributes to gentrification but is secondary to other factors such as new development and transit infrastructure.

Moreover, the chapter underscores the importance of local context in shaping these outcomes. For instance, cities with robust housing affordability policies or those with less aggressive urban redevelopment agendas tend to exhibit weaker or non-significant links between greening and gentrification. This highlights the need for a nuanced understanding of how urban policies and socio-economic factors interact with environmental initiatives, taking into account local particularities and expanded temporal scales.

These findings are crucial for the overall thesis as they underscore the significant scope and magnitude of green gentrification (GG) across diverse urban contexts, challenging the often idealized perception of urban greening as an unequivocal good, yet providing ample evidence about the magnitude of the phenomenon. By revealing the nuanced and varied impacts of greening initiatives, this chapter not only highlights the reality of the so-called "green orthodoxy"—the belief that environmental improvements inherently lead to better outcomes for all—but also validates the concerns raised by activists and communities who have long argued that such projects can exacerbate social inequities. And while this study has enhanced our understanding of processes of green gentrification more broadly, a gap remained in better understanding the relationship between different *types* of green within these processes.

Chapter 3. Exploring green gentrification in 28 Global North cities: the role of urban parks and other types of greenspace

In this third chapter, we explore the intricate relationship between different types of urban greenspaces—such as parks, gardens, nature preserves, recreational spaces, and greenways—and the phenomenon of green gentrification across the 28 mid-sized cities included in the preceding chapter. Utilizing similar quantitative methods as Chapter 2, including Bayesian hierarchical spatial models, this study investigates how these diverse greenspaces contribute to gentrification – or not, particularly in mid-sized cities in North America and Western Europe. The chapter addresses the following critical question: *How do different greenspace typologies influence gentrification processes, and how do these effects vary across time periods and geographical contexts?*

This study aims to fill a significant gap in the literature by examining the role of specific types of greenspaces in gentrification at both citywide and cross-city levels. While prior research has often focused on individual cities or neighborhoods, this chapter offers a

broader perspective, incorporating data from a wide range of cities with diverse urban development trajectories. By analyzing the relationship between newly inaugurated or acquired greenspaces and gentrification, the chapter provides valuable insights into the specific characteristics of green spaces that might shape gentrification – and those that might not, in different regions of North America and Europe.

Findings indicate that parks are the most frequently associated with gentrification processes, particularly in the U.S. context. This relationship is evident in both mid-term and long-term gentrification analyses, suggesting that parks play a central role in driving neighborhood change. Conversely, the study finds that newly designated nature preserves are often negatively associated with gentrification, particularly over longer time frames, indicating their potential as a buffer against displacement. The chapter also explores the mixed results related to gardens, recreational spaces, and greenways, which appear to have more varied impacts on gentrification depending on the city and context. In Europe, results for parks are more varied with consistent results only half the models indicating a positive effect of the variable (new parks) in the explanation of the gentrification index. Greenways were discovered to have the strongest positive relationship, over both mid- and long-term gentrification, in European cities.

This more ‘detailed’ understanding reveals important details for the other empirical chapters of this thesis. For example, it shows that even gardens can be gentrifiable spaces, revealing that extractivism can take place even in smaller and maybe less maintained spaces. Taken alongside scholarship which directly analyzes the role of gardens, both large scale municipal gardens and small-scale neighborhood gardens, we can see how these small-scale, community driven community gardens may play a ‘buffer’ role in contesting process of green accumulation in the city. This further emphasizes the point made in the 'Equitable Green Urbanism' toolkits, developed by research groups across Europe and North America, which call for ongoing support from city governments for these spaces and the social movements that utilize and care for them (CREATE Initative, 2020; BCNUEJ, 2021).

This analysis significantly deepens our understanding of the impacts of large-scale green (re)developments on green gentrification (GG) processes. Specifically, it sheds light on the role of greenways and connectors in accelerating GG, building on previous studies (Rigolon and Németh, 2020). These elements often facilitate increased accessibility and connectivity, which can drive up property values and attract new investments, thereby intensifying gentrification pressures. When combined with other factors such as transportation enhancements and urban development (Padeiro et al., 2019), these projects can lead to profound changes in neighborhoods if precautions are not taken. This becomes especially evident in the next chapter, where a large-scale green redevelopment project aims to link existing green spaces and attract more residents and tourists through expanded transport lines.

Collectively, Chapters 2 and 3 of this thesis not only expand our understanding of green gentrification processes across diverse urban contexts over three decades and the roles played by various types of green spaces, but they also provide a toolkit that social movements, academics, and policymakers can use to anticipate and both chapters call for the careful integration of anti-displacement and inclusive greening policies to ensure that urban sustainability efforts contribute to equitable and just cities.

At this juncture, I felt I had gained a broad and nuanced understanding of contemporary green urbanisms through both the Bristol case study and the quantitative analyses. As I progressed, I began to reflect more deeply on my role as an academic. Is my role merely to comprehend the injustices occurring in real-time, or should I use my privileged position—as a white, US American male and as an academic affiliated with a prestigious research group at a leading institute and university—to actively combat these injustices? The second half of this thesis reflects this shift in perspective. Emerging from these studies are not only deeper connections and more intimate understandings of green gentrification, particularly in the Southern European context, but also a broader application of this knowledge to localized and meaningful events. This part of the thesis reveals both the similarities and differences in urban environmental justice (UEJ) organizing between Southern Europe and North America, offering further insights into the complexities of green urbanization and the mobilization efforts against it.

Chapter 4. Urban green extractivism: nature-based disposession and popular organizing against Barcelona's *Parc dels Tres Turons*

This chapter marks a significant shift in the methodological approach of the thesis, moving from a more traditional qualitative (Chapter 1) and quantitative (Chapter 2 and 3) data analysis and collection to one that is deeply embedded in political activism and community engagement. Unlike earlier chapters, where the primary aim was to analyze and critique green urbanism from a relative distance as researcher, this chapter represents a more direct and involved approach, where the researcher's role is not only to study but also to actively participate in and contribute to ongoing struggles (Chen et al., 2012; Temper et al., 2018; Temper and Shmelev, 2015).

The Parc dels Tres Turons development, as proposed by the city first in 1953 and most recently modified in 2019, threatens nearly 300 working-class homes, which are slated for demolition to make way for an expanded park space. This chapter examines how this planned "greening" project exemplifies "urban green extractivism," where the rhetoric of ecological sustainability is used to justify dispossession, displacement and eviction, and the commodification of urban space.

The chapter's findings are drawn from a combination of ethnographic field notes, participant observation, informal interviews, and analysis of planning documents. The research process was not without challenges, particularly in navigating my dual role as

both a researcher and an activist. This dual role became especially evident during meetings with city officials, where my academic background was both a point of tension and a source of legitimacy. These interactions highlighted the complexities of conducting politically engaged research, where the boundaries between observing, participating, and influencing are often blurred.

The lens of green extractivism (Dunlap et al., 2024) proved particularly useful in this context, as it allowed for a critical examination of the underlying economic motivations driving the *Parc dels Tres Turons* project. While the city's narrative emphasizes the park's potential to enhance urban biodiversity, mitigate climate change impacts, and provide recreational space for residents, these claims often mask the deeper processes of accumulation and dispossession at play. The planned demolition of homes, many of which have been self-built by working-class residents over decades, is framed as a necessary step to create a "modern" and "sustainable" urban park. However, this vision of sustainability is deeply entangled with the economic interests of developers and the broader touristification of Barcelona.

The PTT project represents a form of slow violence (Nixo, 2009; Davies, 2022), where the gradual process of planning and eventual displacement/eviction serves to revalue land and property over time. This process is exacerbated by the broader trends of green gentrification in Barcelona, where environmental improvements are often accompanied by rising property values and the displacement of low-income residents. The PTT project, though not yet realized, is already contributing to these dynamics by fostering intense uncertainty and instability for residents.

The chapter also explores how the aesthetics of "green" are used to justify the transformation of space. The PTT project's emphasis on creating a visually appealing, standardized park space undermines the existing socio-natures— the hybrid landscapes of homes, gardens, and informal green spaces that have developed organically over time (Amorim Maia et al., 2020; Calcagni et al., 2019). These existing spaces, which embody a more complex and lived relationship between nature and the urban environment, are rendered invisible or unworthy of preservation under the guise of modernizing the park. The planned park is indeed not just a local green space but is envisioned as a key component of Barcelona's tourist (and design) economy. By creating new viewpoints, esthetics, pathways, and attractions, the PTT project aligns with broader strategies to commodify the city's natural and cultural landscapes for tourism (MacLeod 2006). This approach not only threatens the social fabric of the affected neighborhoods but also raises important questions about who the park is really for—residents or tourists? What *green* is acceptable versus to be demolished in the city (Anguelovski et al., 2018)?

Despite the challenges, community resistance to the PTT project remains strong. Activists and residents have not only opposed the planned demolitions but have also put forward alternative visions for the park that integrate housing and green spaces in a

way that is more socially and environmentally just. These alternatives emphasize the importance of maintaining the existing socio-natures and the role of community-led planning in creating truly sustainable urban spaces. While this alternative planning perspective and approach aligns with a broader planning and geography literature mostly anchored in the US urban environmental justice or community development activism, and related anti-racism and anti-discrimination fights, (Perez et al., 2015)(Oscilowicz 2023) this study reveals differences in it being a community-led green redevelopment focused on class struggles in a densely populated, Southern European context. The case and story of the PTT highlights the role of class struggle in not only contesting the environmental impact of urban greening but also the commodification of both land a nature for global tourism markets, a dynamic increasingly visible in cities like Barcelona (Cocola-Gant and Lopez-Gay, 2020).

This chapter contributes to the broader thesis by highlighting the extension yet limitations of the green gentrification framework when applied to complex urban environments like Barcelona. While green gentrification is a useful concept, it does not fully capture the range of extractive processes at play in projects like PTT, where the intersection of greening, touristification, and dispossession/eviction creates a unique form of urban green extractivism. By expanding the analytical lens to include these dynamics, this chapter offers a more nuanced understanding of the socio-ecological conflicts that arise in the context of urban sustainability projects.

The findings from this chapter also underscore the importance of alliances between academics and activists in contesting these processes (Mayer 2020; Derickson et al. 2024; Temper et al 2018). The ongoing struggle against the PTT project is not isolated but is part of a broader movement in Barcelona and beyond to resist the commodification of urban green spaces. This chapter sets the stage for the next, which zooms out to examine these dynamics across multiple urban environmental justice struggles in the city, offering a more comprehensive critique of Barcelona's green transition and its implications for social justice.

Chapter 5. Illuminating Radical Spatial imaginaries: Counter-mapping Urban Environmental Justice Struggles for the City to Come

In this chapter, we delve into the concept of radical spatial imaginaries through a counter-mapping exercise of environmental justice (EJ) struggles, particularly within the context of urban greening initiatives in Barcelona. 13 cases of environmental justice struggles were documented through (video) interviews, document analysis (leading to the creation of 'case reports' available in English and Catalan), as well as a feedback event with social movements and other academics throughout the city. Through this approach, we were able deepen our understandings of urban green realities while also creating a tool which places the voices of the protagnists at the forefront.

This chapter critically examines the hegemonic "green social imaginary," which has often been co-opted by neoliberal urbanism, resulting in exclusionary and unjust green developments (Angelo, 2021; Neidig et al., 2022; Garcia-Lamarca et al., 2021). By shifting the focus from top-down urban greening projects to grassroots movements and their radical spatial imaginaries, the chapter seeks to uncover how how green gentrification and other speculative processes "justify" and drive struggles from below and these non-hegemonic visions may lead to more equitable and sustainable urban futures.

The chapter's primary contribution lies in its exploration of how grassroots EJ movements in Barcelona contest dominant municipal narratives around greening. Through the methodology of counter-mapping, the authors collaborate with local activists to visualize and analyze the spatial imaginaries that challenge the neoliberal green city model. The findings reveal three types/themes of spatial imaginaries— (a) place imaginaries centered on preservation and protection, (b) spatial transformation imaginaries rooted in historical traumas and fears of future spatial fixes, and (c) idealized spatial imaginaries envisioning inclusive and livable neighborhoods.

Central to the paper is the reality that these imaginaries are not merely theoretical constructs; they are performed through direct actions, protests, and community initiatives that aim to reshape the urban fabric. The chapter illustrates how these performances have in return influenced local urban policies and other movements throughout Barcelona, Spain, and elsewhere, demonstrating the potential of grassroots movements to challenge and transform the dominant green orthodoxy.

The chapter argues for the importance of recognizing and supporting radical spatial imaginaries as a pathway to achieving just and sustainable cities. It calls for a continued focus on counter-mapping as a tool to document and amplify the voices of those on the frontlines of environmental justice struggles, not only in Barcelona but globally. By highlighting the intersections between local actions and broader urban trends, the chapter contributes to a deeper understanding of the complexities involved in pursuing truly equitable urban greening initiatives and represents an attempt in supporting social movements.

Chapter 6. A Space of Possibilities: situated research from/with *La Casa dels Futurs*

This last chapter brings the ideas around green justice explored in the thesis into a practical context. By collaborating with activists at *La Casa dels Futurs* in a workshop with other academics and neighbors of the area, this chapter explores how academic research and grassroots movements can work together to address social inequities and promote climate justice. This exploration centers around two key questions: First, *how can just processes for scholar-activist/situated research be established within social movements?* Second, *what role can researchers and activists play in legitimizing each other's efforts?* Through the lens of this event, we examine the mutual aid dynamics that

can emerge from such collaborations, as well as the challenges and limitations inherent in these interactions. The event, held at the historic and socially significant Can Masdeu, provided a unique setting for discussing and developing these concepts, with participants reflecting on their experiences and the potential of *La Casa dels Futurs* as a site for transformative research and action.

The findings from this event underscore the importance of long-term, trust-based relationships in conducting situated research. The process of co-creation revealed how scholar-activist alliances can lead to more just research practices by breaking down traditional barriers between academia and social movements. This chapter argues that while researchers often hold privileged positions with greater access to decision-makers, their collaboration with activists can lead to the creation of more caring and intimate research spaces, ultimately fostering more equitable outcomes.

In conclusion, this chapter asserts that engaging in situated research with social movements like *La Casa dels Futurs* is crucial for advancing climate justice. The collaborative process not only strengthens the legitimacy of the movements involved but also enriches the research and researcher(s) by grounding them in real-world struggles and solutions. The reflections shared in this chapter call for continued support and dialogue between researchers, activists, and institutional bodies to ensure that projects being undertaken by grassroots movements can achieve their transformative potential.

Cross cutting results and contributions

Overall, this thesis has contributed to five key areas: namely **(i)** distilling the green city orthodoxy and its implications for social justice, **(ii)** quantifying and qualifying green injustice: the scope and impact of green gentrification, **(iii)** examining threats against and potentials for housing justice in the green city **(iv)** analyzing activism and alternatives in order to challenge the green city orthodoxy, and **(v)** amplifying civic movements and examining the potentials and limits of collaborative research.

(i) Distilling the green city orthodoxy and its implications for social justice.

By comparing two distinct urban contexts—Bristol, impacted by austerity policies, and Barcelona, which employs more progressive urban strategies—a part of my dissertation highlights the nuanced ways in which green branding can serve as both a tool for sustainability and a mechanism of social exclusion. Despite the contrasting political environments, both cities demonstrate how the superficial adoption of "green" principles often perpetuates existing inequalities rather than alleviating them. These two studies, furthermore, represent the growing mobility of greening policies, wherein both cities, despite longstanding and new injustices arising through contemporary green (re)development plans, are held as global leaders in sustainability (Angelo, 2021,

Garcia-Lamarca et al., 2022; Goh, 2021; Temenos and McCann 2012). The travelling of specific aspects of their green transitions – with the most obvious being Barcelona's 'superblock program' – runs the risk of creating and furthering urban injustices through a blanket insertion of a urban green initative from one space to another, oftentimes with little appreciation of localized contexts, histories, and desires .

In both Bristol and Barcelona, green initiatives are frequently intertwined with broader capitalist urbanization processes, where aesthetics and a broad vision of sustainability often overshadow deeper social justice concerns. This aligns with the concept of "green extractivism," where environmental sustainability is co-opted as an tool to justify capitalist accumulation and land speculation (Dunlap et al. 2024). The thesis reveals how, despite the differing political climates, green urbanism in both cities undermines housing rights and exploits community-driven greening efforts. In Bristol, austerity-driven policies force communities to assume responsibilities traditionally held by the state, while in Barcelona, temporary green uses are permitted but often without long-term security for the communities involved.

While much of the literature on green branding focuses on the role of states or real estate developers (Gulsrud et al. 2013; Greenberg, 2015), this thesis contributes a novel perspective by shifting the focus in Chapters 4 and 5 to the "counter-branding" efforts of social movements. If 'green' is understood as a social imaginary, then it is a concept widely held across society and operationalized to varying extents (Angelo, 2021). These chapters explore the reactions to green branding practices and the alternative forms of 'green branding' promoted by social movements. In essence, they investigate what type of green is being branded as desirable 'from below'.

Together, this provides a comprehensive discussion on the impacts of green branding on social justice in urban contexts.The findings challenge the idealized perception of green growth and highlight the need for a more critical understanding of the socio-political dynamics that underlie green urbanism. By situating green branding within the broader context of urban development, the thesis joins in calling for a reevaluation of the sustainability discourse to ensure it genuinely serves socio-ecological justice rather than merely perpetuating neoliberal urban strategies.

(ii) Quantifying and Qualifying Green Injustice: The Scope and Impact of Green Gentrification

This research makes a significant contribution to the understanding of green gentrification. By utilizing both quantitative and qualitative methods, the thesis provides a comprehensive analysis of green gentrification across multiple urban contexts in Europe and North America. The use of advanced statistical techniques, such as spatial autoregressive Bayesian models, allows for a detailed examination of the relationship between green space developments and socio-economic changes in cities.

The findings reveal the pervasive nature of green gentrification, particularly in North American cities, where the introduction of new green spaces often correlates with rising property values and demographic shifts, taken alongside lesser levels of housing rights and secutiry than in European nations. However, the research also identifies variation in the impact of greening across different urban contexts, highlighting the importance of local policies and socio-economic factors in shaping these outcomes. The distinction between "Lead," "Integrated," and "Subsidiary" Green Gentrification cities offers a nuanced understanding of how green spaces contribute to or mitigate gentrification.

This section also bridges the insights from large-scale quantitative analyses with on-the-ground perspectives from activists and social movements in Bristol and Barcelona. By undertaking these studies, the thesis is able to move beyond an analysis of the impacts of green gentrification to an examination of the variety of processes that make green gentrification possible (Sax et al. 2022). In the examination of Barcelona, the analyses found in this thesis highlight the extractivist tendencies that lay the ground for the (potential) future gentrification of the *barris de muntanya,* as well as the way in which social movements outline their experiences of green gentrification. In other words, green gentrification is just as much about aesthetics of urban nature, touristification, and green eviction as it is about the displacement of historically deprived communities following the (re)development of green amenities. Thus, while offering much in regards to deepening quantitative toolkit for the more nuanced quantitative analysis and understanding of green gentrification in Global North cities, this dissertation also highlights further extractive industries which make (green) gentrification possible. By integrating these diverse viewpoints, the thesis underscores the need for a more holistic approach to urban greening that prioritizes social equity alongside environmental sustainability.

(iii) Housing Justice in the Green City

Housing justice emerges as a critical theme throughout the thesis, with urban greening often exacerbating existing housing inequalities (Anguelovski and Connolly 2021; Gould and Lewis, 2012; Zuniga-Teran et al., 2021; Angelo et al., 2022). The research demonstrates how green urbanism, when not carefully managed, can lead to direct eviction and displacement, particularly in working-class neighborhoods. The analysis of case studies like the *Parc dels Tres Turons* in Barcelona illustrates the tangible impact of green urbanism on housing security, where planned green developments threaten to displace long-standing communities. In Bristol, we see how despite a long history of environmental activism, continuing austerity policies are driving housing injustice in the city. As the Bristol City Council searches for new revenues of funding, developers are often able to escape the inclusion of affordable housing through section 106 payments or community infrastructure levies, wherein green amenities in new developments directly lead to the shrinking of affordable housing provision in the city.

The findings of chapters 2 and 3 also highilght issues of housing justice in the green city. These studies show that greening contributes to the loss of working class and minority residents in greening neighborhoods while higher income residents are moving in. The displacement pressures created by rising property values and rents not only reduce access to affordable housing but also erode long-standing community ties and cultural diversity. These dynamics underscore the need for cities to adopt robust housing justice measures, such as anti-displacement protections, affordable housing requirements, and inclusive urban planning. Furthermore, decision makers and social movements may use the findings from these studies to make more informed, equitable decisions about urban greening by more carefully considering factors such as type of green space, the location of green space, the timing and phasing of green projects, all while more seriously engaging communities and implementing anti-displacement strategies.

The thesis argues that for urban greening to be truly just, it must be coupled with strong housing protections and policies that prioritize the right to remain in place. This includes implementing anti-displacement measures such as rent controls, affordable housing mandates, and community land trusts (Anguelovski et al. 2022; Triguero-mas et al., 2022; Kim and Wu 2022). Furthermore, as chapters 1, 4, and 5 highlight, 'green' cities draw in new residents with higher levels of purchasing power – such as in Bristol with the arrrival of residents from London and university students from around the world or the touristification of Barcelona and the increase in rents and short-term tourist rentals – further highlighting the need for intense anti-displacement measures to be widely implemented. Moreover, the research calls for a broader understanding of displacement that goes beyond physical eviction to include cultural and symbolic displacement, where communities feel alienated by changes in their neighborhood's character and accessibility. By linking housing justice with environmental justice, the thesis advocates for a more integrated approach to urban planning that recognizes the interdependence of social and environmental well-being.

(iv) Activism and Alternatives: Challenging the Green City Orthodoxy

The thesis highlights the pivotal role of grassroots activism in challenging the dominant green city narrative. Through a detailed examination of social movements in Barcelona and Bristol, the research showcases how local communities are not only resisting the adverse effects of green urbanism but are also proposing alternative models that prioritize social equity and environmental sustainability while playing a key role in the maintenance of existing green spaces.

These movements, particularly in Barcelona, engage in direct action and alternative forms of living, such as the occupation of buildings and land, to contest green gentrification and advocate for more inclusive planning policies. Importantly, these movements also conduct 'popular planning' wherein current use of green space and future desires for green space 'enhancement' are collected and analyzed. Furthermore, in both Bristol and Barcelona, community members and social movements play key roles in the maintenance of socio-ecological systems. In Bristol, we see how this occurs

in the direct, physical maintenance of green spaces – emerging as a result of budget constrictions. In Barcelona, acvitists hold events for neighbors affected by current plans, offering a level of understanding of current realities that residents are not offered by the city government – who has not met with affected neighbors and the wider community – to discuss their plans for the area. By amplifying these 'radical spatial imaginaries', the research underscores the importance of supporting and legitimizing grassroots efforts as a critical counterpoint to the top-down imposition of green urbanism.

Building on this, the thesis makes a key contribution to the literature by highlighting working-class proposals for green justice and community-based green planning, specifically from the lived experiences of residents in self-built cities like Barcelona. These communities not only resist displacement but also reimagine urban green development in a way that prioritizes social justice and sustainability. Their proposals contrast sharply with top-down, market-driven approaches to greening, offering a vision of sustainability deeply rooted in the needs of working-class residents which aims to be outside the modernist frame of what *ought to be*. By centering on these grassroots movements, the thesis extends the green gentrification framework and highlights a more nuanced understanding of urban sustainability. It underscores how working-class activism can redefine green justice, contributing to a deeper understanding of equitable, community-led green planning in European cities.

(v) Participatory Action Research: Amplifying Civic Movements and Examining the Limits of Research

Finally, the thesis reflects on the role of Participatory Action Research (PAR) in supporting civic movements and advancing social justice. The research process itself is presented as a form of activism, where the researcher engages directly with social movements to co-create knowledge and strategies for resisting green gentrification (Sousa 2022). This approach not only enriches the academic research but also empowers the communities involved by validating their experiences and amplifying their voices (Fernandez et al., 2018).

However, the thesis also acknowledges the challenges and limitations of PAR, particularly the tensions that can arise between academic timelines and the needs of social movements. The research calls for more reflexivity and care in maintaining these relationships, emphasizing the importance of long-term, trust-based collaborations that go beyond the immediate demands of research projects.

Moreover, the thesis advocates for a broader recognition of non-traditional research outputs, such as documentaries, zines, and toolkits, which can have a more significant impact on public discourse and policy than conventional academic publications. By embracing these diverse forms of communication, researchers can better engage with

the communities they study and contribute to more meaningful and lasting social change.

Strengths, Limitations and reflections

Below, I offer a brief reflection on the strengths and limitations of this thesis as an overall collection of works.

Strengths

One of the key strengths of this thesis lies in its operationalization of a wide range of methodological approaches. Through the bringing together of various forms of data coming from various methodological approaches, we are able to gain very detailed insights into urban realities. Through large-scale quantitative analyses of green gentrification, we were able to unmask, with a high degree of certainty, the continued uneven and unjust practices of capitalist urbanization and extraction under the guise of 'sustainable urban development,' 'nature-based solutions,' 'ecosystem services,' and 'green growth. – affirming the validity of social movements' claims and justifying their contestaion.

Through more traditional qualitative approaches, such as those used in the study of Bristol, we were able to offer a historical narrative built around contemporary voices from the grassroots through to developers and decision makers, which critically assessed the city's 'green capital' status. And through engaged research, this thesis was able to offer a modest level of support to social movements throughout the city while gaining access to the richness of placed-based knowledge which enriched both the personal and academic outputs of these collected works. All in all, the immense undertaking of operationalizing a wide variety of methodological approaches, all-consuming varying levels of mental and emotional energy, has elevated the impact of this thesis on our broader understandings of green gentrification and its grassroots resistance.

The thesis also demonstrates strength in its conceptual connections, exercises, and offerings. Specifically, in chapters 4 and 5, the thesis integrates conceptual advancements in related fields to analyze the collected data. In chapter 4, the operationalization of 'green extractivisms' in an urban context is presented as a premier analytical lens for critically analyzing urban green (re)developments, merging discursive and material components under a single framework. This approach answers calls from green gentrification scholarship for deeper analysis into the myriad of processes that enable green gentrification to occur (Sax et al., 2022). In chapter 5, the thesis connects the literatures on social and spatial imaginaries to offer the concept of 'radical spatial imaginaries', understood through the lens of performativity, as a framework for analyzing place-based relationships to space and time. This conceptual exercise responds to

critiques from both social environmental sciences and the broader literature on social imaginaries, moving beyond vagueness toward a framework for exploring various empirical case studies.

Limitations

This thesis also acknowledges several limitations. One could argue that the very strengths outlined above could also be seen as limitations. The thesis explores many cities and zooms in on two (Bristol and Barcelona) through several methodological approaches, which may have led to missed opportunities for a more focused, in-depth exploration of a specific place, methodology, or concept. While colleagues at ICTA-UAB have deeply engaged with specific topics—such as the life cycle of a battery, the importance of intersectionality in climate justice, or the urban green identity of Victoria-Gasteiz—this thesis's broader scope may have resulted in moments of generalization and potential vagueness. Yet both municipalities and activists group a variety of projects, initiatives, or interventions under the general term of “urban greening” and use a variety of concepts to ground their work. Additionally, the wide range of topics and places covered could contribute to a perceived disjointedness in the collection of works. While I do not believe this is universally true of the thesis, certain aspects could undoubtedly have been improved with a more focused approach to research and writing.

More concrete limitations are present throughout the thesis's various chapters. For example, in chapters 2 and 3, data availability limitations (in terms of time periods and demographic indicators) in certain cities prevented full analyses for 11 cities. The issue of data availability also led to some cities being removed from the study, limiting our ability to draw broader, more nuanced conclusions. Furthermore, limitations regarding green space data affected the studies, causing some time periods to approximate but not always align precisely with the decadal splits used in the wider analyses. A detailed description of how these data limitations were addressed is provided in the supplementary material found in the thesis appendix.

In the first chapter, which analyzes Bristol, further limitations are evident. By focusing on the broader picture of Bristol's green identity, the chapter misses the opportunity to gather rich insights that could have been obtained through a more focused analysis of South Bristol, for example. However, this limitation also presents an avenue for future research by offering an overview of potential 'entry points' for more specialized research. Chapters 4 and 5, while focusing heavily on the imaginaries of social movements, could have been enhanced by conducting interviews or focus groups with decision-makers to provide a more comprehensive view of Barcelona's green transition.

The COVID-19 pandemic also imposed significant limitations on this thesis. As mentioned in the preface, the original plan for my doctoral studies was to conduct fieldwork with grassroots organizations involved in urban greening in 'informal neighborhoods' in Nairobi, Kenya. The inability to travel and obtain a visa during the first

two years of the thesis prevented this fieldwork, which I initially deemed essential to the project. While this is not a limitation in itself, it did reduce the time and energy I could devote to research in Barcelona, detracting from the overall dissertation.

The pandemic also had personal impacts that deeply influenced the thesis. After spending nearly a year and a half working on the thesis alone at home, along with other life events, my mental health and social interactions were severely affected. The necessity to change the direction of the thesis and the subsequent development of social anxiety limited my ability to conduct PAR and participate in academic events. Several times, I canceled last-minute or left events early due to anxiety attacks, limiting the time spent with and insights gained from others. However, as chapter 6 reflects, it was precisely these social spaces—interactions with activists, neighbors, colleagues, and friends—that eventually helped me begin overcoming the challenges posed by (social) anxiety. In the end, I did have a continued engagement, and continue to do so, with local social actors and am proud of being able to have continued strengthening this relationship over time.

A reflection is also needed on the limitations of conducting politically motivated and engaged research. As discussed in chapter 6, the misalignment of timelines between academics and activists may pose challenges. My own deadlines and academic requirements did not always align with those of social movements, highlighting the need for deep discussion, reflection, and care in maintaining scholar-activist relationships. I also felt at times uncomfortable with the requests expressed by some members of some civic struggles and needed to recognize my own personal and professional limits in contributing to their own agenda. It is essential for all involved to be clear about their levels of involvement, abilities, and desires, and to respect each other's lives outside the collective work. This discussion goes both ways, as academics can deploy extractivist research practices in their engagement with social movements, just as social movements can place unsustainable, uncaring, and uneven reliance upon academics who are increasingly living in precarious situations.

Further/future research

Looking ahead, this thesis advocates for further research that is politically motivated and conducted through participatory methodologies. I do not believe everyone needs to be deeply embedded within social movements or engage in militant research, as it requires a significant commitment and is a highly emotional endeavor. However, I do call for more situated research practices that incorporate participatory methodologies.

Additionally, more research is needed to analyze the very localized impacts of the expanding green city orthodoxy, across many cities, as to expand our udnerstandings of it’s travelling and its characteristics (Long, 2016; Angelo 2019; Neidig et al., 2022). We are continually expanding our understanding, to which this thesis contributes, of how green urbanisms are manifesting in local contexts. Future research should also explore

smaller cities to understand these dynamics beyond mid- and large-sized urban centers. For example, a colleague I met in Bristol is researching the impacts and pushbacks against the rollout of 'smart city' initiatives in a small city/town in England/Wales.

Moreover, research should address conservative or right-wing pushbacks against greening initiatives. The dialectics of emancipation should be further explored. For instance, in the counter-mapping in Barcelona, it would be beneficial to also map how movements with differing ideals envision their city's transformation. The case of Vallcarca presents an interesting area for deeper exploration, which could help bridge connections between various populations and act as mediators among them.

Further research could also connect my work on activism in Barcelona with other studies on activism in different locations, particularly in cities of the Global South. While I would love to return to my original research plan of analyzing these dynamics in Nairobi, I now believe that I do not necessarily need to be the one conducting this research. Instead, collaboration between research groups and social movements in the Global South would be immensely valuable.

Finally, emerging from the empirical findings of this thesis is the central importance of housing. As the world moves toward extensive retrofitting, we need to understand the role of housing regimes within the green transition. Scholars like Andreucci and Garcia-Lamarca are already pushing these boundaries. Housing is, and will increasingly become, a central component of this process.

My personal goals for future research are aligned with counter-mapping. Ideas for the expansion of the EJ struggles map included in chapter 5 are constantly being explored. A goal to create a large database of contestation to (green) urban (re)development projects in Barcelona which is publically available, constantly updated, and provides links to social movements and the most recent media coverage and city hall plans and/or responses continues to exist and evolve.

Policy implications and recommendations

I have long held a disbelief in the blanket importance of academics offering policy implications/recommendatins in their *academic* publications. My disbelief rests on espistemological concerns, a goal to move beyond technocratic solutions, ethical considerations, all driven by a main focus on knowledge production and representation. My epistemological concerns are that by offering generalized policy recommendations I may risk oversimplifying complexities and may drive ineffective or harmful outcomes (Roy, 2005; Robinson, 2011) – or further driving the coloniality of power this thesis has gone to great lengths to critique. This is related to an aim to move beyond a search for solutions that reduce complexity in socio-ecological systems to technocratic problems that can be solved through top-down planning (Bayat 2010) – or the need to move away from eco-modernization theories wherein we can control ‘socio-natures’ and plan our

way our of the climate crisis. In this way, I see a need to be hesitant in our relationship with the government (Pellow, 2017), especially so when engaging with social movements and associated direct action, to ensure that the data we collect and analyze cannot be missappropriated by governments or organizations to legitimize actions that are not in the best interest of communities near and far (Simone, 2004). I align with argumentation that scholarship should remain autonomous and not be driven by the immediate demands of policy (Hart, 2002; Amin, 2002) which may compromise the critical analysis of urban areas (Swygendouw, 2004; Sennett, 2006).

With this being said, I do recognize the merits of offering policy implications/recommendations after my experiences in more politically engaged research and working alongside colleagues who critically assess and engage in the possibility of acheiving 'green justice' through a combination of policy and practice (Oscilowicz et al., 2022). The policy implications/recommendations offered here are done so in a hopeful gesture. This thesis, more generally, has argued and concludes with the need for a system change, away from socio-ecological releationships rooted in capitalist processes of accmulation and dispoesssion, carried out through governance regimes, to socio-ecological systems based on truly sustainable socio-natures which are to be re/uncovered and taken seriously.

Implement Anti-Displacement and Eviction Measures in Urban Greening Initiatives

Central to this thesis is the recommendation that cities incorporate strong anti-displacement policies when planning and implementing green (re)developments. This could include rent controls, affordable housing mandates, and community land trusts to protect vulnerable residents from the pressures of (green) gentrification. Importantly, displacement does not only maifest in a physical way but also as a feeling of exclusion due to the change of the quality and use new or enhanced green amenities (Aguelovski 2016; Millington 2015; Sax, Nesbitt, and Quinton 2022). Therefore, anti-displacement measures must extend beyond housing and zoning policies to encompass the aesthetics and cultural relevance of green spaces. This requires a genuine inclusion of diverse ways of being and existing in the world into the planning, design, and ongoing management of these spaces (Anguelovski et al., 2020). By doing so, cities can ensure that green developments are not just physically inclusive but also resonate with the cultural and social identities of all community members, thus preventing symbolic and cultural displacement (Anguelovski et al. 2020).

While the literature on green gentrification has explored the *displacement* effects of urban green (re)development, and called for anti-displacement measures to be mplemented in urban greening initiatives (Anguelovski et al., 2022), this thesis has further shown how urban greening may lead to direct *eviction* – meaning a direct,

immediate, and often legally sanctioned removal of residents their homes. While scholars have noted instances wherein green redevelopment projects lead to the direct displacement of residents through legal actions in the global north, the brunt of discussions of green gentrification surround *displacement*. Eviction through the lens of urban sustainability is a well documented occurance throughout the Global Souths (Weinstein 2014; Datta, 2016; Sugranyes and Mathivet 2010).

Urban plans and policies must ensure that residents have a 'right to stay put' (Newman and Wyly, 2006) and must move beyond instrumentalist and modernist understandings of 'sustainability' which rupture socio-ecological systems. By addressing the displacement and eviction risks associated with urban greening, cities can ensure that the environmental and health beneifits of urban re-naturing projects reach all residents and not only those who can afford rising property values. The impact of these policies can be seen through chapters 2 and 3 wherein a majority of 'sustained' green gentrification cities are found in the USA, where fewer anti-displacement policies are in place.

Support and Engage Grassroots Movements for more humble and informal greening

Governments and institutions should actively support and collaborate with grassroots movements that are advocating for environmental justice and equitable urban development. This could involve providing funding, platforms for dialogue, and integrating their perspectives into official planning processes. Recognizing and empowering grassroots initiatives can lead to more just and sustainable outcomes, as these movements often represent the interests and needs of communities at the forefront of injustices. Studies have consistently shown that inclusive governance procedures are critical for achieving just and green futures (Anguelovski, 2015; Agyeman, 2016; and Chatterton, 2013). Engaging and supporting groups that are organized and possess deep local knowledge and data regarding space and visions of (re)development is a fruitful path toward realizing these goals.

However, alongside these grassroots greening efforts, bold and ambitious greening projects should not be neglected. Many urban environments, particularly in working-class neighborhoods, suffer from deep environmental injustices, including severe air and soil contamination, which more modest green initiatives may not be able to address on their own. For example, in the case of San Francisco, extensive greening projects were necessary to address long-term industrial contamination and reduce environmental health risks for vulnerable communities. Therefore, it is critical to distinguish between "greenwashing" or superficial green interventions and genuine ecological improvements that tackle the socio-environmental risks faced by these communities (Connolly, 2021).

Greening efforts must be seen within the context of broader socio-environmental riskscapes. Many working-class neighborhoods are exposed to a range of environmental

threats, from pollution to heat island effects, which are often exacerbated by uneven urban development. For greening to be truly transformative, it must address these structural environmental inequalities. This requires more comprehensive strategies that go beyond aesthetic greening and delve into addressing contamination, improving air quality, and providing climate resilience in ways that prioritize those most vulnerable to environmental harm. Ultimately, urban greening should not only beautify the city but also act as a critical intervention in reducing the socio-environmental risks faced by working-class communities, with solutions based in and built alongside those communities.

Promote Situated and Participatory Research

This thesis has touched the precarity and pressures of neoliberal academia and its negative impacts on research processes and ensuing policy recommendations. Since a significant portion of academic funding comes from governmental institutions through the provision of grants and scholarships, fundamental changes to these contracts and stipends, as well as to the research being funded, are necessary. Competitive grants should encourage research practices that are deeply embedded in and directly connected to the communities they study. Participatory research methods, like those employed in this thesis, should become standard practice, with an emphasis on co-creation and mutual benefit between researchers and local communities. Such research approaches can yield more relevant and impactful findings, ultimately leading to policies that are better tailored to the specific needs of these communities.

However, achieving this would also require a shift in how urban planning and governance are conducted, minimizing the influence of powerful lobbies and self-interested agents who increasingly dominate the planning and (re)development of our urban environments (Crouch, 2004). Furthermore, grants and scholarships should provide a sufficient standard of living for researchers and should last at least four years—something that was only achieved during the third year of my doctoral studies. Another radical, yet necessary, policy change would involve providing funds for non-academic publications or allowing research outputs in formats other than traditional academic articles. Valuing non-traditional forms of communication, such as documentaries, zines, toolkits, and other media that do not rely on academic 'jargon,' can have a broader reach and greater impact on society and governance. This approach would also allow academia to establish a presence outside the increasingly commercialized and profit-oriented domain of large publishing companies.

Concluding remarks

Oftentimes, it seems as if all hope is lost. We are reminded multiple times a day, be it through (social) media, (overheard) discussions at the bar or at work, that our planet continues to reach and surpass social and environmental tipping points. That a new forest fire or flood has devestated a region (floods in Greece (NBC News 2024), Catalan draught (AP news 2024), Brasilian floods (Gaurdian 2024), or extreme heat waves in India (CNN News 2024). At the time of writing this thesis, we have experienced 15 months of

+1.5C heating in a row (NCEI 2024). The Paris agreements wanted us to end at 2C, by 2050. Despite all of the talk and the action, it seems we have no escape.

It can be argued to be undeniable, although still denied (Jacques 2012), that we require dramatic action to ensure a livable and just future for future generations. And while this thesis has gone to great lengths, with varying levels of difficulty, to critique attempts of transitioning to more 'sustainable' urban fabrics, all that is green is not bad. The implementation or expansion of green amenities throughout our urban fabrics does not naturally result in eviction and displacement. This we know from large-scale quantitative studies and from the voices of social movements. Voices which have long faught for and maintained urban green amenities, such as (occupied) gardens, shown to be barriers to green gentrification while offering 'eco-system services' to residents. The resulting eviction and displacement, rather, arise from the enrollment of morally driven 'sustainable' or 'green' justifications for the continuation of capitalist systems of extractivism. Put bluntly, capital always finds a new market. Becoming both the fire extinguisher and the source of the flame.

This is the coloniality of power at play inside of contemporary 'urban greening'. As critical perspectives gather we collectively continue to outline the intracies of this reality. The coloniality of power reveals how European colonial powers created racial classification systems to legitimize domination. Today, our understanding of the roles of race inside of urban greening joins the long history of EJ activism against environmental racism in the United States in highlighting how white supremecy and settler colonialism continue to drive green injustices throughout the world. Coloniality isn't just about racial, economic or political domination but also about control over knowledge and culture. European knowledge systems were imposed as superior, while Indigenous and non-Western forms of knowledge were dismissed as inferior. This continues today, for example, in the manner in which academic thought is produced and what lenses are deemed 'acceptable', leading to dominant frames like those of distribution, recognition, and procedural justice being exported to other areas of the globe and being blanketly placed on communities and missing realities (cite that robinson paper in south africa). This also manifests in dominant forms of 'knowing' what a green city is and that being pushed, through networks, onto other areas of the world. Although not given enough attention in this thesis, the continued imposition of European gender norms through a patricarchal society are present in modern green infrastructure developments, being increasingly outlined and targeted by both scholarship and planning initiatives (Calderon-Areglich et al., 2023; Ajuntament de Barcelona, 2017).

This thesis hopes to not pretend to offer any groundbreaking discoveries. Rather, it represents a modest offering to the academic literature at large and the global environmental justive movements which are collectively aiming to unmask the disastrous path our capitalist system has created and continous. To unmask these systems to reveal and propose well informed and data driven alternatives. To suggest

modest futures outside the modern dream of endless growth. To decolonize our minds, our bodies and our planet.

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Apendix. Supplementary material

Chapter 2.

1. Supplementary Information: Sociodemographic Data Sources and Processing

In preparing the data for analysis, we used a number of data sources to acquire demographic data (see Table 1). For each city included in the analysis, we sought data at the finest geographic scale available. The majority of data came from national censuses, and thus the unit of analysis for demographic data corresponded to the census tract, area, or other similar geographic unit for which data in the corresponding country is released. For each country, we searched for available demographic data at the level of these small geographic units that corresponded to constructs commonly used to measure gentrification (i.e., level of education, income or other measure of socioeconomic status, race/ethnicity or migration status, special variables relative to the local context, and where available data on cost of housing). See Table 2 for a list of variables acquired in each country.

In addition to variables used to measure gentrification, we collected basic population data at the same geographic scale which were included in the analyses and which was used to calculate the relative measure of each variable (see below). The data sources used for the project; variables, geographic units and timeframes used; and the processing of demographic data is described below.

1.1. Data Sources

Table 1. Data sources consulted, organized by country.

Cities (Country)	Demographic Data Source	Unit of Analysis
Lyon and Nantes (France)	INSEE (1999; 2006-2013)	IRIS

Atlanta, Austin, Boston, Cleveland, Denver, Detroit, Louisville, Milwaukee, Philadelphia, Portland, San Francisco, Seattle, Washington DC (US)	US Census (1990-2010), American Community Survey (2006-2010 and 2012-2016), Data standardized to 2010 census tracts purchased from GeoLytics (Neighborhood Change database)	Census Tract
Calgary, Montreal and Vancouver (Canada)	Canadian Census (1991, 1996, 2001, 2006, 2011, 2016)	Enumeration areas (1991, 1996); Dissemination areas (post 1996)
Palermo, and Milan (Italy)	Italian Census from ISTAT (1991, 2001, 2011)	Sezione di censimento (1991, 2001), Aree di censimento (2011)
Barcelona (Spain)	For age, profession, education, vulnerability: Instituto Nacional de Estadística (1991, 2001, 2011) and register of inhabitants (1996 or 1997, 2006, 2016) For socioeconomic data and rent value data: Barcelona Town Council Statistics office (1991, 1992, 1996, 2000, 2001, 2006, 2007, 2008, 2009,	Census tract, Small Research Area or Neighborhood depending on year and variable

	2010, 2011, 2012, 2013, 2014, 2015, 2016)	
Sheffield, and Bristol (UK)	UK Census (1991, 2001, 2011)	Enumeration Districts (1991), Output Area (2001, 2011)
Edinburgh (UK)	UK Census (1991, 2001, 2011)	Output Areas
Amsterdam (The Netherlands)	Municipal Research, Information and Statistics Office (1997-2017), Dutch national Statistics Netherlands (1997-2007, 2001, 2006, 2010),	Wijk
Copenhagen (Denmark)	Danish Statistical Office (yearly from 1990 to 2016)	Roder
Stuttgart (Germany)	For age, vulnerability, housing ownership: Department for Statistics – City of Stuttgart (1990 or 1991, 2000, 2015)	Stadtteil (Sub-District)
Vienna (Austria)	For age, education, profession, socioeconomic status, and vulnerability: City of Vienna Austrian Public Data Portal (1991, 2001, 2014 or 2015 or 2016)	Zählgebiet (Sub-Districts)
Dublin (Ireland)	Ireland Census (1996, 2002, 2006, 2011, 2016)	Electoral Divisions (called SAPS in 1996)
Valencia (Spain)	For age, profession, education, vulnerability: Instituto Nacional de Estadística censuses (1991, 2001, 2011) and register of inhabitants (1996, 2006, 2016). For rent value data: Statistics office at the Valencia Town Council. Statistics Yearbooks (1993, 1996,	Census tract or neighborhood depending on year and variable

	2001, 2002, 2006, 2011, 2012, 2013, 2014, 2015, 2016)	

1.2. Variables

As the type of data collected by national censuses and other data consulted vary by local context, we revised available variables in the case of each city and balanced the availability of data with the two constructs we sought to measure and the local context so that the data sets for each city/country could be as comparable as possible. We sought to find variables representing the following constructs for each city: 1) social vulnerability: population with at least a university education, population with low income (relative to the city-wide median income) or vulnerable racial or immigration origin, population with high income (considered to be higher than 125% above the city-wide median income), adult population working in professional class jobs, race or ethnicity; and 2) housing cost: area average home sale value and area average rental value. In many cases, these exact variables were not available and in these cases, we sought to find the best possible match for the constructs. See Table 2 below for the final list of variables by city.

First, we considered "social vulnerability" as one of the constructs needed to measure gentrification. We included it because measuring change in the proportion of socially vulnerable population over time in a given neighborhood or small area may indicate whether socially vulnerable populations may be experiencing expulsion from the area. We counted as aspects of social vulnerability either household or individual socioeconomic indicators (where individuals with lower levels of education, lower incomes, or lower social classes were considered to be more socially vulnerable than others), measures of race/ethnicity (where populations of minority races or ethnicities may be considered more socially vulnerable than the dominate race or ethnicity), and measures of immigration or migration which may be used in lieu of race/ethnicity in cities in which race/ethnicity is not measured in the data or where recent immigration or place of birth is more important for determining level of social vulnerability than race or ethnicity. To identify which variables to use to measure this construct, we consulted existing academic literature focusing on each local context and local grey literature reporting on social or health inequality to get a sense of the dimensions by which social vulnerability had been reported. We then selected the best variables available at the appropriate geographic scale to fit with the local context regarding social vulnerability.

Measures of socioeconomic social vulnerability also varied by local context. Socioeconomic status was measured using a selection of related variables such as highest level of education, household income, employment status and professional category.

As the second construct, we measured cost of housing as rapidly increasing housing prices, both rental prices and purchasing prices, are an indicator of gentrification. However, this data was often not available or was available from a different source and/or at a

different geographic scale than data from the local census. In the final gentrification score calculation, only change in rental price was used as this was the most universal variable.

Table 2: Specific variables used for each country/city when calculating the gentrification score.

Country (City(ies))	Variable
Lyon and Nantes (France)	-% of residents with higher diplomas (1999); number of out-of-school people aged 15 or over with a higher education qualification (2006-2013) -% of residents who were: farmer operators, craftsmen, tradesmen, heads of companies, executives, intellectual professions. superiors, intermediate professions (1999); residents 15 years or over who were craftsmen, comm., entr. chefs, executives, prof. intel. sup., prof. intermediaries (2006-2013) -% of residents who were: born abroad (1999); immigrants (2006-2013)
Atlanta, Austin, Boston, Cleveland, Denver, Detroit, Louisville, Milwaukee, Philadelphia, Portland, San Francisco, Seattle, Washington DC (US)	-% of residents age 25 or over who have a university degree or higher level of education -% of employed people age 16 and over working in a professional occupation (where professional occupations included were: 1) Professional, scientific, and management, and administrative and waste management services: - Professional, scientific, and technical services and 2) Professional, scientific, and management, and administrative and waste management services: - Management of companies and enterprises) -% of households considered "high income" (household income categories, where those in categories above the 125% of the median for the city for the year were considered high income) -% of households living in poverty

	-% of residents identifying as not Non-Hispanic White (aggregate of racial categories except for Non-Hispanic White) -% of renting households paying high rent (paying above the median value in rent, adjusted for each city and year to the median rent for the city for the year)
Calgary, Montreal and Vancouver (Canada)	-% residents who are age 15+ with university degree or higher (in 2001 20+, all other years 15+) -% residents who working in 8 categories of occupations in 1991, 20+ categores in 1996, 2001 and 2006 -% households with income at least 125% of city median household income -% residents who identified as Black, Arab, S. Asian and multiple visible minorities -% households whose gross rent is more than 30% of household income
Palermo, and Milan (Italy)	-% residents age 5 years and over, Bachelor's degree or university degree -% residents from Africa, Asia and Stateless persons
Barcelona (Spain)	-% residents with university degree or higher -% residents who are management staff of companies and public administrations, technicians and professionals, scientists and intellectuals High income calculated using: family economic capacity index (1991, 1996), territorial distribution of income (2000, 2005, 2008), territorial distribution of income by neighborhood (2008, 2011, 2016) -% residents with nationality from: Countries in Africa, Philippines, Peru, Pakistan, Bolivia, Ecuador, Colombia, or the Dominican Republic -% households paying high rent calculated using the rent price per month in Euro/m2 for second-hand renters

	(1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008)
Valencia (Spain)	-% residents with university degree or higher -% residents who are management staff of companies and public administrations, technicians and professionals, scientists and intellectuals -% residents with nationality from: Countries in Africa, Philippines, Peru, Pakistan, Bolivia, Ecuador, Colombia, or the Dominican Republic
Sheffield, and Bristol (UK)	-% residents over 18 who are: Qualified (Aggregate of Level a (higher degree), Level b (degree), and Level c (diploma etc.) -% households headed by a person with employment in the following categories: (1)Professional etc. Occupations + (2) Managerial & Technical Occupations (1991); (1) Managers & Senior Officials + (2)Professional occupations (2001, 2011) -% residents identifying as Black Caribbean, Black African, Pakistani, or Bangladeshi
Edinburgh (UK)	-% residents over 18 who are: Qualified (Aggregate of Level a (higher degree), Level b (degree), and Level c (diploma etc.) -% households headed by a person with employment in the following categories: (1)Professional etc. Occupations + (2) Managerial & Technical Occupations (1991); (1) Managers & Senior Officials + (2)Professional occupations (2001, 2011) -% residents identifying as Black Caribbean, Black African, Pakistani, or Bangladeshi
Amsterdam (The Netherlands)	-% residents age 15 and over with a high level of education -% residents working in an office profession (bank, insurance, business service, other)

	-% of population belonging to the 2 highest quintiles of income -% residents with migration backgorund (i.e. allochtone) (1997-2001); with migration backgorund from Turkey, Surinam, Dutch Antilles and Morocco (2005 and on) -% households paying higher than city median rent
Copenhagen (Denmark)	-% residents with at least a bachelor's degree -% residents in high income category -% residents born in Non-Western country
Stuttgart (Germany)	-% residents with a high school degree and legal University permission or higher -% residents of Turkish and ex-Yugoslavian, or other Nationalities -% of residents in income sectors 0-5, or 11; sectors 6-9 (2011) (high income)
Vienna (Austria)	-% residents with a university degree or higher -% residents with a professional occupation -% residents in Sector groups: D,E,J,K,L,S,M,N,O,P,Q,R,U (high socioeconomic status) -% residents who are citizens of the following countries: Ex-yugolslavian, Turkey, Africa and "other european countries"
Ireland (Dublin)	-% population over 15 with: (8) Primary university degree, (9) Professional qualification of degree status at least, (X) Both a degree and a professional qualification, (Y) Post-graduate degree (1996, 2002); (1) primary degree, (2) professional qualification, (3) both degree and professional qualification, (4) post graduate diploma, (5) post graduate degree, (6) doctorate (2006); (1) Ordinary bachelor degree or national diploma, (2) honors bachelor degree, professional qualification, or both, (3)

	postgraduate diploma or degree, and (4) doctorate (2011, 2016) -% of residents working as: (1) Employers & Managers and (2) Higher professional -% of residents identifying as Black or Black Irish (2006, 2011, 2016)

1.3. Timeframes

As shown in Table 1, data was collected at the smallest interval available for each country/city between 1990 and 2016, our final year of available data collection. Thus, time intervals varied from annual (Copenhagen) to every 10 years (the US, UK, Canada), and in some cases, less regular intervals (i.e.for Lyon and Nantes, 1999 followed by 2006). In some cases, the years for which data was available from different sources for cities varied between sources. In these cases, in the final dataset, we used the year for which the majority of data was collected and merged data from other sources for the closest possible year to form datasets for Time 1, Time 2, and Time 3 that correspond as close as possible with the 1990s, 2000s, and 2010s.

1.4. Data Processing

Calculating Relative Values

Once data was collected for each city, we standardized the measurement of each variable for each time and geographic unit by calculating the percentage of the population in each geographic area represented by the variable. For example, we calculated the percent of each geographic area that had a low socioeconomic status, were a member of a racial or ethnic minority, etc.

Standardizing geographic scale: the CUDA Approach

In most cases, the small-area geographies at which data was colected changed across years. It is important to note, though, that we were only analyzing data within the formal city boundaries of our 28 cities. Thus, there was usually not a substantial degree of change. In order to standardize the boundaries for analysis across time, we used a hierarchically ordered set of techniques – an approach we

call CUDA. CUDA is an acronym for the hierarchy, which stands for Crosswalk, Unsplit, Dasymetric reapportionment, and aereal reapportionment. In essence, we used this hierarchy to define our order of preference for how to deal with changes in boundaries across time. We took this approach because the overall goal was to develop the most accurate reflection of the data rather tan one standard approach. Where available, we first sought to employ “crosswalks” provided by the public agencies that managed the data to explain how reallocation across years was done and allow for a standardized geography to be reconstructed. When no crosswalk was available, we next sought to “unsplit” the geographies. In many cases, the inconsistencies across time were simply a matter of larger areas being subdivided. In order to create standard boundaries, we unsplit these areas and used the larger geography for analysis. For some cities, we had to turn to reapportioning techniques in order to complete the standardization. When reapportioning, we first used a dasymetric approach wherein aerial imagery or land use files formed the basis for identifying populated areas before data was reapportioned to new areas across years. While this method does not eliminate error, it does reduce it. Finally, when necessary, we employed an areal reapportionment with manual adjustments for outliers. These manual adjustments were carefully considered, often through a tract-by-tract check in the case of all U.S. cities.

2. Supplementary Information: Real estate development dataset

This dataset was built as part of the EU-funded Greenlulus project (2016-2021, GA670834) in 2016-2018, collected to describe the number of new residential properties built per time period. Depending on the city, two types of datasets were available: 1) the year specific residential properties were built (22 cities) and 2) new residential developments per spatial unit per time period collected (six cities). The datasets were available from cadastral, tax or building permit data, provided either through free access online, upon emailing the city in question or in a handful of cases provided by a fee from the city in question.

Most of the data required processing before use, for example, removing non-residential properties. All data was spatialized by either by mapping X,Y coordinates or joining appropriate data columns to shapefiles provided by the city. Ultimately the aim was for each tract to have data for the total number of new residential developments in every year.

Table 3 provides details on the type of dataset used per city.

Table 3: Development data collected per city

City	Type of data	Data details
Amsterdam	Year built	The Cadaster of Amsterdam holds the BAG (Basisregistraties adressen en gebouwen, Basic Registration of Addresses and Buildings in English). A fee was paid to access the Cadaster and the BAG extract to obtain the year built information for all buildings in Amsterdam.
Atlanta	Year built	Annual city tax roll contains year built data for all building types, collected by the Fulton County Board of Assessors. Available free of charge online.
Austin	Year built	The land database digital map, created by the City of Austin Development Services Department, provides year built information. Available free of charge online.
Baltimore	Year built	Real property shapefile available for free of charge download online.
Barcelona	Year built	Cadastral parcels and year built was downloaded from the INSPIRE project at the Dirección General del Catastro, government of Spain. Available free of charge online.
Boston	Year built	Tax parcel information contains building ages, derived from the City of Boston's Building Permits data base thanks to collaboration between the Boston Area Research Initiative and the City of Boston. Available free of charge online.
Bristol	New residential	The Consumer Data Research Centre provided residential dwelling ages, grouped into approximately 10-year age bands and provided per spatial unit (263 in Bristol). We used four age bands to assess new

	developments per spatial unit	building construction: 1) 1983-1992; 2) 1993-1999; 3) 2000-2009; 4) 2010-2015. Data provides the numbers of properties in each Lower Super Output Area (LSOA, around 1000 properties) for each age band, with data rounded at source near 10. Available free of charge online.
Calgary	Year built	The City of Calgary provided building ages in tabular data form from 2014-2018. From 1999 to 2013, permit history was used, with the Geodatabase files allowing for every building permit to be spatially correlated to actual parcels. Data was provided via email by the City of Calgary.
Cleveland	Year built	Parcel data files from Cuyahoga county provides the year all properties were built in Cleveland. Data was provided via email by the City of Cleveland.
Copenhagen	Year built	Cadastral data contains year built information, gathered by city of Copenhagen. Data was provided via email by Lifa, a Danish property inspection company.
Denver		Parcel data files from Denver Open Data Catalogue provide year built information. Available free of charge online.
Detroit	Year built	Parcel data files from City of Denver Open Data Portal provides year built information. Available free of charge online.
Dublin	Data not available	Data not available
Edinburgh	New residential developments per spatial unit	New buildings built per year from 2004 to 2016 per 2001 Data Zone (549 Data Zones in Edinburgh), provided by Scottish Neighbourhood Statistics. Calculated increase in total dwellings from year to year in overall dwellings per Data Zone and in number of dwellings per tax band.
Louisville	Year built	Building permits issued or in progress provides data on new buildings under construction, collected by the Louisville Office of Construction Review and posted on Louisville Open Data. Available free of charge online.
Lyon	New residential developments per spatial unit	Data provided by the National Institute of Statistics and Economic Studies (INSEE) lists new buildings built between 1991-2005 and per year from 2006 to 2010. Partial data per spatial unit (IRIS, 174 in Lyon) only available between 2011 to 2015. Available free of charge online, registration required on the Reseau Quetelet data platform for social scientists.
Montreal	Year built	Two data sets were combined to provide a comprehensive view of the city. 1) Building age data provided by the Canada Broadcast Corporation (CBC) for downtown area and 2) 2016 census data from Statistics Canada provided data on occupied private dwellings by period of construction (1960 or

		before; 1961-1980; 1981-1990; 1991-2000; 2001-2005; 2006-2010; 2011-2016). Available free of charge online.
Milwaukee	Year built	Master property file from Milwaukee Open Data provided year built information. Available free of charge online.
Nantes	New developments per spatial unit	Data provided by the National Institute of Statistics and Economic Studies (INSEE) lists new buildings built between 1991-2005 and per year from 2006 to 2010. Partial data per spatial unit (IRIS, 91 in Nantes) only available between 2011 to 2015. Available free of charge online, registration required on the Reseau Quetelet data platform for social scientists.
Portland	Year built	Building permits issued or in progress provides data on new buildings under construction, collected by the Portland Development Services Center since 1995. Available free of charge online. https://www.portlandmaps.com/arcgis/rest/services/Public/COP_OpenData_PlanningDevelopment/MapServer/89
Philadelphia	New developments per spatial unit	Building permits issued for new residential construction available free of charge online.
San Francisco	Year built	DataSF provides year built information, collected by the San Francisco property tax assessor. Available free of charge online.
Seattle	Year built	Building permits issued or in progress provides data on new buildings under construction, from data collected by the Seattle Department of Constructions and Inspections. Available free of charge online.
Sheffield	New residential developments per spatial unit	The Consumer Data Research Centre provided residential dwelling ages, grouped into approximately 10-year age bands and provided per spatial unit (345 in Sheffield). We used four age bands to assess new building construction: 1) 1983-1992; 2) 1993-1999; 3) 2000-2009; 4) 2010-2015. Data provides the numbers of properties in each Lower Super Output Area (LSOA, around 1000 properties) for each age band, with data rounded at source near 10. Available free of charge online.
Valencia	Year built	Cadastral parcels and year built was downloaded from the INSPIRE project at the Dirección General del Catastro, government of Spain. Available free of charge online.
Vancouver	Year built	Property tax report table from city of Vancouver provides data on building age. Available free of charge online.
Vienna	New residential developmen	City of Vienna, Department for Economy, Labour and Statistics, provided data on the number of constructed residential buildings per year at the Zählbezirk (smallest geography) spatial unit level. Data

	ts per spatial unit	is collected by the Building-Housing-Address-Register of the Austrian Statistic Institute. Data was provided via email from the City of Vienna.
Washington DC	Year built	Historical data on the buildings of Washington DC, collected over 15 years by Brian Kraft, with support from JMT Inc., for the DC Historic Preservation Office. Available free of charge online.

3. CITY-LEVEL MODEL RESULTS

3.1. VARIABLE CODE DEFINITIONS

CH_GSAB_PRE2: Changes in greenspace prior to Period 2
CH_GSAB_PRE3: Changes in greenspace prior to Period 3
CENTER: Distance from the centroid of the tract to the approximate centerpoint of the historic city center
TRACTDENSITY_2010: Residential density of the tract in 2010
PRE_1990_GREEN: Percent of área of the tract covered in greenspace prior to 1990
NEWTRANSITB_PRE2: Number of new transit stops added to the tract prior to Period 2
NEWTRANSITB_PRE3: Number of new transit stops added to the tract prior to Period 3
DEV_TIME2: Number of new residential buildings constructed in the tract during Period 2
DEV_TIME3: Number of new residential buildings constructed in the tract during Period 3
DEV_TIME23: Number of new residential buildings constructed in the tract during Periods 2 and 3

3.2 MODEL RESULTS

Amsterdam – No clear indication of green gentrification
Hypothesis 1 - Composite gentrification score for the tract for time period 2 (second earliest period, roughly representative of changes in the 2000s)
Summary of the posterior distribution for the fixed effects - (final spatial model).

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p*
(Intercept)		0.161456	0.011030	0.139674	0.161455	0.183209	0.161456	
CH_GSAB_PRE2	Total green space area, roughly 2000s	-0.798752	0.571915	-1.928078	-0.798776	0.329170	-0.798772	0.0795

Hypothesis 3 - Composite gentrification score for the tract for time period 3 (most recent period, roughly representative of changes in the 2010s).
Summary of the posterior distribution for the fixed effects - (final spatial model).

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.0487	0.0064	0.0362	0.0487	0.0614	0.0487	
CH_GSAB_PRE3	Total green space area, roughly 2010s	-0.3389	0.3970	-1.1019	-0.3452	0.4625	-0.3566	0.191

Hypothesis 2 Composite gentrification score for the tract beginning the first year of time period 2 and ending the last year of time period 3
Summary of the posterior distribution for the fixed effects - (final spatial model).

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p

(Intercept)		0.071490	0.006829	0.058068	0.071484	0.084928	0.071473	
CH_GSAB_PRE2	Total green space area, roughly 2000s	-0.402441	0.380795	-1.142372	-0.405810	0.357121	-0.411661	0.1423

Atlanta – Sustained green gentrification throughout the study period

Hypothesis 1 - Composite gentrification score for the tract for time period 2 (second earliest period, roughly representative of changes in the 2000s)

Summary of the posterior distribution for the fixed effects - (final spatial model).

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.2444	0.0098	0.2250	0.2444	0.2638	0.2444	
CH_GSAB_PRE2	Total green space area, roughly 2000s	5.6592	5.0842	-4.4410	5.6654	15.7116	5.6788	0.8704
CENTER	Distance to city center from the centroid of the tract	-0.0047	0.0005	-0.0057	-0.0047	-0.0036	-0.0047	0.0000

Hypothesis 3 - Composite gentrification score for the tract for time period 3 (most recent period, roughly representative of changes in the 2010s).

Summary of the posterior distribution for the fixed effects - (final spatial model).

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.2314	0.0148	0.2023	0.2314	0.2605	0.2314	
CH_GSAB_PRE3	Total green space area, roughly 2010s	15.0377	6.6387	1.9500	15.0450	28.0699	15.0608	0.9876
CENTER	Distance to city center from the	-0.0039	0.0008	-0.0055	-0.0039	-0.0023	-0.0039	0.0000

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

	centroid of the tract							

Hypothesis 2 Composite gentrification score for the tract beginning the first year of time period 2 and ending the last year of time period 3

Summary of the posterior distribution for the fixed effects - (final spatial model).

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.1841	0.0057	0.1728	0.1841	0.1955	0.1841	
CH_GSAB_PRE2	Total green space area, roughly 2000s	2.5258	2.9557	-3.4246	2.5279	8.4639	2.5322	0.8158
CENTER	Distance to city center from the centroid of the tract	-0.0045	0.0003	-0.0051	-0.0045	-0.0039	-0.0045	0.0000

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Austin – Green gentrification only in the later period

Hypothesis 1 - Composite gentrification score for the tract for time period 2 (second earliest period, roughly representative of changes in the 2000s)

Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.185804	0.006321	0.173213	0.185804	0.198375	0.185805	
CH_GSAB_PRE2	Total green space area, roughly 2000s	-5.857736	1.094680	-8.036963	-5.858195	-3.679530	-5.859011	0
PRE_1990_GREEN	Prior green coverage (in 1990)	0.492803	0.055858	0.381528	0.492807	0.603870	0.492822	1
TRACTDENSITY_2010	People per square kilometer in the tract in the year 2010	-0.000024	0.000004	-0.000031	-0.000024	-0.000017	-0.000024	0

Hypothesis 3 - Composite gentrification score for the tract for time period 3 (most recent period, roughly representative of changes in the 2010s).

Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.2072	0.0141	0.1794	0.2072	0.2349	0.2072	
CH_GSAB_PRE3	Total green space area, roughly 2010s	12.8320	6.8922	-0.7393	12.8370	26.3624	12.8481	0.9682
CENTER	Distance to city center from the	-0.0025	0.0006	-0.0036	-0.0025	-0.0014	-0.0025	0.0000

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

	centroid of the tract							

Hypothesis 2 Composite gentrification score for the tract beginning the first year of time period 2 and ending the last year of time period 3

Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.145451	0.002298	0.140564	0.145451	0.150334	0.145451	
CH_GSAB_PRE2	Total green space area, roughly 2000s	-6.123893	0.201179	-6.551222	-6.124037	-5.695900	-6.124088	0
PRE_1990_GREEN	Prior green coverage (in 1990)	0.420204	0.011027	0.396750	0.420204	0.443631	0.420207	1
CENTER	Distance to city center from the centroid of the tract	-0.001558	0.000070	-0.001707	-0.001558	-0.001409	-0.001558	0
TRACTDENSITY_2010	People per square kilometer in the tract in the year 2010	-0.000015	0.000001	-0.000016	-0.000015	-0.000013	-0.000015	0

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Baltimore – No clear indication of green gentrification

Hypothesis 1 - Composite gentrification score for the tract for time period 2 (second earliest period, roughly representative of changes in the 2000s)

Summary of the posterior distribution for the fixed effects - (final spatial model).

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.3162	0.0212	0.2743	0.3162	0.3581	0.3162	
CH_GSAB_PRE2	Total green space area, roughly 2000s	-1.7838	2.6475	-7.0140	-1.7842	3.4411	-1.7849	0.2452
CENTER	Distance to city center from the centroid of the tract	-0.0281	0.0037	-0.0354	-0.0281	-0.0208	-0.0281	0.0000

Hypothesis 3 - Composite gentrification score for the tract for time period 3 (most recent period, roughly representative of changes in the 2010s).

Summary of the posterior distribution for the fixed effects - (final spatial model).

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.4390949	0.0467010	0.3470596	0.4390986	0.5310095	0.4391106	
CH_GSAB_PRE3	Total green space area, roughly 2010s	-9.0294773	4.1469443	-17.1930256	-9.0319985	-0.8612556	-9.0368745	0.0151826
DEV_TIME3	New residential buildings, roughly 2010s	5.6249275	2.2303820	1.2291982	5.6252321	10.0142161	5.6260714	0.9935665

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

PRE_1990_GREEN	Prior green coverage (in 1990)	0.1243579	0.0478836	0.0300026	0.1243578	0.2186106	0.1243619	0.9947520
CENTER	Distance to city center from the centroid of the tract	-0.0355439	0.0058792	-0.0471273	-0.0355445	-0.0239699	-0.0355453	0.0000000
TRACTDENSITY_2010	People per square kilometer in the tract in the year 2010	-0.0000075	0.0000045	-0.0000164	-0.0000075	0.0000014	-0.0000075	0.0485331

Hypothesis 2 Composite gentrification score for the tract beginning the first year of time period 2 and ending the last year of time period 3

Summary of the posterior distribution for the fixed effects - (final spatial model).

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.2836625	0.0200388	0.2429877	0.2836612	0.3243753	0.2836613	
CH_GSAB_PRE2	Total green space area, roughly 2000s	-3.0652948	1.4911095	-6.0896116	-3.0662900	-0.0338445	-3.0679091	0.0235943
NEWTRANSITB_PRE2	Number of public transit stops added, roughly 2000s	-0.2802205	0.0992353	-0.4815998	-0.2802487	-0.0785489	-0.2802871	0.0050191
DEV_TIME23	New residential	5.7357291	0.8200467	4.0699871	5.7362169	7.4003900	5.7372126	1.0000000

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

	buildings, roughly beginning last year of time period 2 and first year of time period 3							
PRE_1990_GREEN	Prior green coverage (in 1990)	0.1083153	0.0185443	0.0706705	0.1083155	0.1459885	0.1083181	0.9999980
CENTER	Distance to city center from the centroid of the tract	-0.0287397	0.0024387	-0.0336902	-0.0287397	-0.0237854	-0.0287393	0.0000000
TRACTDENSITY_2010	People per square kilometer in the tract in the year 2010	-0.0000081	0.0000018	-0.0000117	-0.0000081	-0.0000045	-0.0000081	0.0000749

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Barcelona - Sustained green gentrification throughout the study period with no impact on recent gentrification
Hypothesis 1 - Composite gentrification score for the tract for time period 2 (second earliest period, roughly representative of changes in the 2000s)
Summary of the posterior distribution for the fixed effects - (final spatial model).

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.0560	0.0002	0.0556	0.0560	0.0564	0.0560	
CH_GSAB_PRE2	Total green space area, roughly 2000s	-0.0226	0.0031	-0.0288	-0.0226	-0.0165	-0.0226	0
NEWTRANSITB_PRE2	Number of public transit stops added, roughly 2000s	-0.0116	0.0003	-0.0121	-0.0116	-0.0111	-0.0116	0

Hypothesis 3 - Composite gentrification score for the tract for time period 3 (most recent period, roughly representative of changes in the 2010s).
Summary of the posterior distribution for the fixed effects - (final spatial model).

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.1343251	0.0009797	0.1323056	0.1343250	0.1363448	0.1343251	
CH_GSAB_PRE3	Total green space area, roughly 2010s	0.4127892	0.0188356	0.3739624	0.4127881	0.4516204	0.4127893	1
NEWTRANSITB_PRE3	Number of public transit stops added, roughly 2010s	-0.0170054	0.0006993	-0.0184470	-0.0170055	-0.0155637	-0.0170054	0

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

DEV_TIME3	New residential buildings, roughly 2010s	0.0669933	0.0024998	0.0618402	0.0669931	0.0721469	0.0669933	1
CENTER	Distance to city center from the centroid of the tract	-0.0084544	0.0001956	-0.0088577	-0.0084544	-0.0080511	-0.0084544	0
TRACTDENSITY_2010	People per square kilometer in the tract in the year 2010	-0.0000006	0.0000000	-0.0000006	-0.0000006	-0.0000005	-0.0000006	0

Hypothesis 2 Composite gentrification score for the tract beginning the first year of time period 2 and ending the last year of time period 3

Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.0375	0.0004	0.0368	0.0375	0.0382	0.0375	
CH_GSAB_PRE2	Total green space area, roughly 2000s	0.0716	0.0032	0.0654	0.0716	0.0778	0.0716	1
DEV_TIME23	New residential buildings, roughly beginning last year of time	0.0139	0.0005	0.0130	0.0139	0.0149	0.0139	1

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

	period 2 and first year of time period 3							
CENTER	Distance to city center from the centroid of the tract	-0.0049	0.0001	-0.0051	-0.0049	-0.0047	-0.0049	0

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Boston – Sustained green gentrification throughout the study period with no impact on recent gentrification

Hypothesis 1 - Composite gentrification score for the tract for time period 2 (second earliest period, roughly representative of changes in the 2000s)

Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.181371	0.015920	0.149819	0.181371	0.212873	0.181372	
CH_GSAB_PRE2	Total green space area, roughly 2000s	2.937234	1.451074	0.060814	2.937431	5.807766	2.938004	0.9772
CENTER	Prior green coverage (in 1990)	-0.008682	0.001731	-0.012113	-0.008682	-0.005256	-0.008682	0.0000
TRACTDENSITY_2010	People per square kilometer in the tract in the year 2010	-0.000004	0.000001	-0.000006	-0.000004	-0.000002	-0.000004	0.0000

Hypothesis 3 - Composite gentrification score for the tract for time period 3 (most recent period, roughly representative of changes in the 2010s).

Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.1508	0.0150	0.1213	0.1508	0.1804	0.1508	
CH_GSAB_PRE3	Total green space area, roughly 2010s	-0.5636	1.0777	-2.6864	-0.5637	1.5569	-0.5637	0.2973
CENTER	Distance to city center	-0.0098	0.0022	-0.0141	-0.0098	-0.0054	-0.0098	0.0000

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

	from the centroid of the tract							

Hypothesis 2 Composite gentrification score for the tract beginning the first year of time period 2 and ending the last year of time period 3

Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.094066	0.011299	0.071719	0.094065	0.116383	0.094065	
CH_GSAB_PRE2	Total green space area, roughly 2000s	1.847995	0.930031	0.008521	1.848015	3.684713	1.848148	0.9755
DEV_TIME23	New residential buildings, roughly beginning last year of time period 2 and first year of time period 3	2.554708	0.469629	1.625859	2.554710	3.482206	2.554761	1.0000
CENTER	Distance to city center from the centroid of the tract	-0.006706	0.001151	-0.008982	-0.006706	-0.004432	-0.006706	0.0000
TRACTDENSITY_2010	People per square kilometer in	-0.000002	0.000001	-0.000003	-0.000002	-0.000001	-0.000002	0.0002

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

	the tract in the year 2010							

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Bristol – No clear indicator of green gentrification
Hypothesis 1 - Composite gentrification score for the tract for time period 2 (second earliest period, roughly representative of changes in the 2000s)
Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.0119	0.0021	0.0079	0.0119	0.0160	0.0119	
CH_GSAB_PRE2	Total green space area, roughly 2000s	-0.5692	0.6953	-1.9382	-0.5693	0.7984	-0.5692	0.2037
DEV_TIME2	New residential buildings, roughly 2000s	0.0012	0.0002	0.0008	0.0012	0.0016	0.0012	1.0000

Hypothesis 3 - Composite gentrification score for the tract for time period 3 (most recent period, roughly representative of changes in the 2010s).
Summary of the posterior distribution for the fixed effects.

The hypothesis H1.1.2b (for model 1.1.2.b) and 1.1.2c (for model 1.1.3.a) were not analyzed because of lack of availability of data in the response variable (*GENT_TIME3* and *GENT_TIME23*, respectively).

Hypothesis 2 Composite gentrification score for the tract beginning the first year of time period 2 and ending the last year of time period 3
Summary of the posterior distribution for the fixed effects.

The hypothesis H1.1.2b (for model 1.1.2.b) and 1.1.2c (for model 1.1.3.a) were not analyzed because of lack of availability of data in the response variable (*GENT_TIME3* and *GENT_TIME23*, respectively).

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Calgary – No clear indicator of green gentrification

Hypothesis 1 - Composite gentrification score for the tract for time period 2 (second earliest period, roughly representative of changes in the 2000s)

Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.146194	0.008428	0.129585	0.146193	0.162783	0.146194	
CH_GSAB_PRE2	Total green space area, roughly 2000s	-1.468956	0.863102	-3.169653	-1.468999	0.229893	-1.469010	0.044

Hypothesis 3 - Composite gentrification score for the tract for time period 3 (most recent period, roughly representative of changes in the 2010s).

Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.1702	0.0135	0.1438	0.1702	0.1967	0.1702	
CH_GSAB_PRE3	Total green space area, roughly 2010s	2.3612	5.0584	-7.5839	2.3614	12.2949	2.3623	0.679

Hypothesis 2 Composite gentrification score for the tract beginning the first year of time period 2 and ending the last year of time period 3

Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.096385	0.005374	0.085796	0.096385	0.106963	0.096385	
CH_PARKAB_PRE2	Total park area added, roughly 2000s	-0.686617	0.550386	-1.771188	-0.686636	0.396806	-0.686627	0.1042

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Cleveland– No clear indicator of green gentrification

Hypothesis 1 - Composite gentrification score for the tract for time period 2 (second earliest period, roughly representative of changes in the 2000s)

Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.144473	0.008294	0.128166	0.144472	0.160764	0.144473	NA
CH_GSAB_PRE2	Total green space area, roughly 2000s	-1.012651	3.680636	-8.248649	-1.012843	6.216951	-1.012913	0.3896
NEWTRANSITB_PRE2	Number of public transit stops added, roughly 2000s	0.980696	0.207791	0.572157	0.980690	1.388844	0.980696	1.0000
DEV_TIME2	New residential buildings, roughly 2000s	0.002431	0.000433	0.001580	0.002431	0.003281	0.002431	1.0000
TRACTDENSITY_2010	People per square kilometer in the tract in the year 2010	-0.000011	0.000003	-0.000018	-0.000011	-0.000004	-0.000011	0.0008

Hypothesis 3 - Composite gentrification score for the tract for time period 3 (most recent period, roughly representative of changes in the 2010s).

Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.284513	0.023202	0.238820	0.284511	0.330164	0.284509	

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

CH_GSAB_PRE3	Total green space area, roughly 2010s	4.708788	11.337849	-17.625755	4.715801	26.981008	4.731548	0.6610
DEV_TIME3	New residential buildings, roughly 2010s	0.009317	0.003544	0.002338	0.009317	0.016289	0.009317	0.9953
CENTER	Distance to city center from the centroid of the tract	-0.005714	0.001178	-0.008034	-0.005714	-0.003397	-0.005714	0.0000
TRACTDENSITY_2010	People per square kilometer in the tract in the year 2010	-0.000022	0.000006	-0.000034	-0.000022	-0.000011	-0.000022	0.0001

Hypothesis 2 Composite gentrification score for the tract beginning the first year of time period 2 and ending the last year of time period 3

Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.159444	0.008698	0.142226	0.159444	0.176631	0.159445	
CH_GSAB_PRE2	Total green space area, roughly 2000s	-3.701782	1.955709	-7.571449	-3.702331	0.163964	-3.703315	0.0297
NEWTRANSITB_PRE2	Number of public transit stops added, roughly 2000s	0.488620	0.111152	0.268607	0.488616	0.708276	0.488616	1.0000

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

DEV_TIME23	New residential buildings, roughly beginning last year of time period 2 and first year of time period 3	0.002943	0.000329	0.002292	0.002943	0.003593	0.002943	1.0000
CENTER	Distance to city center from the centroid of the tract	-0.003811	0.000441	-0.004684	-0.003811	-0.002940	-0.003811	0.0000
TRACTDENSITY_2010	People per square kilometer in the tract in the year 2010	-0.000015	0.000002	-0.000020	-0.000015	-0.000011	-0.000015	0.0000

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Copenhagen – Green gentrification only in the later period
Hypothesis 1 - Composite gentrification score for the tract for time period 2 (second earliest period, roughly representative of changes in the 2000s)
Summary of the posterior distribution for the fixed effects.

The hypothesis H1.1.2a and H1.1.3a were not analyzed because of lack of availability of data in the response variable (*GENT_TIME2* and *GENT_TIME23*, respectively).

Hypothesis 3 - Composite gentrification score for the tract for time period 3 (most recent period, roughly representative of changes in the 2010s).
Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.0397	0.0029	0.0340	0.0397	0.0455	0.0397	
CH_GSAB_PRE3	Total green space area, roughly 2010s	1.0037	0.1161	0.7743	1.0037	1.2328	1.0037	1
CENTER	Distance to city center from the centroid of the tract	-0.0054	0.0008	-0.0070	-0.0054	-0.0039	-0.0054	0

Hypothesis 2 Composite gentrification score for the tract beginning the first year of time period 2 and ending the last year of time period 3
Summary of the posterior distribution for the fixed effects.

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

The hypothesis H2.1.2a and H2.1.3a were not analyzed because of lack of availability of data in the response variable (*DEV_TIME2* and *DEV_TIME23*, respectively).

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Denver – Sustained green gentrification throughout the study period
Hypothesis 1 - Composite gentrification score for the tract for time period 2 (second earliest period, roughly representative of changes in the 2000s)
Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.335194	0.044474	0.247441	0.335294	0.422308	0.335494	
CH_GSAB_PRE2	Total green space area, roughly 2000s	25.552443	7.004014	11.700399	25.579671	39.239620	25.633267	0.9998
NEWTRANSITB_PRE2	Number of public transit stops added, roughly 2000s	0.633832	0.192372	0.255375	0.633899	1.011542	0.634043	0.9994
CENTER	Distance to city center from the centroid of the tract	-0.018262	0.003691	-0.025334	-0.018328	-0.010792	-0.018455	0.0000
TRACTDENSITY_2010	People per square kilometer in the tract in the year 2010	-0.000024	0.000009	-0.000042	-0.000024	-0.000005	-0.000024	0.0060

Hypothesis 3 - Composite gentrification score for the tract for time period 3 (most recent period, roughly representative of changes in the 2010s).
Summary of the posterior distribution for the fixed effects.

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.1655	0.0113	0.1432	0.1655	0.1877	0.1655	
CH_GSAB_PRE3	Total green space area, roughly 2010s	-4.7204	7.3915	-19.2717	-4.7249	9.8373	-4.7334	0.2581

Hypothesis 2 Composite gentrification score for the tract beginning the first year of time period 2 and ending the last year of time period 3

Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.175400	0.010982	0.153684	0.175400	0.197086	0.175400	
CH_GSAB_PRE2	Total green space area, roughly 2000s	13.706424	2.691833	8.374964	13.709471	19.013752	13.715977	1.0000
NEWTRANSITB_PRE2	Number of public transit stops added, roughly 2000s	0.295313	0.073675	0.149636	0.295302	0.440819	0.295289	0.9999
CENTER	Distance to city center from the centroid of the tract	-0.013515	0.001225	-0.015936	-0.013516	-0.011096	-0.013516	0.0000

Detroit – Green gentrification only in the later period

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Hypothesis 1 - Composite gentrification score for the tract for time period 2 (second earliest period, roughly representative of changes in the 2000s)
Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.245803	0.017444	0.211528	0.245802	0.280051	0.245801	
CH_GSAB_PRE2	Total green space area, roughly 2000s	6.853312	30.396723	-52.831668	6.854402	66.477760	6.859177	0.5881
DEV_TIME2	New residential buildings, roughly 2000s	0.003183	0.000831	0.001549	0.003183	0.004815	0.003183	0.9999
PRE_1990_GREEN	Prior green coverage (in 1990)	-0.186438	0.043383	-0.271687	-0.186439	-0.101267	-0.186438	0.0000
CENTER	Distance to city center from the centroid of the tract	-0.002484	0.000598	-0.003660	-0.002484	-0.001309	-0.002484	0.0000
TRACTDENSITY_2010	People per square kilometer in the tract in the year 2010	-0.000021	0.000005	-0.000030	-0.000021	-0.000011	-0.000021	0.0000

Hypothesis 3 - Composite gentrification score for the tract for time period 3 (most recent period, roughly representative of changes in the 2010s).
Summary of the posterior distribution for the fixed effects.

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.306391	0.023266	0.260679	0.306389	0.352068	0.306387	
CH_GSAB_PRE3	Total green space area, roughly 2010s	17.561477	5.758637	6.240466	17.563429	28.860590	17.567891	0.9988
DEV_TIME3	New residential buildings, roughly 2010s	0.006808	0.002421	0.002050	0.006808	0.011562	0.006808	0.9974
CENTER	Distance to city center from the centroid of the tract	-0.002383	0.000807	-0.003969	-0.002383	-0.000799	-0.002383	0.0016
TRACTDENSITY_2010	People per square kilometer in the tract in the year 2010	-0.000031	0.000007	-0.000045	-0.000031	-0.000018	-0.000031	0.0000

Hypothesis 2 Composite gentrification score for the tract beginning the first year of time period 2 and ending the last year of time period 3

Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.190491	0.010993	0.168882	0.190490	0.212088	0.190487	

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

CH_GSAB_PRE2	Total green space area, roughly 2000s	9.872540	28.770542	-46.642775	9.880890	66.290066	9.900239	0.6333
DEV_TIME23	New residential buildings, roughly beginning last year of time period 2 and first year of time period 3	0.003791	0.000696	0.002421	0.003791	0.005159	0.003791	1.0000
PRE_1990_GREEN	Prior green coverage (in 1990)	-0.087570	0.027310	-0.141264	-0.087570	-0.033928	-0.087569	0.0007
CENTER	Distance to city center from the centroid of the tract	-0.002640	0.000378	-0.003382	-0.002640	-0.001898	-0.002639	0.0000
TRACTDENSITY_2010	People per square kilometer in the tract in the year 2010	-0.000018	0.000003	-0.000025	-0.000018	-0.000012	-0.000018	0.0000

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Dublin – No clear indicator of green gentrification

Hypothesis 1 - Composite gentrification score for the tract for time period 2 (second earliest period, roughly representative of changes in the 2000s)

Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.0262	0.0035	0.0193	0.0262	0.0330	0.0262	
CH_GSAB_PRE2	Total green space area, roughly 2000s	1.1691	7.2722	-13.1395	1.1695	15.4603	1.1709	0.5628

Hypothesis 3 - Composite gentrification score for the tract for time period 3 (most recent period, roughly representative of changes in the 2010s).

Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.0299	0.0023	0.0254	0.0299	0.0344	0.0299	
CH_GSAB_PRE3	Total green space area, roughly 2010s	0.2902	0.5667	-0.8279	0.2902	1.4068	0.2902	0.697

Hypothesis 2 Composite gentrification score for the tract beginning the first year of time period 2 and ending the last year of time period 3

Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.0235	0.0018	0.0199	0.0235	0.0272	0.0235	
CH_PARKAB_PRE2	Total park area added, roughly 2000s	1.4776	3.9328	-6.2901	1.4780	9.2332	1.4793	0.6475

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Edinburgh – Green gentrification in the early period only
Hypothesis 1 - Composite gentrification score for the tract for time period 2 (second earliest period, roughly representative of changes in the 2000s)
Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.0070	0.0009	0.0052	0.0070	0.0088	0.0070	
CH_GSAB_PRE2	Total green space area, roughly 2000s	0.9595	0.4209	0.1323	0.9594	1.7860	0.9594	0.9884
DEV_TIME2	New residential buildings, roughly 2000s	0.0004	0.0001	0.0003	0.0004	0.0005	0.0004	1.0000

Hypothesis 3 - Composite gentrification score for the tract for time period 3 (most recent period, roughly representative of changes in the 2010s).
Summary of the posterior distribution for the fixed effects.

The hypothesis H1.1.2b (for model 1.1.2.b) and 1.1.2c (for model 1.1.3.a) were not analyzed because of lack of availability of data in the response variable (*GENT_TIME3* and *GENT_TIME23*, respectively).

Hypothesis 2 Composite gentrification score for the tract beginning the first year of time period 2 and ending the last year of time period 3
Summary of the posterior distribution for the fixed effects.

The hypothesis H1.1.2b (for model 1.1.2.b) and 1.1.2c (for model 1.1.3.a) were not analyzed because of lack of availability of data in the response variable (*GENT_TIME3* and *GENT_TIME23*, respectively).

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Louisville – Sustained green gentrification throughout the study period

Hypothesis 1 - Composite gentrification score for the tract for time period 2 (second earliest period, roughly representative of changes in the 2000s)

Summary of the posterior distribution for the fixed effects - (final spatial model).

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.142847	0.005349	0.132133	0.142841	0.153585	0.142828	
CH_GSAB_PRE2	Total green space area, roughly 2000s	9.893577	5.721929	-1.639231	9.921201	21.271579	9.978058	0.9563

Hypothesis 3 - Composite gentrification score for the tract for time period 3 (most recent period, roughly representative of changes in the 2010s).

Summary of the posterior distribution for the fixed effects - (final spatial model).

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.1455	0.0087	0.1284	0.1455	0.1626	0.1455	
CH_GSAB_PRE3	Total green space area, roughly 2010s	2.2310	3.1462	-3.9546	2.2311	8.4103	2.2314	0.7605

Hypothesis 2 Composite gentrification score for the tract beginning the first year of time period 2 and ending the last year of time period 3

Summary of the posterior distribution for the fixed effects - (final spatial model).

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.094967	0.004108	0.086848	0.094965	0.103079	0.094963	
CH_GSAB_PRE2	Total green space area,	9.377863	4.430451	0.606777	9.383037	18.109441	9.394617	0.9816

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

	roughly 2000s							

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Lyon – No clear indicator of green gentrification
Hypothesis 1 - Composite gentrification score for the tract for time period 2 (second earliest period, roughly representative of changes in the 2000s)
Summary of the posterior distribution for the fixed effects - (final spatial model).

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.0505	0.0047	0.0412	0.0505	0.0598	0.0505	
CH_GSAB_PRE2	Total green space area, roughly 2000s	-0.2154	0.4014	-1.0103	-0.2154	0.5782	-0.2154	0.2898

Hypothesis 3 - Composite gentrification score for the tract for time period 3 (most recent period, roughly representative of changes in the 2010s).
Summary of the posterior distribution for the fixed effects - (final spatial model).

The hypothesis H1.1.2b (for model 1.1.2.b) and 1.1.2c (for model 1.1.3.a) were not analyzed because of lack of availability of data in the response variable (*GENT_TIME3* and *GENT_TIME23*, respectively).

Hypothesis 2 Composite gentrification score for the tract beginning the first year of time period 2 and ending the last year of time period 3
Summary of the posterior distribution for the fixed effects - (final spatial model).

The hypothesis H1.1.2b (for model 1.1.2.b) and 1.1.2c (for model 1.1.3.a) were not analyzed because of lack of availability of data in the response variable (*GENT_TIME3* and *GENT_TIME23*, respectively).

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Milwaukee – Sustained green gentrification throughout the study period with no impact on recent gentrification
Hypothesis 1 - Composite gentrification score for the tract for time period 2 (second earliest period, roughly representative of changes in the 2000s)
Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.241856	0.012072	0.217889	0.241857	0.265778	0.241859	
CH_GSAB_PRE2	Total green space area, roughly 2000s	7.222621	5.697944	-4.109651	7.232928	18.482831	7.255481	0.8996
CENTER	Prior green coverage (in 1990)	-0.011305	0.000902	-0.013094	-0.011305	-0.009517	-0.011305	0.0000
TRACTDENSITY_2010	People per square kilometer in the tract in the year 2010	-0.000013	0.000002	-0.000016	-0.000013	-0.000009	-0.000013	0.0000

Hypothesis 3 - Composite gentrification score for the tract for time period 3 (most recent period, roughly representative of changes in the 2010s).
Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.1489	0.0060	0.1371	0.1489	0.1608	0.1489	
CH_GSAB_PRE3	Total green space area, roughly 2010s	22.7879	11.2549	0.5539	22.8193	44.8297	22.8862	0.9777

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Hypothesis 2 Composite gentrification score for the tract beginning the first year of time period 2 and ending the last year of time period 3

Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.168153	0.008553	0.151078	0.168152	0.185211	0.168153	
CH_GSAB_PRE2	Total green space area, roughly 2000s	1.001814	4.070888	-7.124559	1.002800	9.113956	1.005245	0.6008
CENTER	Distance to city center from the centroid of the tract	-0.007494	0.000639	-0.008770	-0.007494	-0.006220	-0.007494	0.0000
TRACTDENSITY_2010	People per square kilometer in the tract in the year 2010	-0.000010	0.000001	-0.000012	-0.000010	-0.000007	-0.000010	0.0000

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Montreal – Green gentrification only in the later period

Hypothesis 1 - Composite gentrification score for the tract for time period 2 (second earliest period, roughly representative of changes in the 2000s)

Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.0899	0.0028	0.0843	0.0899	0.0955	0.0899	
CH_GSAB_PRE2	Total green space area, roughly 2000s	-0.4654	0.4967	-1.4414	-0.4654	0.5099	-0.4654	0.1731

Hypothesis 3 - Composite gentrification score for the tract for time period 3 (most recent period, roughly representative of changes in the 2010s).

Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.1424	0.0050	0.1325	0.1424	0.1523	0.1424	
CH_GSAB_PRE3	Total green space area, roughly 2010s	2.5457	1.8154	-1.0209	2.5457	6.1090	2.5458	0.9193

Hypothesis 2 Composite gentrification score for the tract beginning the first year of time period 2 and ending the last year of time period 3

Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.0880	0.0039	0.0804	0.0880	0.0956	0.0880	0.0880

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

CH_GSAB_PRE3	Total green space area, roughly 2010s	-0.4936	0.3851	-1.2499	-0.4936	0.2621	-0.4936	-0.4936
CENTER	Prior green coverage (in 1990)	-0.4936	0.3851	-1.2499	-0.4936	0.2621	-0.4936	-0.4936

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Nantes – Green gentrification only in the later period

Hypothesis 1 - Composite gentrification score for the tract for time period 2 (second earliest period, roughly representative of changes in the 2000s)

Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.0412	0.0113	0.0177	0.0412	0.0646	0.0412	
CH_GSAB_PRE2	Total green space area, roughly 2000s	-1.3142	0.6746	-2.7200	-1.3143	0.0918	-1.3145	0.9691
CENTER	Prior green coverage (in 1990)	0.0235	0.0037	0.0158	0.0235	0.0312	0.0235	1.0000

Hypothesis 3 - Composite gentrification score for the tract for time period 3 (most recent period, roughly representative of changes in the 2010s).

Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.0415	0.0064	0.0289	0.0415	0.0542	0.0415	
CH_GSAB_PRE3	Total green space area, roughly 2010s	0.5969	0.5952	-0.5806	0.5969	1.7730	0.5969	0.8447

Hypothesis 2 Composite gentrification score for the tract beginning the first year of time period 2 and ending the last year of time period 3

Summary of the posterior distribution for the fixed effects.

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.0152	0.0035	0.0078	0.0152	0.0227	0.0152	
CH_GSAB_PRE3	Total green space area, roughly 2010s	-0.1845	0.2067	-0.6290	-0.1845	0.2604	-0.1845	0.8675
CENTER	Prior green coverage (in 1990)	0.0121	0.0011	0.0096	0.0121	0.0145	0.0121	1.0000

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Philadelphia - Sustained green gentrification throughout the study period with no impact on recent gentrification
Hypothesis 1 - Composite gentrification score for the tract for time period 2 (second earliest period, roughly representative of changes in the 2000s)
Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.1677	0.0113	0.1453	0.1677	0.1900	0.1677	
CH_GSAB_PRE2	Total green space area, roughly 2000s	7.6167	10.1796	-12.4608	7.6277	27.6117	7.6521	0.7736
DEV_TIME2	New residential buildings, roughly 2000s	0.0058	0.0007	0.0045	0.0058	0.0071	0.0058	1.0000
CENTER	Prior green coverage (in 1990)	-0.0075	0.0011	-0.0097	-0.0075	-0.0054	-0.0075	0.0000

Hypothesis 3 - Composite gentrification score for the tract for time period 3 (most recent period, roughly representative of changes in the 2010s).
Summary of the posterior distribution for the fixed effects - (final spatial model).

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.2745	0.0156	0.2437	0.2745	0.3051	0.2745	
CH_GSAB_PRE3	Total green space area, roughly 2010s	-9.9247	2.6610	-15.1736	-9.9265	-4.6741	-9.9300	2e-04
DEV_TIME3	New residential	0.0095	0.0009	0.0078	0.0095	0.0112	0.0095	1e+00

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

	buildings, roughly 2010s							
CENTER	Distance to city center from the centroid of the tract	-0.0091	0.0014	-0.0118	-0.0091	-0.0064	-0.0091	0e+00

Hypothesis 2 Composite gentrification score for the tract beginning the first year of time period 2 and ending the last year of time period 3
Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.1303	0.0068	0.1169	0.1303	0.1437	0.1303	
CH_GSAB_PRE3	Total green space area, roughly 2010s	7.9164	6.2191	-4.3803	7.9236	20.1565	7.9394	0.8993
DEV_TIME3	New residential buildings, roughly 2010s	0.0086	0.0004	0.0078	0.0086	0.0095	0.0086	1.0000
CENTER	Distance to city center from the centroid of the tract	-0.0073	0.0007	-0.0086	-0.0073	-0.0060	-0.0073	0.0000

Portland – No clear indication of green gentrification
Hypothesis 1 - Composite gentrification score for the tract for time period 2 (second earliest period, roughly representative of changes in the 2000s)
Summary of the posterior distribution for the fixed effects.

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.1259	0.0023	0.1209	0.1259	0.1309	0.1259	
CH_GSAB_PRE2	Total green space area, roughly 2000s	-3.8262	0.7684	-5.4824	-3.8274	-2.1619	-3.8281	0.001
CENTER	Prior green coverage (in 1990)	-0.0049	0.0002	-0.0053	-0.0049	-0.0045	-0.0049	0.000

Hypothesis 3 - Composite gentrification score for the tract for time period 3 (most recent period, roughly representative of changes in the 2010s).
Summary of the posterior distribution for the fixed effects - (final spatial model).

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.0839	0.0088	0.0664	0.0839	0.1014	0.0839	
CH_GSAB_PRE3	Total green space area, roughly 2010s	-4.5675	2.6878	-9.9385	-4.5701	0.8131	-4.5750	0.0447
DEV_TIME3	New residential buildings, roughly 2010s	0.0076	0.0011	0.0053	0.0076	0.0098	0.0076	1.0000

Hypothesis 2 Composite gentrification score for the tract beginning the first year of time period 2 and ending the last year of time period 3
Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.1074	0.0014	0.1046	0.1074	0.1103	0.1074	

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

CH_GSAB_PRE2	Total green space area, roughly 2000s	-4.5284	0.4664	-5.4870	-4.5288	-3.5673	-4.5290	0
CENTER	Prior green coverage (in 1990)	-0.0046	0.0001	-0.0048	-0.0046	-0.0043	-0.0046	0

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

San Francisco - Sustained green gentrification throughout the study period with no impact on recent gentrification
Hypothesis 1 - Composite gentrification score for the tract for time period 2 (second earliest period, roughly representative of changes in the 2000s)
Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.055196	0.002588	0.049856	0.055195	0.060542	0.055194	
CH_GSAB_PRE2	Total green space area, roughly 2000s	2.401907	2.007365	-1.746382	2.403731	6.540933	2.406557	0.8985
NEWTRANSITB_PRE2	Number of public transit stops added, roughly 2000s	0.125940	0.019054	0.086607	0.125938	0.165291	0.125939	1.0000
PRE_1990_GREEN	Prior green coverage (in 1990)	-0.025529	0.003823	-0.033423	-0.025528	-0.017634	-0.025527	0.0000

Hypothesis 3 - Composite gentrification score for the tract for time period 3 (most recent period, roughly representative of changes in the 2010s).
Summary of the posterior distribution for the fixed effects - (final spatial model).

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.1123	0.007	0.0985	0.1123	0.1261	0.1123	
CH_GSAB_PRE3	Total green space area, roughly 2010s	0.0191	20.023	-39.3345	0.0186	39.3365	0.0193	0.4992

Hypothesis 2 Composite gentrification score for the tract beginning the first year of time period 2 and ending the last year of time period 3
Summary of the posterior distribution for the fixed effects.

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.054871	0.004934	0.045098	0.054870	0.064632	0.054869	
CH_GSAB_PRE2	Total green space area, roughly 2000s	4.313102	2.686562	-1.012002	4.314200	9.624019	4.316809	0.9457
CENTER	Prior green coverage (in 1990)	-0.004951	0.000846	-0.006628	-0.004951	-0.003277	-0.004951	0.0000

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Seattle - Sustained green gentrification throughout the study period
Hypothesis 1 - Composite gentrification score for the tract for time period 2 (second earliest period, roughly representative of changes in the 2000s)
Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.070821	0.003346	0.064238	0.070821	0.077397	0.070821	
CH_GSAB_PRE2	Total green space area, roughly 2000s	4.674098	1.547916	1.628763	4.674152	7.715961	4.674400	0.9986
DEV_TIME2	New residential buildings, roughly 2000s	0.006900	0.001263	0.004415	0.006900	0.009382	0.006900	1.0000

Hypothesis 3 - Composite gentrification score for the tract for time period 3 (most recent period, roughly representative of changes in the 2010s).
Summary of the posterior distribution for the fixed effects - (final spatial model).

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.1560	0.0097	0.1370	0.1560	0.1751	0.1560	
CH_GSAB_PRE3	Total green space area, roughly 2010s	8.1066	9.6735	-10.9154	8.1100	27.0906	8.1180	0.7988
CENTER	Prior green coverage (in 1990)	-0.0022	0.0005	-0.0031	-0.0022	-0.0013	-0.0022	0.0000

Hypothesis 2 Composite gentrification score for the tract beginning the first year of time period 2 and ending the last year of time period 3
Summary of the posterior distribution for the fixed effects - (final spatial model).

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.053917	0.006860	0.040420	0.053916	0.067399	0.053916	
CH_GSAB_PRE2	Total green space area, roughly 2000s	2.375917	1.140597	0.131809	2.375913	4.617504	2.376005	0.9809
DEV_TIME23	New residential buildings, roughly beginning last year of time period 2 and first year of time period 3	0.003613	0.000815	0.002009	0.003613	0.005214	0.003613	1.0000
CENTER	Distance to city center from the centroid of the tract	-0.001003	0.000252	-0.001500	-0.001003	-0.000507	-0.001003	0.0001
TRACTDENSITY_2010	People per square kilometer in the tract in the year 2010	0.000005	0.000001	0.000003	0.000005	0.000007	0.000005	1.0000

Sheffield - No clear indication of green gentrification
Hypothesis 1 - Composite gentrification score for the tract for time period 2 (second earliest period, roughly representative of changes in the 2000s)
Summary of the posterior distribution for the fixed effects.

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.0191	0.0021	0.0149	0.0191	0.0233	0.0191	
CH_GSAB_PRE2	Total green space area, roughly 2000s	-3.9561	3.6850	-11.1979	-3.9565	3.2804	-3.9569	0.1401
NEWTRANSITB_PRE2	Number of public transit stops added, roughly 2000s	0.0378	0.0129	0.0124	0.0378	0.0633	0.0379	0.9981
DEV_TIME2	New residential buildings, roughly 2000s	0.0010	0.0002	0.0007	0.0010	0.0014	0.0010	1.0000

Hypothesis 3 - Composite gentrification score for the tract for time period 3 (most recent period, roughly representative of changes in the 2010s).
Summary of the posterior distribution for the fixed effects - (final spatial model).

The hypothesis H1.1.2b (for model 1.1.2.b) and 1.1.2c (for model 1.1.3.a) were not analyzed because of lack of availability of data in the response variable (*GENT_TIME3* and *GENT_TIME23*, respectively).

Hypothesis 2 Composite gentrification score for the tract beginning the first year of time period 2 and ending the last year of time period 3
Summary of the posterior distribution for the fixed effects - (final spatial model).

The hypothesis H1.1.2b (for model 1.1.2.b) and 1.1.2c (for model 1.1.3.a) were not analyzed because of lack of availability of data in the response variable (*GENT_TIME3* and *GENT_TIME23*, respectively).

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Valencia – No clear indication of green gentrification

Hypothesis 1 - Composite gentrification score for the tract for time period 2 (second earliest period, roughly representative of changes in the 2000s)

Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.011691	0.001174	0.009385	0.011691	0.013994	0.011691	
CH_GSAB_PRE2	Total green space area, roughly 2000s	-0.023820	0.018745	-0.060643	-0.023821	0.012966	-0.023820	0.1012
DEV_TIME2	New residential buildings, roughly 2000s	0.005859	0.001714	0.002491	0.005859	0.009224	0.005859	0.9997

Hypothesis 3 - Composite gentrification score for the tract for time period 3 (most recent period, roughly representative of changes in the 2010s).

Summary of the posterior distribution for the fixed effects - (final spatial model).

The hypothesis H1.1.2b (for model 1.1.2.b) and 1.1.2c (for model 1.1.3.a) were not analyzed because of lack of availability of data in the response variable (*GENT_TIME3* and *GENT_TIME23*, respectively).

Hypothesis 2 Composite gentrification score for the tract beginning the first year of time period 2 and ending the last year of time period 3

Summary of the posterior distribution for the fixed effects - (final spatial model).

The hypothesis H1.1.2b (for model 1.1.2.b) and 1.1.2c (for model 1.1.3.a) were not analyzed because of lack of availability of data in the response variable (*GENT_TIME3* and *GENT_TIME23*, respectively).

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Vancouver - Sustained green gentrification throughout the study period with no impact on recent gentrification
Hypothesis 1 - Composite gentrification score for the tract for time period 2 (second earliest period, roughly representative of changes in the 2000s)
Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.0954	0.0119	0.0721	0.0954	0.1187	0.0954	
CH_GSAB_PRE2	Total green space area, roughly 2000s	3.6890	2.6175	-1.4607	3.6892	8.8331	3.6897	3.6890
CENTER	Prior green coverage (in 1990)	-0.0071	0.0020	-0.0111	-0.0071	-0.0031	-0.0071	-0.0071

Hypothesis 3 - Composite gentrification score for the tract for time period 3 (most recent period, roughly representative of changes in the 2010s).
Summary of the posterior distribution for the fixed effects - (final spatial model).

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.1430	0.0118	0.1198	0.1430	0.1661	0.1430	
CH_GSAB_PRE3	Total green space area, roughly 2010s	-7.7529	17.3151	-41.7356	-7.7745	26.3148	-7.8178	0.3247

Hypothesis 2 Composite gentrification score for the tract beginning the first year of time period 2 and ending the last year of time period 3
Summary of the posterior distribution for the fixed effects - (final spatial model).

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.0982208	0.0103433	0.0777949	0.0982200	0.1186270	0.0982193	

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

CH_GSAB_PRE3	Total green space area, roughly 2010s	5.4011900	1.6136386	2.2135303	5.4014864	8.5836506	5.4023066	0.9993742
CENTER	Prior green coverage (in 1990)	-0.0061997	0.0014041	-0.0089730	-0.0061997	-0.0034298	-0.0061994	0.0000152
TRACTDENSITY_2010	People per square kilometer in the tract in the year 2010	-0.0000023	0.0000006	-0.0000035	-0.0000023	-0.0000011	-0.0000023	0.0001216

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Vienna
Hypothesis 1 - Composite gentrification score for the tract for time period 2 (second earliest period, roughly representative of changes in the 2000s)
Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.0088	0.0007	0.0074	0.0088	0.0103	0.0088	
CH_GSAB_PRE2	Total green space area, roughly 2000s	0.8041	0.3635	0.0938	0.8029	1.5206	0.8004	0.9868
DEV_TIME2	New residential buildings, roughly 2000s	0.0213	0.0026	0.0162	0.0213	0.0263	0.0213	1.0000

Hypothesis 3 - Composite gentrification score for the tract for time period 3 (most recent period, roughly representative of changes in the 2010s).
Summary of the posterior distribution for the fixed effects - (final spatial model).

The hypothesis H1.1.2b (for model 1.1.2.b) and 1.1.2c (for model 1.1.3.a) were not analyzed because of lack of availability of data in the response variable (*GENT_TIME3* and *GENT_TIME23*, respectively).

Hypothesis 2 Composite gentrification score for the tract beginning the first year of time period 2 and ending the last year of time period 3
Summary of the posterior distribution for the fixed effects - (final spatial model).

The hypothesis H1.1.2b (for model 1.1.2.b) and 1.1.2c (for model 1.1.3.a) were not analyzed because of lack of availability of data in the response variable (*GENT_TIME3* and *GENT_TIME23*, respectively)

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Washington D.C. - Sustained green gentrification throughout the study period with no impact on recent gentrification
Hypothesis 1 - Composite gentrification score for the tract for time period 2 (second earliest period, roughly representative of changes in the 2000s)
Summary of the posterior distribution for the fixed effects.

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.255183	0.021689	0.212300	0.255184	0.298002	0.255186	
CH_GSAB_PRE2	Total green space area, roughly 2000s	2.750009	8.815165	-14.677985	2.755721	20.124084	2.768713	0.6235
NEWTRANSITB_PRE2	Number of public transit stops added, roughly 2000s	1.065925	0.222003	0.626993	1.065926	1.504205	1.065951	1.0000
CENTER	Distance to city center from the centroid of the tract	-0.090643	0.023385	-0.136881	-0.090642	-0.044479	-0.090638	0.0001
PRE_1990_GREEN	Prior green coverage (in 1990)	-0.023965	0.003427	-0.030739	-0.023966	-0.017198	-0.023967	0.0000

Hypothesis 3 - Composite gentrification score for the tract for time period 3 (most recent period, roughly representative of changes in the 2010s).
Summary of the posterior distribution for the fixed effects - (final spatial model).

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.2709699	0.0297322	0.2122691	0.2709715	0.3295800	0.2709778	

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

CH_GSAB_PRE3	Total green space area, roughly 2010s	4.1168133	9.8159963	-15.2665083	4.1250484	23.4315247	4.1436917	0.6635
PRE_1990_GREEN	Prior green coverage (in 1990)	-0.0830677	0.0231392	-0.1287476	-0.0830681	-0.0374499	-0.0830667	0.0003
CENTER	Prior green coverage (in 1990)	-0.0221695	0.0037526	-0.0295761	-0.0221701	-0.0147702	-0.0221710	0.0000
TRACTDENSITY_2010	People per square kilometer in the tract in the year 2010	-0.0000044	0.0000021	-0.0000085	-0.0000044	-0.0000003	-0.0000044	0.0172

Hypothesis 2 Composite gentrification score for the tract beginning the first year of time period 2 and ending the last year of time period 3

Summary of the posterior distribution for the fixed effects - (final spatial model).

	Variable description	mean	sd	0.025quant	0.5quant	0.975quant	mode	p
(Intercept)		0.208801	0.016356	0.176322	0.208802	0.241216	0.208806	
CH_GSAB_PRE2	Total green space area, roughly 2000s	4.456241	6.763124	-8.985118	4.465356	17.828968	4.486189	0.7499
NEWTRANSITB_PRE2	Number of public transit stops added, roughly 2000s	0.957883	0.167409	0.625452	0.957890	1.289672	0.957921	1.0000

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

CENTER	Distance to city center from the centroid of the tract	-0.088120	0.017637	-0.123145	-0.088118	-0.053169	-0.088111	0.0000
PRE_1990_GREEN	Prior green coverage (in 1990)	-0.021352	0.002586	-0.026485	-0.021353	-0.016224	-0.021354	0.0000

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Chapter 3.

Rationale behind our study design

Our selection of the 1990s as the starting period corresponds approximately to the beginning of urban green agendas after a series of international policy decisions and reports (Brundtland Report Our Common Future by the United Nations 1987, the Rio Declaration on Environment and Development and its Agenda 21 1992, and the Habitat Agenda 1997) catalyzed urban sustainability planning in the 1990s, which then became further materialized in the next three decades re-naturing (Wachsmuth & Angelo, 2018). We focused on North America and Western Europe because these two regions have been influenced by similar modern planning traditions and trajectories, even if the practical impacts have differed (Wheeler, 2013). Our study explored medium-sized cities (500 000 to 1.5 million residents) because these compete in a similar acute manner to secure transnational investment through urban regeneration, innovation and green livability experimentation (Garcia-Lamarca et al., 2019).

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Table S1 – Definitions and data sources for each of the sociodemographic and rent values constructs used to assess the SGU situation in 2000. These data were used to build the variable "gentrification for the 2000s" and "gentrification throughout the decades of the 2000s and 2010s".

City	Year represented	No ethnic/racial vulnerability	High education	Income	Rental housing	No poverty	Professional occupation
Atlanta (Georgia, US) **Austin** (Texas, US) **Baltimore** (Maryland, US) **Boston** (Massachusetts, US) **Cleveland** (Ohio, US) **Denver** (Colorado, US) **Detroit** (Michigan, US) **Louisville** (Kentucky, US) **Milwaukee** (Wisconsin, US) **Philadelphia** (Pennsylvania, US) **Portland** (Oregon, US) **San Francisco** (California, US) **Seattle** (Washington, US) **Washington DC** (District of Columbia, US)	2000	Percentage of non-Hispanic White residents among the total number of people in the census tract. **Data source:** US Census (2000). Data standardized to 2010 census tracts purchased from GeoLytics (Neighborhood Change database)	Percentage of residents with university degree or higher among total number of people in the census tract. **Data source:** US Census (2000). Data standardized to 2010 census tracts purchased from GeoLytics (Neighborhood Change database)	Percentage of households with high income among total households in the census tract. **Data source:** US Census (2000). Data standardized to 2010 census tracts purchased from GeoLytics (Neighborhood Change	Percentage of rental households paying above median value in rent among total of rental households from census tract. **Data source:** US Census (2000). Data standardized to 2010 census tracts purchased from GeoLytics (Neighborhood Change	Percentage of residents not below poverty level among total number of people in the census tract from which poverty is determined. **Data source:** US Census (2000). Data standardized to 2010 census tracts purchased from GeoLytics (Neighborhood Change database)	Percentage of residents with professional occupation (professional, scientific, and technical services and management of companies and enterprises) among total number of people in the census tract. **Data source:** US Census (2000). Data standardized to 2010 census tracts purchased from GeoLytics (Neighborhood Change

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Calgary (Canada) **Montreal** (Canada) **Vancouver** (Canada)	2001	Percentage of non-vulnerable community (i.e. non-Black, non-Arab, no South Asian and not multiple of these visible vulnerabilities) among total population in the dissemination area. **Data source:** 2001 Canadian Census	Percentage of residents with university degree or higher among total number of people from which education was collected in the dissemination area. **Data source:** 2001 Canadian Census	Percentage of household with high median household income among total private households in the dissemination area. **Data source:** 2001 Canadian Census	Percentage of rental households paying above median value in year city rent among total rental household in the dissemination area. **Data source:** 2001 Canadian Census	**N/A**	Percentage of residents with professional occupation (including over 20 different categories) among total people with occupation data in the dissemination area. **Data source:** 2001 Canadian Census
Lyon (France) **Nantes** (France)	1999	Percentage of residents born in France in the IRIS. **Data source:** 1999 INSEE	Percentage of residents with university degree or higher among people over 15 years of age in the IRIS. **Data source:** 1999 INSEE	Median income in the IRIS **Data source:** 1999 INSEE	**N/A**	Percentage of primary residences that are not social housing in the IRIS. **Data source:** 1999 INSEE	Percentage of residents with professional occupation (farmers, craftsmen, traders, business leaders, executives, superior intellectual professions, intermediate professions) among total population over 15 years of age in the IRIS. **Data source:** 1999 INSEE

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Bristol (United Kingdom) **Sheffield** (United Kingdom) **Edinburgh** (United Kingdom)	2001	Percentage of non-vulnerable residents (White British, White Scottish and Other White) among the total people in the output area **Data source:** 2001 UK Census	From a 10% sample, percentage of people with a university degree or higher among total people aged 18 or over in the output area **Data source:** 2001 UK Census	**N/A**	**N/A**	Percentage of residents living in housing with no social rent (i.e. excluding local council, housing association and other social rent) among the total number of households in the output area. **Data source:** 2001 UK Census.	From a 10% sample, percentage of residents with professional occupation (i.e. managers, senior officials, professional occupations) among total residents in the output area **Data source:** 2001 UK Census
Amsterdam (The Netherlands)	2006/2007	Percentage of people with both parents born in The Netherlands among the total people in the wijk (i.e. neighborhood). **Data source:** 2007 Amsterdam Municipal Research, Information and Statistics Office	Percentage of people with higher education among total people in the wijk (i.e. neighborhood). **Data source:** 2006 Dutch National Statistics Netherlands	Average income in the wijk (i.e. neighborhood). **Data source:** 2007 Amsterdam Municipal Research, Information and Statistics Office.	Average rent paid in the wijk (i.e. neighborhood). **Data source:** 2007 Amsterdam Municipal Research, Information and Statistics Office.	**N/A**	**N/A**
Barcelona (Spain)	2000/2001	Percentage of non-vulnerable residents according to nationality (i.e. EU27, USA, Canada, Norway, Luxembourg, Andorra, Island, Litchestein) among	Percentage of people with university degree, superior professional education or higher among total population in the census tract.	Average income for the small research area (i.e. “zona recerca petita”) later transformed to census tract. **Data source:** 2000 Statistics office of	Rental price per month in Euro/m2 for second hand housing renters in 2001 at the big statistical area (i.e. “zona estadística gran”) later	**N/A**	**N/A**

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

		total population in the census tract. **Data source:** 2001 Spanish Census from Statistics National Institute.	**Data source:** 2001 Spanish Census from Instituto Nacional de Estadística	the Barcelona Town Council	transformed to census tract. **Data source:** 2001 data from INCASÒL.		
Copenhagen (Denmark)	N/A	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Dublin (Ireland)	2006	Percentage of non-vulnerable residents (i.e. white Irish) among total people in the electoral division. **Data source:** 2006 Ireland Census	Percentage of residents with a university degree or higher among population over 15 years of age in the electoral division. **Data source:** Ireland Census (1996, 2002, 2006, 2011, 2016)	**N/A**	**N/A**	Percentage of social housing household among total number of households in the electoral division. **Data source:** 2006 Ireland Census	Percentage of people working in a professional occupation (i.e. employers, managers or professionals) among total people in the electoral division. **Data source:** 2006 Ireland Census.
Valencia (Spain)	2001	Percentage of non-vulnerable residents according to nationality (i.e. EU27, US, Canada, Australia) among the total population in the census tract. **Data source:** 2001 Spanish Census from Statistics National Institute.	Percentage of people with a university degree or higher among total population in the census tract, small research area or neighborhood **Data source:** 2001 Spanish Census from Instituto	**N/A**	**N/A**	**N/A**	**N/A**

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

			Nacional de Estadística				
Vienna (Austria)	2001	**N/A**	Percentage of residents with university degree among total residents in the zählgebiet (i.e. sub-districts). **Data source:** 2001 City of Vienna Austrian Public Data Portal	Percentage of residents with high income (i.e. sector groups D, E, J-R,S,U) among total residents in the zählgebiet (i.e. sub-districts). **Data source:** 2001 City of Vienna Austrian Public Data Portal	**N/A**	**N/A**	Percentage of residents with professional occupation among total residents in the zählgebiet (i.e. sub-districts). **Data source:** 2001 City of Vienna Austrian Public Data Portal

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Table S2 – Definitions and data sources for each of the sociodemographic and rent values constructs used to assess the SGU situation in 2010. These data were used to build the variable "gentrification for the 2000s" and "gentrification for the 2010s".

City	Year represented	No ethnic/racial vulnerability	High education	Income	Rental housing	No poverty	Professional occupation
Atlanta (Georgia, US) **Austin** (Texas, US) **Baltimore** (Maryland, US) **Boston** (Massachusetts, US) **Cleveland** (Ohio, US) **Denver** (Colorado, US) **Detroit** (Michigan, US) **Louisville** (Kentucky, US) **Milwaukee** (Wisconsin, US) **Philadelphia** (Pennsylvania, US) **Portland** (Oregon, US) **San Francisco** (California, US) **Seattle** (Washington, US) **Washington DC** (District of Columbia, US)	2010	Percentage of non-Hispanic White residents among total number of residents in the census tract. **Data source:** US Census (2010), Data standardized to 2010 census tracts purchased from GeoLytics (Neighborhood Change database)	Percentage of residents with university degree or higher among total number of residents in the census tract. **Data source:** American Community Survey (2006-2010), Data standardized to 2010 census tracts purchased from GeoLytics (Neighborhood Change database)	Percentage of household with high income (i.e. above 125% of the median city income) among total number of households from which there is an income in the census tract. **Data source:** American Community Survey (2006-2010), Data standardized to 2010 census tracts purchased from GeoLytics (Neighborhood Change database).	Percentage of households paying above median value in rent (adjusted for each city and year) among total number of households from which there is rent data in the census tract. **Data source:** American Community Survey (2006-2010), Data standardized to 2010 census tracts purchased from GeoLytics (Neighborhood Change database)	Percentage of residents not below poverty level among total number for which poverty is determined in the census tract. **Data source:** American Community Survey (2006-2010), Data standardized to 2010 census tracts purchased from GeoLytics (Neighborhood Change database)	Percentage of residents with professional occupation (professional, scientific, and technical services and management of companies and enterprises) among total number of people in the census tract from which occupation data was collected. **Data source:** American Community Survey (2006-2010), Data standardized to 2010 census tracts purchased from GeoLytics (Neighborhood Change database)
Calgary (Canada)	2011	Percentage of non-vulnerable	Percentage of residents with	Percentage of household with	Percentage of households	**N/A**	Percentage of residents with

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Montreal (Canada) **Vancouver** (Canada)		community (i.e. non-Black, non-Arab, no South Asian and not multiple of these visible vulnerabilities) among total population in the dissemination area. **Data source:** 2011 Canadian Census	20 years or more and university degree or higher among total number of people from which educational data was collected in the dissemination area. **Data source:** 2011 Canadian Census	high income (i.e. above 125% of the median city income) among total number of private households from which there is an income in the dissemination area. **Data source:**2011 Canadian Census	paying above median value in rent (adjusted for each city and year) among total number of households from which there is rent data in the dissemination area. **Data source:** 2011 Canadian Census		professional occupation (including over 20 categories) among total residents in the dissemination area from which occupation data was collected. **Data source:** 2011 Canadian Census
Lyon (France) **Nantes** (France)	2013	Percentage of residents born in France in the IRIS. **Data source:** 2013 INSEE	Percentage of residents (over 15 years of age) with a university degree or higher in the IRIS. **Data source:** 2013 INSEE	Median income in the IRIS. **Data source:** INSEE (1999; 2006-2013)	**N/A**	Percentage of primary residences that are not social housing in the IRIS. **Data source:** 2013 INSEE	Percentage of residents with professional occupation (farmers, craftsmen, traders, business leaders, executives, superior intellectual professions, intermediate professions) among total residents in IRIS aged 15 or older. **Data source:** 2013 INSEE
Bristol (United Kingdom)	2011	Percentage of non-vulnerable residents (i.e. white british,	From a 10% sample, percentage of	**N/A**	**N/A**	Percentage of residents living in housing with no	From a 10% sample, percentage of

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Sheffield (United Kingdom) **Edinburgh** (United Kingdom)		white Scottish and other white) among total residents in the output area from which vulnerability data was collected. **Data source:** 2011 UK Census	people with a university degree or higher (i.e. higher degree, degree, diploma, etc.) among In the output area **Data source:** 2011 UK Census			social rent (i.e. excluding local council, housing association and other social rent) among the total number of households in the output area. **Data source:** 2011 UK Census.	residents with professional occupation (i.e. managers, senior officials and professional occupations) among total residents in the output area. **Data source:** 2011 UK Census
Amsterdam (The Netherlands)	2009/2010	Percentage of people with both parents born in The Netherlands among total number of people in the wijk (i.e. neighborhood). **Data source:** 2010 Amsterdam Municipal Research, Information and Statistics Office	Percentage of people aged 15-75 years with higher education among total people in the wijk (i.e. neighborhood) from which education data was collected. **Data source:** 2010 Amsterdam Municipal Research, Information and Statistics Office.	Average income in the wijk (i.e. neighborhood). **Data source:** 2010 Amsterdam Municipal Research, Information and Statistics Office.	Average rent paid in the wijk (i.e. neighborhood). **Data source:** 2009 Amsterdam Municipal Research, Information and Statistics Office),	**N/A**	**N/A**
Barcelona (Spain)	2011	Percentage of non-vulnerable residents according to nationality (i.e. EU27, USA, Canada,	Percentage of people with university degree or higher (i.e. university	Average income for the small research area (i.e. “zona recerca petita”)	Rental price per month in Euro/m2 for second hand housing renters	**N/A**	**N/A**

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

		Norway, Luxembourg, Andorra, Island, Litchestein) among total population in census tract. **Data source:** 2011 Spanish Census from Statistics National Institute.	studies, superior professional education or higher) among population from which education data was collected in census tract.. **Data source:** 2011 Spanish Census from Statistics National Institute.	later transformed to census tract **Data source:** 2011 Statistics office of the Barcelona Town Council	in 2011 at the big statistical area (i.e. "zona estadística gran") later transformed to census tract. **Data source:** 2011 data from INCASÒL		
Copenhagen (Denmark)	2009	Percentage of non-vulnerable residents (i.e. origins in Denmark or other Western countries) among total of people answering vulnerability question in roder *** **Data source:** 2009 Danish Statistical Office	Percentage of residents with a university degree or higher among total people in the roder. **Data source:** 3009 Danish Statistical Office	Percentage of residents with high-income among total people in the roder answering from which income data is availabe **Data source:** 2009 Danish Statistical Office	**N/A**	Percentage of households not living in public housing. In the roder. **Data source:** 2009 Danish Statistical Office	**N/A**
Dublin (Ireland)	2011	Percentage of non-vulnerable community (i.e. white Irish) among total number of residents from which vulnerability data	Percentage of residents with a university degree or higher among residents over 15 years or age in the	**N/A**	**N/A**	Percentage of social housing household among total number of households in the electoral division.	Percentage of people working in a professional occupation (i.e. employers, managers and higher

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

		was collected in the electoral division. **Data source:** 2011 Ireland Census	electoral division. **Data source:** 2011 Ireland Census			**Data source:** 2011 Ireland Census	professionals) among total people in the electoral division. **Data source:** 2011 Ireland Census
Valencia (Spain)	2011	Percentage of non-vulnerable community (i.e. EU27, US, Canada, Australia) among the total population in the census tract. **Data source:** 2011 Spanish Census from Statistics National Institute.	Percentage of people with a university degree or higher among all the residents in the census tract or neighborhood **Data source:** 2011 Instituto Nacional de Estadística census	**N/A**	**N/A**	**N/A**	**N/A**
Vienna (Austria)	N/A	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Table S3 – Definitions and data sources for each of the sociodemographic and rent values constructs used to assess the SGU situation in 2016. These data were used to build the variable "gentrification for the 2010s" and "gentrification throughout the decades of the 2000s and 2010s".

City	Year represented	No ethnic/racial vulnerability	High education	Income	Rental housing	No poverty	Professional occupation
Atlanta (Georgia, US) **Austin** (Texas, US) **Baltimore** (Maryland, US) **Boston** (Massachusetts, US) **Cleveland** (Ohio, US) **Denver** (Colorado, US) **Detroit** (Michigan, US) **Louisville** (Kentucky, US) **Milwaukee** (Wisconsin, US) **Philadelphia** (Pennsylvania, US) **Portland** (Oregon, US) **San Francisco** (California, US) **Seattle** (Washington, US) **Washington DC** (District of Columbia, US)	2016	Percentage of non-Hispanic White residents among total number of residents in the census tract from which race/ethnicity data was collected **Data source:** American Community Survey (2012-2016), Data standardized to 2010 census tracts purchased from GeoLytics (Neighborhood Change database)	Percentage of residents with university degree or higher among total number of people in the census tract from which education data was collected **Data source:** American Community Survey (2012-2016), Data standardized to 2010 census tracts purchased from GeoLytics (Neighborhood Change database)	Percentage of households with high income (above 125% of the median for the city for the year) among all household in the census tract. **Data source:** American Community Survey (2012-2016), Data standardized to 2010 census tracts purchased from GeoLytics (Neighborhood Change database)	Percentage of rental households paying above median value in rent (for the city and year) among all rental households in the census tract **Data source:** American Community Survey (2012-2016), Data standardized to 2010 census tracts purchased from GeoLytics (Neighborhood Change database)	Percentage of residents not below poverty level among total number of residents in the census tract from which poverty was determined **Data source:** American Community Survey (2012-2016), Data standardized to 2010 census tracts purchased from GeoLytics (Neighborhood Change database)	Percentage of residents with professional occupation (professional, scientific, and technical services and management of companies and enterprises) among total number of people in the census tract from which occupation data was collected. **Data source:** American Community Survey (2012-2016), Data standardized to 2010 census tracts purchased from GeoLytics (Neighborhood Change database)

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Calgary (Canada) **Montreal** (Canada) **Vancouver** (Canada)	2016	Percentage of non-vulnerable residents (i.e. non-Black, non-Arab, no South Asian and not multiple of these visible vulnerabilities) among total population in the dissemination area. **Data source:** 2016 Canadian Census	Percentage of residents aged 20 years old or older with university degree or higher among total population in the dissemination area from which education data was collected. **Data source:** 2016 Canadian Census	Percentage of private households with high income (i.e. 125% above city median household income) among all private households in the dissemination area. **Data source:** 2016 Canadian Census	Percentage of rental households paying above median value in rent (adjusted for city and year) among total number of rental households in the dissemination area. **Data source:** 2016 Canadian Census	**N/A**	Percentage of residents with professional occupation (i.e. over 20 categories) among total number people in the dissemination area from which occupation data was collected. **Data source:** 2016 Canadian Census
Lyon (France) **Nantes** (France)	N/A	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Bristol (United Kingdom) **Sheffield** (United Kingdom) **Edinburgh** (United Kingdom)	N/A	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Amsterdam (The Netherlands)	2013/2014	"Percentage of people with both of their parents born in The Netherlands among total number	Percentage of people aged 15-75 years old with high education among total number of	Average income in the wijk (i.e. neighborhood). **Data source:** 2014 Amsterdam	Average rent paid in the wijk (i.e. neighborhood).	**N/A**	**N/A**

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

		of people in the wijk (i.e. neighborhood). **Data source:** 2014 Amsterdam Municipal Research, Information and Statistics Office.	people in the wijk (i.e. neighborhood) from which education data was collected). **Data source:** 2014 Amsterdam Municipal Research, Information and Statistics Office.	Municipal Research, Information and Statistics Office.	**Data source:** 2013 Amsterdam Municipal Research, Information and Statistics Office.		
Barcelona (Spain)	2016	Percentage of non-vulnerable residents according to nationality (i.e. EU27, USA, Canada, Norway, Luxembourg, Andorra, island, Litchestein) among total residents in the census tract. **Data source:** 2016 register of inhabitants.	Percentage of people with university degree or higher (i.e. university studies, superior professional education or higher) among population from which education data was collected in the census tract, small research area or neighborhood **Data source:** 2016 register of inhabitants.	Average income for the small research area (i.e. "zona recerca petita") later transformed to census tract **Data source:** 2016 Statistics office of the Barcelona Town Council	Rental price per month in Euro/m2 for second hand housing renters in 2016 at the big statistical area (i.e. "zona estadística gran") later transformed to census tract. **Data source:** 2016 data from INCASÒL	**N/A**	**N/A**
Copenhagen (Denmark)	2015	Percentage of non-vulnerable residents (i.e. origins in Denmark or other	Percentage of residents with a university degree among total	Percentage of residents with high-income among all	**N/A**	Percentage of households not living in public	**N/A**

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

		Western countries) among total people in the roder which answered the vulnerability question **Data source:** 2015 Danish Statistical Office	residents in the roder. **Data source:** 2015 Danish Statistical Office	residents in the roder from which income data was collected. **Data source:** 2015 Danish Statistical Office		housing. In the roder. **Data source:** 2015 Danish Statistical Office	
Dublin (Ireland)	2016	Percentage of non-vulnerable residents (i.e. white Irish) among total number of people in the electoral division from which vulnerability data was collected. **Data source:** 2016 Ireland Census	Percentage of residents over 15 years of age with a university degree or higher among all the electoral division residents. **Data source:** 2016 Ireland Census	**N/A**	**N/A**	Percentage of social housing household among total number of households in the electoral division. **Data source:** 2016 Ireland Census	Percentage of people working in a professional occupation (employers, managers and higher professionals) among total residents in the electoral division from which occupation data was collected. **Data source:** 2016 Ireland Census
Valencia (Spain)	2016	Percentage of non-vulnerable residents according to nationality (i.e. EU27, US, Canada, Australia) among the total population in the census tract. **Data source:** 2016 register of inhabitants	Percentage of people with a university degree or higher among total population in the census tract. **Data source:** 2016 register of inhabitants	**N/A**	**N/A**	**N/A**	**N/A**

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Vienna (Austria)	2014/2015	**N/A**	Percentage of residents with university degree among total number of residents in zählgebiet (Sub-Districts) **Data source:** 2014 City of Vienna Austrian Public Data Portal	Percentage of residents with high income (i.e. sectors groups D, E, J-S, U) among total number of residents in zählgebiet (Sub-Districts) from which socioeconomic groups data was collected. **Data source:** 2015 City of Vienna Austrian Public Data Portal	**N/A**	**N/A**	Percentage of residents with professional occupation among total number of residents in zählgebiet (Sub-Districts) from which occupation data was collected. **Data source:** 2014 City of Vienna Austrian Public Data Portal

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Details on the assessment of gentrification

Due to differences in data availability, the number of variables used to build the gentrification score varied among time periods and cities and the years measured did not always align exactly with decennial breakpoints. However, the gentrification score we developed are appropriate to compare associations between types of greenspaces and gentrification over the decades and across geographical contexts.

In most cases, the SGU at which the data were reported changed slightly across years or even across variables. To standardize the data, if available, we employed convertors provided by the public agencies that managed the data. When not available, we divided the geographies, as in many cases the differences across years or variables were simply a matter of larger areas being an ensemble of SGUs. If dividing was not useful, we used a dissymmetric approach with aerial imagery or land use files forming the basis for identifying populated areas and transforming the variables. Finally, if none of the previous methods was possible, we employed an aerial reapportionment with manual adjustments for outliers carefully considered (often SGU by SGU).

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Details on the assessment of new greenspaces of different typologies

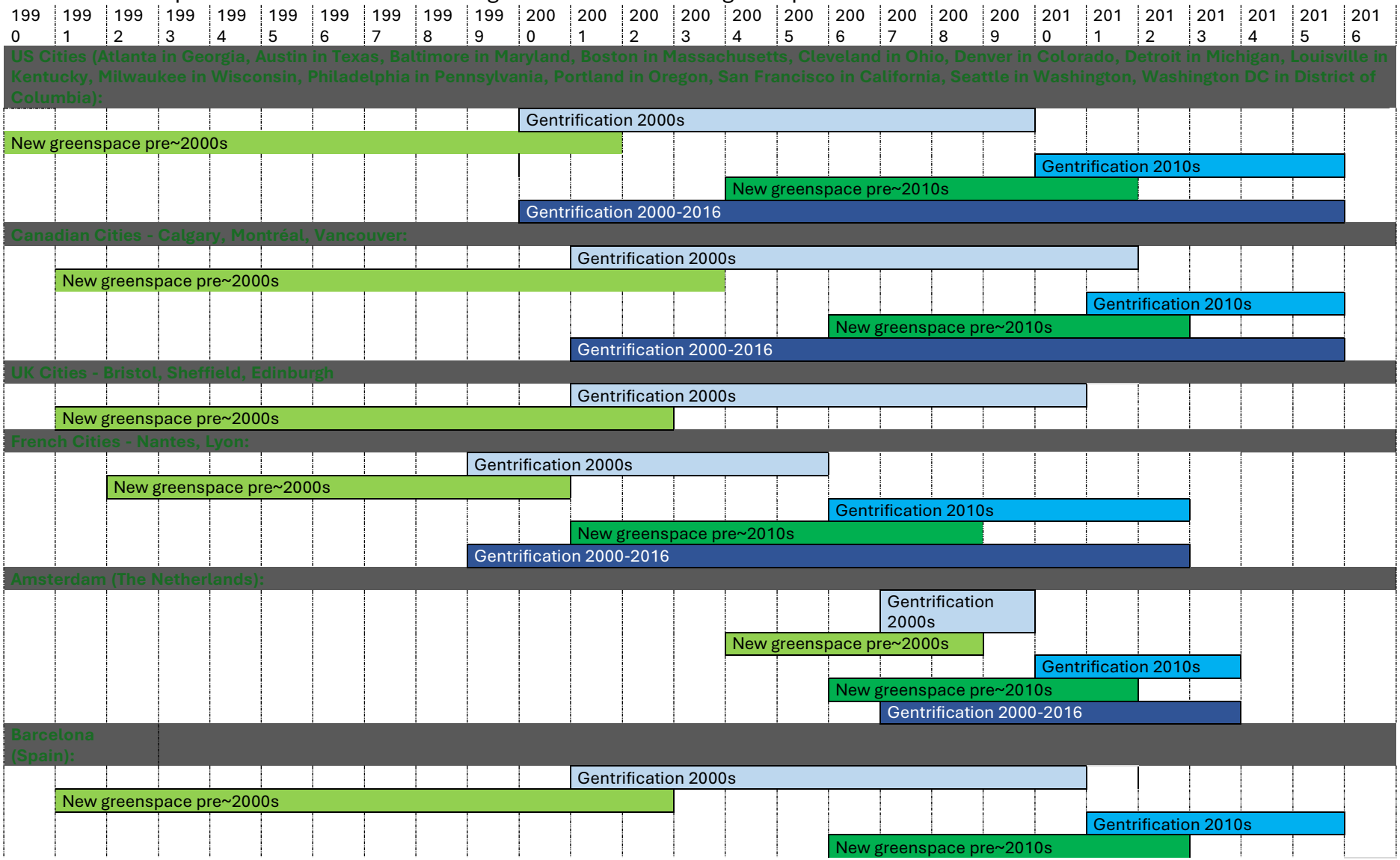
In general, the consideration of parks, gardens and nature preserves as greenspaces was straightforward. However, for some spaces such as plazas and promenades, the greenspace consideration was less clear (particularly for Mediterranean cities), so we used the subjective rule of a minimum of roughly 20% of the space being vegetated in order to consider them as a greenspace.

The time window considered to build each indicator was city dependent and had the same length as the one used to build the variable "gentrification in the decade of the 2000s" (or "gentrification in the decade of the 2010s") plus two years. For example, for Amsterdam, gentrification in the decade of the 2000s is calculated based on data from 2007 and 2009 (i.e. 3 years change), so Parks pre~2000s is calculated for the time window 2004-2008 (i.e. 5 years, that is 3 years plus 2 of overlap with the gentrification period). Meanwhile, for Atlanta gentrification in the decade of the 2000s is calculated based on data from 2000 and 2009 (i.e 10 years change), so Parks pre~2000s is calculated for the time window 1990-2001 (i.e. 12 years change, that is 10 years plus 2).

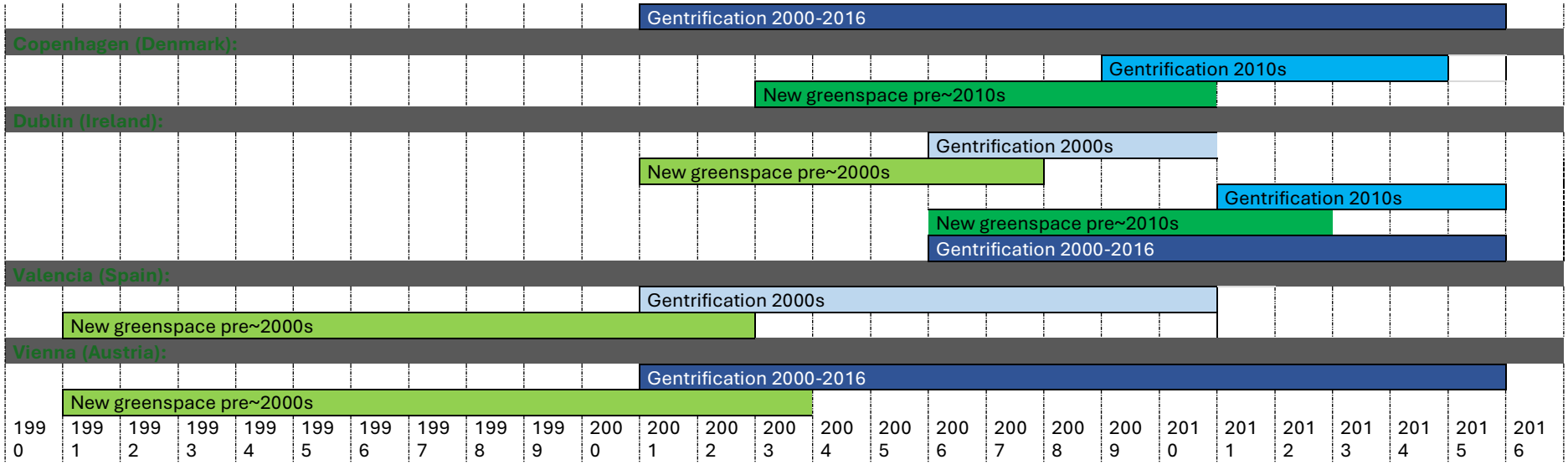
To determine the total area of parks, gardens, nature preserves, recreational areas or greenways added to each city SGU we first considered that each greenspace has a catchment area. In brief, there is a certain area around greenspaces where residents that are drawn to that greenspace live. According to what previous studies have shown (Stark et al., 2014), we considered 400-meter Euclidean distance buffers around each SGU to capture greenspaces located at 5-10 minute walking distances from SGU limits (i.e. to include greenspaces catchment areas). Considering the catchment area is important to control for boundary effects (i.e. tracts that are directly next to a green space can be considered as new greenspace of the tract in our study) (for a detailed description see [REF deleted for peer-review]).

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Table S4 – Time period included in each of the gentrification and new greenspace variables.



* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.



Note: For the Canadian and French cities and for Vienna (Austria) the time periods were built slightly differently than the standardized model due to data treatment challenges

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Details on statistical analyses

Following the usual procedure in Bayesian spatial statistics, the development of our models was a three-step process. The first step was determining which covariates were relevant for each exposure-outcome pair in presence of the rest of potential covariates. To do that, we used the library *BayesVarSel* (Garcia-Donato & Forte, 2018) from R (R Core Team, 2020). The second step consisted in determining whether there was any spatial effect (i.e. if there were any geographical drivers of association, in particular, if the relationships between gentrification and type of greenspace of a SGU depended on the values of neighboring SGU). To do so, we employed Moran's I (Moran, 1950) as a measure of the spatial autocorrelation. We computed it directly in the residuals to determine whether the remaining variability after incorporating the independent variables (i.e. variable of interest and covariates) in the model presented spatial autocorrelation. Given that in all our models there was spatial autocorrelation, the third step involved adding a spatial random effect to explain the underlying spatial effect. In order to avoid confounding between the spatial effect and the independent variables, an additional restriction was introduced into the model: orthogonality between both effects. In this way, the variability not explained by the independent variables was intended to be explained by the spatial effect.

Inference was performed within the Bayesian framework and so prior elicitation for all the parameters and hyperparameters of the model was required. Inference is performed within the Bayesian statistical approach as it allows us to deal in a natural way with the uncertainty of both the parameters and the models. In particular, we chose vague prior distributions to emphasize our lack of knowledge about them. The complete model can be expressed as follows:

$$
\begin{aligned}
y_i &\sim \mathcal{N}(\mu_i, \sigma_\epsilon)\,,\ i = 1, \ldots, n \\
\mu_i &= \boldsymbol{V_i}\boldsymbol{\beta} + s_i\,, \\
\beta_1, \beta_2, \ldots, \beta_{p+1} &\sim \mathcal{N}(0, \sigma^2 = 1000) \\
s_{i|j} &\sim \mathcal{N}\left(\frac{1}{k_i}\sum_{i\sim j} s_j, \frac{\sigma_s^2}{k_i}\right),\ i \neq j, \\
\sigma_\epsilon, \sigma_s &\sim \text{pc-prior}(2, 0.5)\,.
\end{aligned}
$$

where *i* represents the SGU, *p* represents the covariate, y_i is the realization of the variable of interest, in our case the gentrification score, V_i represents a matrix with the values of the independent variables (including both covariates and the types of new greenspaces) and s_i is the spatial effect.

As the posterior distributions of the parameters and hyperparameters do not have an analytical expression, all the resulting models were fitted using the Integrated Nested Laplace Approximation methodology, which is a computationally fast software implementation that provides accurate approximations to posterior distributions (Rue, Martino, and Chopin 2009).

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Table S5 – Models exploring the association of different types of greenspace (inaugurated or acquired pre2000s or pre2010s) with mid-term gentrification (2000s or 2010s) by city. The values in the cells are the posterior distribution parameter (postprob-value). If postprob-value is greater than 0.5 it shows a positive effect of the variable in the explanation of the gentrification index, and a negative one if it is smaller than 0.5. Moreover, if it is around 0 or around 1 it indicates that the variable is relevant, with a negative (postprob-value in italics) or positive (postprob-value in bold) effect in the explanation of the gentrification index, respectively. However, if postprob-value takes a value close to 0.5, it indicates that the variable has a not-relevant effect in the explanation of the gentrification index (postprob-value in grey).

	Greenspaces~pre2000s vs gentrification in the 2000s						**Greenspaces~pre2010s vs gentrification in the 2010s**					
	Parks	**Gardens**	**Nature preserves**	**Recreational spaces**	**Greenways**		**Parks**	**Gardens**	**Nature preserves**	**Recreational spaces**	**Greenways**	
Atlanta	**0.96**	-	*0.02*	**>0.99**	-	§	**0.99**	-	*0.32*	-	**0.68**	§
Austin	*<0.01*	0.51	*<0.01*	*<0.01*	*0.01*	£	**>0.99**	**0.68**	**0.69**	*0.21*	0.44	⊢
Baltimore	*0.05*	0.44	*0.38*	-	*0.17*	¥	-	*0.04*	0.45	-	*0.06*	⋎
Boston	**0.61**	**0.94**	**0.98**	**0.80**	0.48	¥	*0.03*	0.56	*0.18*	-	**0.91**	§
Cleveland	**0.68**	**0.90**	-	-	*0.31*	€	**0.87**	0.55	-	0.51	-	
Denver	**>0.99**	0.46	*0.36*	0.48	**0.84**	◀	**0.66**	*0.01*	**0.70**	-	**0.85**	■
Detroit	-	-	-	-	-		0.54	**0.97**	-	-	**0.99**	ϖ
Louisville	**0.89**	0.56	-	-	**0.90**		**0.77**	0.55	**0.61**	-	-	
Milwaukee	**0.96**	**0.87**	**0.75**	*0.27*	-	¥	-	**>0.99**	-	-	*0.19*	
Philadelphia	0.52	**0.88**	-	-	-	▲	*0.29*	*0.20*	0.40	*0.29*	-	▲
Portland	**0.95**	**>0.99**	*<0.01*	0.49	*<0.01*	§	*0.02*	*0.39*	*0.32*	**0.76**	*0.17*	♣
SF	**0.74**	**>0.99**	-	-	*0.03*	◊	0.44	0.59	-	-	-	
Seattle	**1.00**	**0.78**	0.43	**0.61**	**>0.99**	♣	**0.75**	**0.66**	0.53	0.52	0.58	§
Washington DC	*0.38*	0.53	-	**0.65**	-	◘	**0.63**	**0.92**	-	*0.38*	-	≈
Calgary	*0.03*	-	0.59		-		0.46	-	**0.68**	-	-	
Montreal	*0.08*	**0.62**	**0.92**	0.50	0.57		-	*0.38*	*0.33*	-	-	
Vancouver	**0.92**	0.57	-	-	-	§	*0.11*	*0.65*	-	-	0.52	
Amsterdam	*0.32*	*0.05*	*0.11*	-	-		*0.31*	*0.36*	*0.13*	*0.22*	0.45	

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Barcelona	*<0.01*	*<0.01*	-	*0.33*	**>0.99**	♠	**>0.99**	*<0.01*	-	-	*<0.01*	◘
Bristol	**0.67**	0.50	*0.20*	-	-	♣	-	-	-	-	-	
Copenhagen	-	-	-	-	-		**0.97**	**>0.99**	**>0.99**	*0.06*	-	§
Dublin	0.56	0.50	-	-	-		**0.67**	*0.28*	**0.63**	-	-	
Edinburgh	*0.22*	**0.99**	-	**>0.99**	-		-	-	-	-	-	
Lyon	*0.01*	**0.87**	-	-	-		-	-	-	-	-	
Nantes	**0.99**	**0.97**	**0.99**	-	-	¥	**0.73**	**0.72**	-	-	-	
Sheffield	*0.15*	*0.35*	-	-	-	◪	-	-	-	-	-	
Valencia	*0.10*	-	-	-	-	♣	-	-	-	-	-	
Vienna (central)	**0.99**	-	-	-	**0.65**	◙	-	-	-	-	-	

Notes: - indicates that insufficient or no data was available for that variable § indicates model is also adjusted by distance to the city center (postprob-value <0.01); £ indicates adjusted by green coverage prior to 1990 (postprob-value>0.99) and population density in 2010 (postprob-value<0.01); ¥ indicates adjusted by distance to the city centre (postprob-value<0.01) and population density in 2010 (postprob-value<0.01); € indicates adjusted by number of new public transit stops (postprob-value>0.99), number of new residential buildings (postprob-value>0.99) and population density in 2010 (postprob-value<0.01); ◄ indicates adjusted by number of new public transit stops (postprob-value>0.99), distance to the city center (postprob-value<0.01) and population density in 2010 (postprob-value<0.01); ▲ indicates adjusted by number of new residential buildings (postprob-value>0.99) and distance to the city centre (postprob-value<0.01); ◊ indicates adjusted by number of new public transit stops (postprob-value>0.99), number of new residential buildings (postprob-value =0.98), green coverage prior to 1990 (postprob-value<0.01), distance to the city center (postprob-value<0.01) and population density in 2010 (postprob-value<0.01); ♣ indicates adjusted by number of new residential buildings (postprob-value >0.99); ◙ indicates adjusted by number of new residential buildings (postprob_value=1.00) ◘ indicates adjusted by number of new public transit stops (postprob-value>0.99), green coverage prior to 1990 (postprob-value<0.01) and distance to the city center (postprob-value <0.01); ♠ indicates adjusted by number of new public transit stops (postprob-value<0.01); ¥ indicates adjusted by distance to the city center (postprob-value >0.99); ◪ indicates adjusted by number of new public transit stops (postprob-value>0.99) and number of new residential buildings (postprob-value>0.99); ⊢ indicates adjusted by distance to the city center (postprob-value<0.01) and number of new residential buildings (postprob-value>0.99); ⩛ indicates adjusted by number of new residential buildings (postprob-value=0.99), green coverage prior to 1990 (postprob-value>0.99), distance to the city center (postprob-value<0.01) and population density in 2010 (postprob-value=0.05); ■ indicates adjusted by distance to the city center (postprob-value<0.01), number of new public transit stops (postprob-value=0.94), population density in 2010 (postprob-value>0.99), number of new residential buildings (postprob-value=0.58), and green coverage prior to 1990 (postprob-value>0.99); ⊕ indicates adjusted by distance to the city center (postprob-value<0.01), number of new residential buildings (postprob-value<0.01) and population density in 2010 (postprob-value=0.01); ≃ indicated adjusted by green coverage prior to 1990 (postprob-value=0.02), distance to the city center (postprob-value=0.01) and population density in 2010 (postprob-value=0.04); ◘ indicates adjusted by number of new public transit stops (postprob-value<0.01), number of new residential buildings (postprob-value>0.99), distance to the city center (postprob-value<0.01) and population density in 2010 (postprob-value<0.01).

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

Table S6 – Models exploring the association of different types of greenspace (inaugurated or acquired pre2000s) with long-term gentrification (throughout the 2000s and the 2010s) by city. The values in the cells are the posterior distribution parameter (postprob-value). If postprob-value is greater than 0.5 it shows a positive effect of the variable in the explanation of the gentrification index, and a negative one if it is smaller than 0.5. Moreover, if it is around 0 or around 1 it indicates that the variable is relevant, with a negative (postprob-value in italics) or positive (postprob-value in bold) effect in the explanation of the gentrification index, respectively. However, if postprob-value takes a value close to 0.5, it indicates that the variable has a not-relevant effect in the explanation of the gentrification index (postprob-value in grey).

	Parks	Gardens	Nature preserves	Recreational spaces	Greenways	
Atlanta	**0.93**	-	*0.05*	**>0.99**	-	§
Austin	*<0.01*	**0.63**	*<0.01*	*<0.01*	*<0.01*	£
Baltimore	*0.03*	**0.83**	*0.20*	-	*0.03*	¥
Boston	**0.97**	0.56	**0.70**	**0.92**	0.53	€
Cleveland	*0.14*	0.56	-	-	*0.03*	◀
Denver	**>0.99**	0.53	*0.03*	**0.78**	**0.61**	▲
Detroit	-	-	-	-	-	
Louisville	**0.98**	0.53	-	-	**0.79**	
Milwaukee	**0.98**	**0.97**	*0.20*	*0.04*	-	◊
Philadelphia	0.48	**0.98**	-	-	-	♣
Portland	**0.93**	**>0.99**	*<0.01*	0.49	**0.99**	§
SF	**0.80**	**>0.99**	-	-	**0.66**	§
Seattle	**1.00**	0.46	*0.16*	*0.36*	**0.94**	◘
Washington DC	0.41	0.56	-	**0.75**	-	♠
Calgary	*0.07*	-	**0.65**	-	-	
Montreal	*0.07*	**0.92**	*0.21*	0.50	0.53	ϖ
Vancouver	**>0.99**	**0.86**	-	-	-	∴
Amsterdam	0.40	*0.14*	*0.16*	-	-	
Barcelona	**>0.99**	*<0.01*	-	**>0.99**	**>0.99**	♣
Bristol	-	-	-	-	-	
Copenhagen	-	-	-	-	-	
Dublin	**0.65**	0.52	-	-	-	
Edinburgh	-	-	-	-	-	
Lyon	-	-	-	-	-	
Nantes	0.58	**0.65**	**0.79**	-	-	■
Sheffield	-	-	-	-	-	
Valencia	-	-	-	-	-	
Vienna (central)	-	-	-	-	-	

Notes: - indicates that insufficient or no data was available for that variable § indicates model is also adjusted by distance to the city center (postprob-value<0.01); £ indicates adjusted by green coverage prior to 1990 (postprob-value>0.99), distance to the city center (postprob-value<0.01) and population density in 2010 (postprob-value<0.01); ¥ indicated adjusted by number of new residential buildings (postprob-value>0.99), green coverage prior to 1990 (postprob-value>0.99), distance to the city center (postprob-value<0.01), population density in 2010 (postprob-value<0.01) and number of new public transit stops (postprob-value=0.01); € indicated adjusted by distance to the city center (postprob-value<0.01), population density in 2010 (postprob-value<0.01), number of new residential buildings (postprob-value>0.99); ◀ indicates adjusted by number of new public transit stops (postprob-value>0.99), number of new residential buildings (postprob-value>0.99), population density in 2010 (postprob-value<0.01) and distance to the city center (postprob-value<0.01); ▲ indicates adjusted by

* The value of p corresponds to the probability that the parameter is greater than 0 and so, large values imply relevant positive effects while small values imply relevant negative effects.

number of new public transit stops (postprob-value=0.98) and distance to the city center (postprob-value<0.01); ◊ indicates adjusted by distance to the city center (postprob-value<0.01) and number of people per square kilometer since 2010 (postprob-value<0.01); ♣ indicates adjusted by number of new residential buildings (postprob-value>0.99) and distance to the city center (postprob-value<0.01); ◘ indicates adjusted by number of new residential buildings (postprob-value>0.99), distance to the city center (postprob-value<0.01) and population density in 2010 (postprob-value>0.99); ♠ indicates number of new public transit stops (p>0.99), green coverage prior to 1990 (postprob-value<0.01) and distance to the city center (p<0.01); ⍵ indicates adjusted by change in population (postprob-value<0.01); ≃ indicates adjusted by population change (postprob-value>0.99) and population density in 2010 (postprob-value<0.01); ■ indicates adjusted by distance to the city center (postprob-value=0.95).

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