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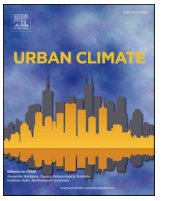

From greening the climate-adaptive city to green climate gentrification? Civic perceptions of short-lived benefits and exclusionary protection in Boston, Philadelphia, Amsterdam and Barcelona

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ABSTRACT

Municipal governments are increasingly promoting green climate-adaptive infrastructure projects to address climate threats and impacts while maximizing multiple socio-environmental benefits. Although these strategies are repeatedly advanced as "win-win" solutions for all, recent literature has drawn attention to numerous negative effects, especially the displacement and exclusion of vulnerable social groups, pointing at yet another layer of climate injustice. In this article, we focus our analysis on the experienced and/or perceived negative social effects of greening interventions for climate adaptation on historically marginalized groups through a cross-case qualitative comparison of four neighborhoods in North American and European cities (Boston, Philadelphia, Amsterdam and Barcelona). Interviews conducted among a diverse sample of civic groups related to each neighborhood reveal that most respondents highly value green resilient infrastructures for their socio-environmental benefits. However, unless these green interventions are implemented alongside policies that guarantee equitable outcomes for all, then civic respondents mostly identify negative social impacts on marginalized residents, making those benefits short-lived. Most prominent negative impacts include physical displacement and the related threat of more displacement together with risks that new (green) real estate developments and resilient greening will remain exclusionary for marginalized groups. Such similar findings across different socio-political contexts point to the need for bolder policies that guarantee that investments in green climate adaptation interventions secure both environmental and social benefits in underinvested and environmentally neglected neighborhoods and mitigate the negative impacts of such interventions, namely socio-cultural and physical displacement and overall exclusionary climate protection.

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1. Introduction

Municipal authorities play a central role in urban climate change mitigation and adaptation governance, considering that urban landscapes are already feeling most acutely the impacts of climate change – ranging from heat waves, to droughts, flooding, or vector-borne diseases (Bulkeley and Tuts, 2013; Nordgren et al., 2016). The more recent focus on climate adaptation has allowed municipal governments to save money and lives by "anticipating the adverse effects of climate change and taking appropriate action to prevent or minimize the damage they can cause" (Mees and Driessen, 2011; European Commission, 2020). Yet as cities respond to climate change by rolling out adaptation interventions, recent research calls for greater attention to their social implications and impacts, especially so with regards to long-term equity issues and impacts and, most recently, climate gentrification (Meerow and Newell, 2019; Anguelovski et al., 2016; Shi et al., 2016; Shokry et al., 2021). Deploying adaptation interventions does not only have equity implications at the planning and immediate implementation stage, but also over the long term when evaluating unequal mid- and long-term benefits of adaptation for socially vulnerable groups (Gould and Lewis, 2018; Anguelovski et al., 2019a, 2019b; Shokry et al., 2020). As urban climate adaptation injustice can indeed be "a dual process of favoring certain privileged groups while simultaneously denying resources and voice to marginalized communities," novel research is needed that considers "historic legacies of social and racial injustice to avoid turning adaptation into a private and privileged environmental good with exclusionary and maladaptive externalities" (Anguelovski et al., 2016, p. 11–13).

Urban greening, an increasingly deployed climate adaptation strategy, is the use of green infrastructure (GI) as "an interconnected network of green space that conserves natural ecosystem values and functions and provides associated benefits to human populations" (Benedict and McMahon, 2002, p. 12) to address risks and impacts of climate change. Among others, GI includes the construction of urban green amenities such as so-called "resilient" parks, rain gardens, bioswales, berms, green roofs, restored shorelines, or greenways. The use of GI is attractive to city officials as it offers different features of urban resilience both in the short and long-term (Gaffin et al., 2012). From an environmental perspective, GI projects regulate water flow paths and flow quantities, thereby reducing vulnerability to flooding and storms (Meerow, 2020). GI also helps moderate urban temperature and thus counteract the urban heat island effect while simultaneously lowering greenhouse gas emissions as well as the energy demand for cooling buildings (Mees and Driessen, 2011). At the community and social scale, GI can also serve as a local source of food for urban residents, thereby also contributing to food security (Meerow and Newell, 2019). From an economic perspective, greening interventions can lead to green job creation, greater investment in local areas, and increased property values while remaining more pragmatic and less costly than improvements to grey infrastructure (Shokry et al., 2020). Finally, from a public health perspective, this strategy can reduce noise and air pollution, promote physical activity, foster social cohesion and reduce stress among users and nearby residents (Cole et al., 2020). Urban green climate adaptation interventions are thus often presented as "no-regrets" strategies with multiple ecological, economic, and social co-benefits (Mees and Driessen, 2011).

However, with the growing popularity of GI (re)development and implementation, there is growing evidence of greening initiatives accelerating gentrification and displacement by directly or indirectly revalorizing neighborhoods that were previously marginalized (Kim and Wu, 2021; Anguelovski et al., 2018; Haase et al., 2017; Shokry et al., 2020), what some are calling green climate gentrification (Anguelovski et al., 2019a, 2019b). We define gentrification as "a process in which the influx of capital transforms a neighborhood socially, economically, culturally, physically, and demographically", which can then expel low-income and socially marginalized residents from these neighborhoods (Cole et al., 2020, p. 2). By extension, green gentrification is defined as "new or intensified urban socio-spatial inequities produced by urban greening agendas and interventions, such as greenways, parks, community gardens, ecological corridors or green infrastructure" (Anguelovski et al., 2019a, 2019b, p. 2). As a result of recent green redevelopment in formerly industrialized and under-invested neighborhoods, that is those with often a high proportion of working-class and racialized residents, green gentrification also seems to contribute to socio-cultural exclusion and displacement through increased housing costs and new uses and norms practiced in the new green spaces (Cole et al., 2020; Gould and Lewis, 2018).

Within the literature on green gentrification, recent literature on climate and resilience gentrification highlights how climate adaptation interventions are meant to enhance overall resilience capacity but do not always address climate insecurities, or at least, not for all (Shokry et al., 2021). This failure of adaptation is particularly acute since working class communities and people of colour are among the social groups that suffer disproportionately from the effects of climate hazards, thus adding a new form of urban environmental/climate injustice (Anguelovski et al., 2019a, 2019b). In Philadelphia, for example, green resilience interventions have been shown to be spatially concentrated in wealthier and gentrified central Philadelphia and increasingly in neighborhoods adjacent to them that are exhibiting signs of more intensive real estate development, economic reinvestment, and growth-driven interventions. As a result, neighborhoods that fall out of this scope experience under-investment in climate resilient infrastructure, and thus suffer a continuing greater exposure to climate risks (Shokry et al., 2021).

In sum, while GI is often presented as a panacea for climate-responsive cities to promote sustainability and resilience, planners often minimize the negative individual and collective social impacts of these greening interventions on residents or other stakeholders affected (Meerow and Newell, 2019). Fig. 1 summarizes the broad and diverse negative social effects of green gentrification that researchers have previously identified. *Experienced* negative effects include multi-displacement, that is physical and sociocultural displacement, the former which tends to take place because of an increase in real estate values and housing prices, and the latter which occurs when residents feel socially or culturally excluded from their own neighborhood. Research also shows that some green resilience infrastructure can exacerbate socioenvironmental risks, as shown by the 2018 Resilient Boston plan, which aimed to deploy green infrastructure projects, yet has contributed to increased flood risk of older housing stocks located nearby (Anguelovski et al.,

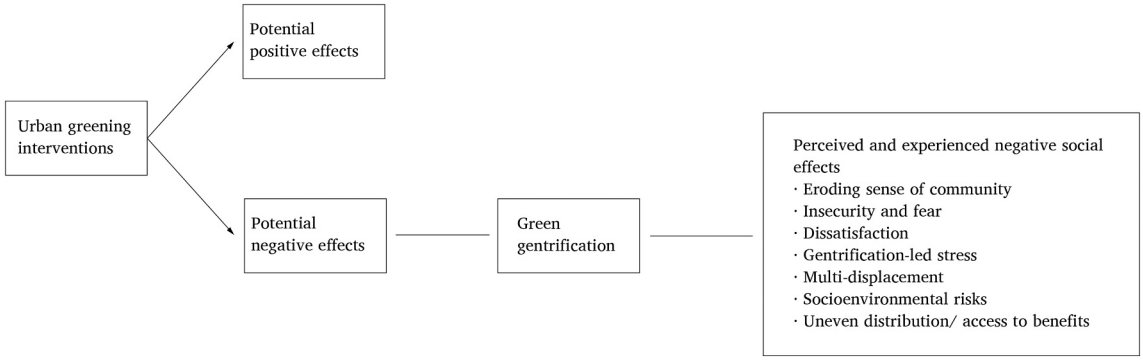


Fig. 1. Hypothesized relationship between urban greening interventions and associated negative social effects (Source: Planas-Carbonell, 2021).

2019a, 2019b). Finally, the benefits of greening tend to be not equally distributed, as shown by the differences in the size of green spaces, the structure of its vegetation, and its quality (Haase et al., 2017). As per *perceived* negative effects, a study by Oscilowicz et al. (2020) evidenced how gentrification in greened neighborhoods can erode place attachment and sense of community, and among the drivers of this community erosion the study found perceptions of insecurity driven by fear and crime and tourism-related delinquency, leading residents to feeling unwelcome in their own green spaces and neighborhood, and increased self-rated levels of stress.

In attempting to move beyond assessing quantitative and spatial trends of climate injustice and climate gentrification (Shokry et al., 2020; Keenan et al., 2018; Aune et al., 2020), researchers have called for qualitative analytical and empirical lenses able to assess perceptions of such risks and lived experiences of injustice for historically marginalized residents themselves due to new green, adaptive infrastructure, and how those are produced. This article seeks to shed light primarily on the potential negative effects rather than on the positive effects of green climate-adaptive infrastructure so as to nuance the dominant claims about green infrastructure being a "win-win" solution for climate mitigation and adaptation. The intention is not to ignore the positive effects, but to dissect more deeply and specifically the range of possible negative effects. We do so by analyzing the lived experience of four neighborhoods in North American and European cities (Boston, Philadelphia, Amsterdam, and Barcelona) where much green infrastructure has been recently (re)developed. We ask: "*To what extent and how do urban green interventions for climate adaptation produce negative perceived and/or experienced social effects for historically marginalized civic groups?*"

2. Materials and methods

2.1. Research design and case selection

For this study, we selected four neighborhoods in cities at the forefront of green adaptation planning - East Boston in Boston, Hunting Park in Philadelphia, Amsterdam Noord in Amsterdam, and Poblenou in Barcelona - with the aim of comparing perceptions and experiences of green climate adaptation projects across different urban planning and policy contexts and assessing the social dynamics and processes that can contextualize or explain them. These four cities and neighborhoods were selected from a larger parent EU-funded research project (GreenLULUs), which investigated green gentrification processes across several mid-sized cities in the United States (US), Canada and Western Europe. As part of this larger research project, we conducted qualitative field research in 24 neighborhoods from 24 cities across these different geographical contexts, including the cities selected for this study. A summary of the key characteristics of the four cities, of the embedded neighborhoods/districts, and of urban greening, climate-adaptive interventions can be found in Table 1. Among the 24 cities, the four selected corresponded to those where most green adaptation planning was discussed by residents and civic groups around them and where a series of identified plans and reports identified a variety of emblematic green adaptive projects, of varying size and implementation stage. The high diversity and visibility of existing projects helped identify a variety of impacts that respondents can perceive and positively or negatively associate perceptions with. These were precisely the types of tensions and tradeoffs we meant to examine and dissect more in depth. Additionally, we aimed at comparing North American and European cities as American cities are often considered rapidly gentrifying due to large scale, fast-implemented real estate (re)development projects with few housing and other social protections in place for socially vulnerable groups at both the municipal and broader federal levels, while European cities –at least historically– tend to have greater supportive policies or have a greater social welfare system in place (Fainstein, 2008; Oscilowicz et al., 2021; Anguelovski and Connolly, 2021). Within those cities, we selected neighborhoods with emblematic, already visibly deployed climate-responsive greening projects, which we identified both via grey sources of data collection (municipal reports and plans, non-profit websites and reports, and media articles) and expert interviews.

Table 1
Summary of urban development history, environmental and climate hazards, recent or planned urban greening interventions, gentrification pressures from private new (luxury) developments and support system/policies in the four neighborhoods/cities of study (Source: Authors).

Neighborhood/ City	Demographics and urban development history	Environmental/ Climate hazards (20th century-present)	Recent/ planned urban greening interventions	Gentrification pressures (city-wide and neighborhood-focused)	Anti-displacement and anti-gentrification initiatives
East Boston, Boston *695,925 inhabitants (2018 figures published by*BPDA, 2020*)*	In 2015, the majority (58%) of the population in East Boston were of Hispanic origin, as opposed to only 19% in Boston as a whole (BPDA, 2017). In the 20th century, EB saw the construction of a shipping port, the first subway connection to Downtown Boston (1905), Logan International Airport (1923), Sumner Tunnel (1934), and several highways.	Logan Airport (1923) and its expansion (1960's): · Air/noise pollution · Loss of green spaces Waterfront: · River pollution · Gas tanks by river · Salt piles · Soil pollution · Sea level rise risk · Flooding risk Threat of proposed electrical substation by Eversource with risk of explosion in flood-prone area (McDonald, 2020).	City/private-led: · Award-winning Piers Park (1995) · East Boston Greenway (2007) · Bayswater Street Embankment · LoPresti Park (2016) Civic-led: · Eastie Farm (2016) · Bremen Street Community Garden and other gardens.	Real estate projects that have contributed to the displacement of working-class residents. (Jennings, 2016) They include the luxury housing developments of The Eddy (2016), Boston East (2018), Clippership Wharf (2019), The Mark (2020).	EB residents' are fighting for equitable land redevelopment without displacement. That includes cooperative housing, community land trust proposals, and new affordable housing construction. Other groups (e.g. Greenroots) are also organizing "Green Walks" to improve community ownership of the newly greened waterfront.
Hunting Park, Philadelphia *1,584,138 inhabitants (*City of Philadelphia, 2019*)*	In HP, 30,000 residents, mostly identifying as Latinx and/or African American.[a]Former industrial hub, that experienced economic and population decline in the 20th century, as industries left or closed. Gentrification and greening are focused in central and western parts of city, while HP.	Largely residential neighborhood, next to dense transit routes, and commercial and industrial area e.g., waste recycling facility, and SEPTA bus repair facility. · Air pollution · Noise pollution · Exposure to toxic chemicals · Greenspace deprivation · Higher prevalence of respiratory diseases e. g., asthma · One of the highest heat exposures in city (Hopkins, 2012).	Since 2009, the revitalization of an 87-acre park `Hunting Park, including 385 new trees and recreational spaces.[b] Tree planting is a key greening intervention (especially for climate resilience) led by neighborhood groups, in concert with public agencies, non-profit organizations and private funders. Seven raingardens are planned (2019) as part of a new green stormwater infrastructure (GSI) project. (Maiorano, 2020).	Inequitable commercial and real estate investment (e.g., Opportunity zoning) in adjacent areas may exacerbate falling homeownership rates and cost-burdened renters in HP (Shokry et al., 2021). Gentrification in central parts of Philadelphia may be driving residents of color to areas with lower or no green resilience infrastructure (GRI), such as HP (Shokry et al., 2020).	A focus on key social and health services, reducing crime,and preserving affordability Longtime residents may benefit from a property tax freeze offered by the city. (Ding et al., 2016)
Amsterdam Noord, Amsterdam 882, 633 *inhabitants (*Statista, 2022*)*	District made up of 12 neighborhoods, which together are home to 99,238 residents. Separated from city by river Ij and without access to a metro line until 2018. By 1980s, industrial decline and abandonment. Recent transformation into waterfront creative hotspot and adjacent greenspaces.	With opening of North Sea Canal (1876), area transformed into site of heavy industry and port-related activities. · Air pollution · Noise pollution · Toxic brownfields Waterfront: · Flooding risk.	Merging of Florapark and Volewijkspark into Noorderpark (2014). City plans to transform Noordholland Canal area into landscape park. Additional greening projects in neighborhoods of Elzenhagen Zuid, Banne Noord, Molenwijk. Experimental climate-focused project: De Ceuvel.	Creative hubs e.g., De Ceuvel, Stichting Kinetisch Noord. Cultural amenities: Eye Filmmuseum High-end buildings: A'DAM tower, Faranda crane hotel, and other luxury housing developments.	Housing Vision Amsterdam from 2009 states that city strives for "mixed neighborhoods of poor, rich, young and old" and that "social segregation and spatial division should be avoided". Amsterdam's liberalization of housing market has been moderate. Low-income residents have been supported by rent controls and subsidies (Veldboer and Bergstra, 2011), yet both rental and private housing have risen

(*continued on next page*)

Table 1 (*continued*)

Neighborhood/ City	Demographics and urban development history	Environmental/ Climate hazards (20th century-present)	Recent/ planned urban greening interventions	Gentrification pressures (city-wide and neighborhood-focused)	Anti-displacement and anti-gentrification initiatives
					sharply in recent years and the share of rental housing without rent control is increasing.
Poblenou, Barcelona 1.636.732 *inhabitants* (Statistical Institute of Catalonia, *2022*)	The Poblenou neighborhood in the Sant Martí district is home to 33,521 residents (Shojaee Far, 2019). Historically a predominately industrial zone until the mid-1990s, when many industries closed down, and the neighborhood became dominated by brownfield sites,abandoned warehouses and docks (Shojaee Far, 2019). Transformations started with the preparations for the 1992 Olympic Games. More recent urban transformations included the Universal Forum of Cultures (2004), the 22@ Plan launched in 2000, and the housing and greening boom since the early 2010s.	Dense city and on the Mediterranean coast: · Air and noise pollution · Urban heat island effect · Flooding risk Erosion and shrinking beaches.	In preparation for Olympic Games 1992: waterfront re-development of La Vila Olímpica, new parks e. g., Parc del Poblenou Other more recent city-led greening projects: Parc del Centre del Poblenou (2008), Pere IV Street transformation incl. 77 new trees (2014–2019), Poblenou Superblock (2016), green corridor of Cristóbal de Moura (ongoing). Community-driven greening interventions: Hort Indignat de Poblenou (2011), ConnectHort, La Vanguàrdia community garden (2016) recently bulldozed to serve as front lawn of Voraport hotel.	Major urban renewal plan of 22@ aims to transform Poblenou into innovation, tech-based district, filled with office buildings for companies related to ICT, design and scientific research, and hotels to meet needs of high-income workers and tourists. Fear that it will exacerbate effects from tourism sector already felt across the city (Colomer and Gaston, 2021). Next to ongoing green corridor of Cristóbal de Moura, construction of a large student hotel and other adjacent large-scale hotels.	Tourism gentrification in Barcelona has been prominent and rising in the last decades. The increase in tourism dwellings since 2011 resulted from a relaxation of rules to use private housing in order to boost tourism, although the municipality stopped granting licenses in 2014 and is heavily regulating short-term rentals. Still, such policies have threatened the livability and security of many neighborhoods in the city, which have led to much community resistance (Anguelovski et al., 2018; Lambea Llop, 2017).

[a] https://www.phila.gov/media/20190719092954/HP_R8print-1.pdf (Retrieved on August 27, 2021).
[b] https://myphillypark.org/what-we-do/capital-projects/hunting-park/ (Retrieved on August 29, 2021)

2.2. Data collection and analysis

Primary data for the broader parent project was collected for each city and neighborhood by one or more co-authors through semi-structured interviews in 2018, 2019, and early 2021. Interviewes were conducted with civic groups (residents, nonprofits, community organizations, and neighborhood leaders), municipal employees and representatives, architects, and private real estate developers. Only those with civic groups were used and analyzed for the purpose of this research, which was to focus primarily on their views and experiences.

Among other themes, interviews revolved significantly around the social impacts of green infrastructure on historically marginalized groups, that is working-class, racialized minorities, and immigrant residents. Questions asked at the beginning of the interviews were rather general and open, an example being 'what is your perception of the green spaces in your neighborhood?', while latter questions often targeted more specifically the negative effects, such as: 'To what extent do you think XXX new green spaces in XXX made the neighborhood a more attractive place and contributed to gentrification?'

Respondents were identified through pre-fieldwork desk research and snowball sampling techniques. In our snowball sampling techniques, we identified respondents by aiming at achieving a diversity of views: We included people from different sectors, backgrounds and perspectives, specifically asking for people with strong knowledge or experience of neighborhood changes rather than people with similar views. Not all interviewees were specifically from the neighborhood under study as we were also interested in interviewing respondents. with good knowledge of the broader politics of socio-ecological resilience as having this broader perspective helped situate and contextualize perceptions.

The interviews were recorded and fully transcribed. Interviews ranged from 30 to 90 min and included questions on the history of urban developments in the neighborhood, the historical and current exposure to environmental and climate hazards, the equity considerations in decision-making on urban climate-adaptation plans, and their socio-environmental and health effects for residents. For this paper, our final dataset of civic respondents was made up of 62 transcribed interviews (see Table 2) out of a full original dataset

Table 2
Interviewees by type and neighborhood ($N = 62$) (Source: Authors).

	Civic groups (residents, nonprofits, community organizations, and neighborhood leaders)
East Boston, Boston	23
Hunting Park, Philadelphia	15
Amsterdam Noord, Amsterdam	11
Poblenou, Barcelona	13
Total	**62**

of close to 500 transcribed interviews in our 24 original cities.

In addition to the semi-structured interviews, we gathered relevant secondary data and documents (urban plans and projects; non-profit and expert reports about each neighborhood development context; recent decisions on green projects, and media articles on each neighborhood). This data was mostly used to understand the broader context of the projects we examined as well as the urban development changes experienced in each neighborhood. By using several data methods, this research relied on methodological triangulation, which is often used to facilitate data saturation, that is when "additional data do not lead to any new emergent themes", and to enhance the internal validity of the study (Saunders et al., 2018, p. 1895; Fusch et al., 2018).

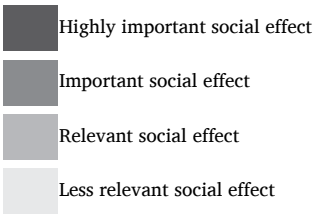
Using Nvivo 12, we analyzed our results through a deductive and inductive approach. To guide the initial analysis of our semi-structured interviews and drawing on literature on environmental and climate justice in adaptation practice, we created a *preliminary* analytical framework (Table 3) with relevant negative social effects of greening interventions, their indicators, and main sources. These were grouped into broader themes and based on the earlier Fig. 1.

Table 3
Preliminary analytical framework about experienced and perceived negative social effects of urban greening (Source: Planas-Carbonell, 2021, p. 21).

Categories	Indicators	Main sources
Eroding sense of community	- Breakdown of relationships with neighbors - Weakened place attachment - Feeling of non-belonging - Sense of poor community safety - Loss of informal support systems - Loss of trust	Oscilowicz et al. (2020); Hyra et al. (2019); Gibbons et al. (2020)
Insecurity and fear in the neighborhood	- Fear of crime and delinquency - Insecurity from potential house displacement	Oscilowicz et al. (2020); Anguelovski et al. (2021a, 2021b)
Feeling unwelcome in one's own neighborhood	- Less frequent use of public (green) spaces - Increased likelihood to stay home - Disproportionate use by specific group - Feeling displaced from new green spaces	Oscilowicz et al. (2020)
Dissatisfaction	- Poor quality of public (green) space	Oscilowicz et al. (2020)
Loss of freedom	- Feeling excluded from public (green) space in which user used to belong	Oscilowicz et al. (2020)
Gentrification-led stress	- Above average self-rated stress, namely associated with loss of community ties and housing insecurity pressures	Gibbons (2019); Versey et al. (2019)
Physical displacement	- Housing insecurity via increased rents, insufficient affordable rentals, and reduced housing stock - Residential displacement	Oscilowicz et al. (2020); Marcuse (1985); Shokry et al. (2022)
Resettlement in climate unprotected zones	- Less protection in urban poor areas	Shokry et al. (2020); Anguelovski et al. (2019a, 2019b); Shokry et al. (2022)
Sociocultural displacement	- Social and cultural exclusion from benefits of new green infrastructure - Less frequent use of new green infrastructure	Shokry et al. (2020); Anguelovski et al. (2019a, 2019b); Oscilowicz et al. (2020);
Socioenvironmental risks	- Increased environmental risks such as flooding for vulnerable groups	Anguelovski et al. (2019a, 2019b)
Uneven distribution or access to benefits	- Green spaces for low-income minority groups being smaller, fewer, less well-maintained and unsafe	Haase et al. (2017); Oscilowicz et al. (2020);
Exposure to (new) stressors in new neighborhoods	- Increased livelihood insecurities	Shokry et al. (2020)

Table 4
Magnitude of social effects discussed in each neighborhood (Source: Authors).

Social effects/neighborhood	East Boston, Boston	Hunting Park, Philadelphia	Amsterdam Noord, Amsterdam	Poblenou, Barcelona
Perceived socio-environmental value and benefits of greening projects				
Physical displacement and neighborhood unaffordability				
Perceived threat of continued, future displacement				
Exclusive new developments and resilient greening for others				
Dissatisfaction with new developments				
Explicit fear of green gentrification				
Enduring unequal distribution/access to green spaces and their benefits				
Disruption of social cohesion around green spaces				



As a starting point for the case comparison, we created a scale that would allow us to rate the importance of each social effect based on the number of references to each social effect in the interviews analyzed: the darkest shade represents those social effects that are ranked as 'highly important' with between 25 and 60 references, the second darkest shade represents those ranked as 'important' with 16–24 references, the lighter shade those that were simply 'relevant' with 6–15 references, and finally, the lightest shade represents those that were 'less relevant' with less than 6 references. This enabled us to better grasp the magnitude of each social effect across the neighborhoods and additionally served to structure the results section through a comparison of references within and across cases. We use shades in Table 4 in order to present the magnitude of each effect. We were eventually able to identify key similarities across cases based on high importance of some social effects, as well as key differences given the discrepant rate of importance of some social effects across neighborhoods. In our *Results* section, we further discuss those social effects that exemplify key similarities and key differences.

3. Results

Our analysis indicates that civic groups (residents, nonprofits, community organizations, and neighborhood leaders) in all four neighborhoods acknowledge the positive value of urban greening projects for climate adaptation, yet also share negative perceptions linked to their underuse and the broader displacement dynamics they see as possibly accelerating or worsening. Most respondents in East Boston, Amsterdam Noord, Poblenou report physical and social displacement trends and perceive the future risks thereof, although they do not make the direct connection or leap to calling it green or climate gentrification apart from Hunting Park (Philadelphia) respondents. Across all cities, we found numerous and elaborate upon mentions of negative social effects. In short, as demonstrated in our analysis, civic groups tend to connect urban greening, despite its benefits, to new or increasing climate and other socio-environmental injustices. These effects are discussed in detail below. After starting with a brief identification of the positive mentions of greening, we follow by a longer analysis of the several negative impacts that interviewees perceived or experienced, impacts which – together **–** amount to an exclusionary climate protection affecting historically marginalized residents.

3.1. Perceived socio-environmental value and benefits of greening projects

Greening is perceived by most civic respondents in East Boston, Hunting Park, Amsterdam Noord and Poblenou as offering high socio-environmental value for the residents of these traditionally working-class neighborhoods. These reported socio-environmental benefits range from feeling a greater sense of safety and connectivity, to better greenspace maintenance, or a higher aesthetic value, all of which foster greater social cohesion. These benefits were widely discussed in all four cases and have been classified as `highly important´ in Poblenou, as `important´ in Amsterdam Noord and Hunting Park, and as `relevant´ in East Boston (see Table 4). In Poblenou, civic groups feel positive about the implementation of the Superblock project and its green spaces, as well as about the new green corridor in Cristóbal de Moura (see Fig. 2), as they argue that they provide the space for greater interaction between neighbors, foster social mixing, offer a site to play for children, improve their quality of life thanks to reduced air and noise pollution, and guarantee a stronger sense of security. Additionally, they argue that these spaces have brought biodiversity to the formerly industrial area and alluded to the climate and ecological values of the green infrastructure that includes Sustainable Urban Drainage Systems (SUDS), given the improved rainwater management. A resident (2019) from Poblenou described the radical change that took place before and after the Superblock was implemented: “From three years ago to now, it’s one extreme to another. We wouldn’t be sitting here talking to each other, those kids wouldn’t have their birthday party over there. There wasn’t space for it. I think the contrast is’just radical” (resident, 2019). Another neighbor made a similar claim: “I think my kids have a more relaxed life now. There’s no noise from cars, no pollution, it’s a place that feels like an extension of your home […]. We invite our friends to the Superblock”.

In Amsterdam Noord, green spaces are valued for providing recreational spaces, play opportunities for children, and for minimizing car traffic and noisem especially given that the Noord district’s long-lasting industrial contamination, poor interconnectivity, and overall underinvestment undermined residents’ ability to have access to any type of local green infrastructure. Many civic respondents thus consider that the construction of Noorderpark (see Fig. 3), built in the Southern part of Amsterdam Noord between the IJ river and the Waterlandse Zeedijk embankment in the early 2010s, is a big step forward. Noorderpark is also equipped with space-borne remote

Fig. 2. Play spaces in the first stretch of the green corridor in Cristóbal de Moura street. (Source: Authors, 2021)

Fig. 3. Noorderpark in Amsterdam Noord (Source: Authors, 2019).

sensing to facilitate drainage and avoid flooding in times of extreme precipitation. Local neighbors were pleased that they have this large green area to lay down and relax: "it is our only chance to go recreate and hang out in some small part of nature […] we can have a natural feeling" (resident, 2019), and another resident (2019) also mentioned how the park is increasingly used also for doing sports activities, thus valuable for the physical and mental health benefits those can bring.

In Philadelphia's Hunting Park, the green space around the Hunting Park Recreation Center, is also strongly valued for being a place in which to relax, enjoy a healthy environment, and gather as neighbors. Thanks to a 5.5-million-dollar investment that began in 2010, the park has also benefited from renewed summer cooling infrastructure, such as an Olympic-sized pool and eight new rain gardens for improved stormwater management.[1] A resident (2019) from Hunting Park described how parks being a major source of open space and a healthy environment provide a "sense of pride in the community" and referred to the Hunting Park Recreation Center as "shining jewel" and "a destination for picnics and family gathering and a relaxing venue".

Finally, in East Boston, civic groups spoke of the critical importance of green spaces, with a particularly strong emphasis on their role for improving resilience and connectivity, including the East Boston Greenway, which connects the inner part of the neighborhood with the waterfront. They also value Piers Park I and its adjacent green waterfront spaces (including the resilient shoreline) for their new recreational opportunities and the protection they offer against flood pathways along Marginal St. Finally, a community activist mentioned how guerrilla gardening –a community-led greening intervention e.g., Eastie Farm in Sumner Street in East Boston– can be used as a tool to prevent developers from building the luxury condos that are rapidly being constructed across the neighborhood while offering access to nature and food for residents.

In sum, civic groups of all four neighborhoods embrace green infrastructure implemented in the context of climate adaptation for its diverse climate-protective, ecological, and recreational values, recognizing its multi-functional benefits for local landscapes and residents.

3.2. A range of greening-related negative social effects: Exclusionary climate protection unraveled

Yet, civic respondents' much more vocal and elaborated references to negative impacts seem to indicate that green infrastructure benefits are feared to be short-lived and partial, and somewhat replaced by acute climate injustices linked to the unequal and privileged urban redevelopments triggered by or accompanying climate-adaptive green projects. Our analysis builds on the preliminary framework we presented above while sharpening and bringing together categories in ways that best made sense according to our data analysis. These perceived trends exemplify the creation of what we call exclusionary climate protection through (a) multiple displacement linked to GRI planning, (b) privileged green adaptive investments, and (c) sustained environmental dichotomies and inequities.

3.2.1. Multi-displacement linked to green climate-resilient planning

3.2.1.1. Physical displacement and neighborhood unaffordability. We categorized existing physical displacement as `highly important´ in East Boston, Amsterdam Noord and Poblenou, and as `relevant´ in Hunting Park (see Table 4). The main reason for the lower degree of importance in Hunting Park might be that gentrification is currently taking place more in the central and Western parts of Philadelphia while northern neighborhoods of Philadelphia such as Hunting Park are only beginning to witness gentrification, especially with the displacement of vulnerable residents from central areas northward (Shokry, 2021). In the case of East Boston, the imminent or actual residential displacement is already a reality felt by many civic groups in the neighborhood, especially for Hispanic or Latinx groups. As many civic respondents report, working-class and racialized groups had managed to acquire some residential stability in the neighborhood during the 1990s and 2010s, but the current gentrification in East Boston is too fast for them to adapt to constantly increasing rental prices, particularly as over 70% of East Bostonians are renters and most are cost burdened (BPDA, 2017). E xperienced imminent displacement in the neighborhood is well described by a member of a non-profit organization (2019) that works to clean and protect the harbor while engaging the community to enhance coastal resilience in East Boston: "Displacement will affect the whole community […]. Obviously, it will affect people of lower income and people who struggle more. So, the new people who have moved to The Eddy that can afford the $3,000 rent a month won't be affected by the displacement, but what they don't realize is that it's affecting the fabric of the neighborhood that they love, too".

The racialized component of displacement is similarly present in Amsterdam Noord which holds the highest percentage of residents with a non-Western background of the city, namely Surinamese, Antillean, Turkish and Moroccan. These residents are disproportionately impacted by higher living costs and the precarization of their housing situation in the form of temporary, uncertain, or too expensive rental housing contracts. Despite 30% of all housing offered being social housing in the Netherlands as a whole –the highest in the EU– residents of Amsterdam Noord insisted most on the dismantling and problematic selection criteria of the social housing sector and increasing affordability issues (Moeys, 2021). Here, a Noord resident (2019) describes the (racialized) physical displacement in their neighborhood: "I knew people that were living here, and they don't come back […]. There is no dialogue about who can stay, on what terms you can stay and for whom is the area in the end […]. I want my neighborhood to be full of everybody […] but I end up in a white neighborhood". Much of this social change is attributed to several national and municipal-led gentrification strategies in the last decades aimed at spatially deconcentrating lower-income, immigrant neighborhoods and encouraging the influx of

[1] https://myphillypark.org/what-we-do/capital-projects/hunting-park/ (Retrieved on August 29, 2021).

affluent residents in so-called probleemwijken (problem neighborhoods), which include many in Amsterdam Noord (Van Gent et al., 2018; Pérez-del-Pulgar, 2021). As a result, the most vulnerable are left out of social housing eligibility in these areas, and, once the land has been cleaned up and redeveloped, only 20% of the newly built housing units (vs. the regulatory 40%) are reserved for social housing (Perez-del-Pulgar, 2021).

Finally, in Poblenou, physical residential displacement issue is also classified as the main negative social effect residents are facing. Civic respondents mostly point out the higher living costs in the neighborhood, especially higher rents and the shortage of social housing in a city where only 4–5% of all units are state protected. Many interviewees alluded to the negative effects of gentrification on the neighborhood's socio-economic fabric, and how the real estate speculation has highly impacted the affordability of housing in the neighborhood. The former president and member of the neighborhood association of Poblenou (2021) describes the situation as follows: "A big part of the small industries in the neighborhood has disappeared because the 22@ Plan has wiped them out. They have destroyed buildings, pushed them out, given workers the minimal legal compensation, which is next to nothing, and they have got to fend for themselves".

3.2.1.2. Perceived threat of continued, future displacement. The perception of residential displacement as a continued, future threat is most felt in East Boston, which we therefore classified as `highly important´. Hunting Park follows, ranking it as `important´and finally, we categorized Amsterdam Noord and Poblenou as `relevant´ (see Table 4). In East Boston, the rapidly rising property costs —sale prices increased by 108% between 2014 and 2019[2]— explain much of this increasing perceived threat. This threat is also coupled with that of climate change impacts, especially the anticipated increased frequency and magnitude of coastal storms and flooding, which are increasing flood insurance costs to levels that are unaffordable for residents and indirectly prices them out. This threat of displacement is forcing residents to ask themselves if they should start looking for more affordable homes before having to face an eviction notice, foreclosure, or an extreme flooding event. Finally, the active anti-displacement work led by organizations in the neighborhood, including CityLife/VidaUrbana and NOAH (Neighborhood of Affordable Housing), reinforces this perception that displacement is an active threat and makes it clear that anti-displacement and housing rights are a priority for many community groups.

In Hunting Park, civic respondents' testimonies reveal that people living in the northern part of the city fear that they will soon be affected by gentrification pressures felt in the center and western parts of the city such as Southwest Centre City, University City, North Philadelphia East, West Philadelphia and Brewerytown. Shokry et al. (2020, p. 13) found these neighborhoods to be those most gentrified and with the highest concentrations of green resilient infrastructure (GRI) and have also witnessed how minority and low-income residents have moved from wealthier areas with high investments in GRI to green resilience dis- /underinvested neighborhoods. Thus, Hunting Park could be a potential destination and, according to respondents, historically, a "wave of gentrification" has already made it a destination for residents displaced from the city center, and not only those in the lowest economic strata.

In Amsterdam Noord, civic interviewees also described how neighbors have become scared and threatened by urban renewal and new developments in general, as they are linked to gentrification and the lack of affordable housing availability. A Noord resident and activist (2019) described as follows: "in these houses everybody feels that […] they know that the end has come for them, so they see the future coming […] and everybody realizes it will have consequencesm […] so everyone is getting really afraid of new development".

Fig. 4. Construction works next to Cristóbal de Moura Street with grafitis that read "no offices" and "we want green spaces" (Source: Authors, 2021).

[2] https://www.bostonmagazine.com/property/2020/03/16/boston-home-prices-doubled/ (Retrieved on September 16, 2021).

Finally, in Poblenou, residents who have witnessed the displacement of some families fear a similar fate, and the increasing demand for protected housing by many neighborhood associations, such as Observatori dels Barris de Poblenou or EnsPlantemP9, give voice to residents who fear this potential displacement. Civic groups also see the rapid real estate developments rolled out around them after a few years of economic slowdown, mostly in the aftermath of the 2009 financial crisis which affected the construction sector in much of Barcelona, especially in Poblenou. Since 2017 or so, cranes have been popping up everywhere around residents, making them realize that the neighborhood is experiencing rapid change (see Fig. 4).

In short, displacement is being felt both as a threat and as lived experience, depending on the respondents, with most direct experiences and threats in East Boston, Amsterdam Noord, and Poblenou.

3.2.2. The privilege of green-adaptive investments

3.2.2.1. Exclusive new developments and resilient greening for others. Furthermore, our analysis reveals that respondents saw trends of exclusive new developments and resilient greening as `highly important´ in East Boston and Amsterdam Noord, as `important´ in Poblenou, and as `relevant´ in Hunting Park (see Table 4). These responses likely reflect that in East Boston and Amsterdam Noord greening projects are the most visible and advanced of all four neighborhoods, followed by Poblenou. In the case of East Boston, the large-scale waterfront redevelopment and the new luxury buildings and services that have accompanied it, such as Clippership Wharf, Portside at East Pier, and the Eddy (see Fig. 5), make civic groups feel that these luxury new developments and the greening that has often been co-funded by these developers do not respond to historically marginalized residents' needs or abilities to pay. This is how a community activist (2019) from East Boston described this: "I think that most things they started to build have been thought for people who are now coming, and not for people who already lived there". While existing residents seek more economic opportunities in terms of secure jobs and support to new minority businesses in the area, the new amenities built alongside greenspace and condo development, such as gyms, water sports, or restaurants, fit higher-income residents' tastes and consumption habits around recreation and social venues. Additionally, all the greening around the waterfront, including Piers Park, Lopresti Park, the East Boston Green, and the Living Shoreline, is physically surrounded by large-scale luxury buildings which create barriers to access for the working-class, longer-term residents living more on the interior part of the neighborhood.

Amsterdam Noord follows a similar pattern: Many high-end buildings have been restored or constructed (e.g., A'DAM Tower or the Faralda crane hotel), along with new trendy cafés (e.g., De Ceuvel), entertainment facilities (e.g., the Eye Filmmuseum) and new luxury estates designed to be gated communities with enclosed private courtyards, separated from the public space by fences and accessible from private parking garages. These new high-end and increasingly popular estates and venues are visible and emblematic, attracting large numbers of tourists, commuters from other parts of town and new, high-income, and educated ethnically-Dutch residents. This leaves working-class residents with the feeling that the new constructions and parks are directed to the more financially and socially privileged groups expected to increase in the neighborhood in the near future. A nearby resident and activist (2019) described the new luxury estate as insipidly mono-functional and a sort of "patisserie urbanism" due to its monotony and socially exclusive nature.

In Barcelona's Poblenou, civic perceptions of exclusive green developments are also widespread, especially given the 22@ Plan, an urban development plan in place since 2000 which prioritizes the creation of new office buildings, hotels, and tech-driven facilities that have attracted mainly investors, and upper-class Spanish and expatriate university-educated workers, within the area surrounding

Fig. 5. The Eddy luxury apartment building located along the East Boston greened waterfront. (Source: Anthony Crisafully, n.d.)

Fig. 6. The Student Hotel under construction next to the green corridor on Cristóbal de Moura. (Source: Authors, 2021)

the traffic-pacified and green Poblenou Superblock. Respondents report a similar social impact for some of the new climate-adaptive green projects inaugurated in 2020, namely the green corridor in Cristóbal de Moura. Some interviewees also believe that current residents will be replaced by higher-income groups —workers in the new offices or international students that will reside in the new Student Hotel currently under construction (see Fig. 6)— and they will be the future beneficiaries of this investment in greening rather than longtime residents. A member of a housing association in Poblenou (2021) said: "there is no question that the area around Cristóbal de Moura is nicer than before, but the question is: why is it nicer, and most importantly, for whom?"

In Philadelphia's Hunting Park, respondents mentioned the exclusiveness of greening fewer times in the interviews. Hunting Park is indeed not (yet) experiencing the combination of greening and real estate development to the same extent as Boston, Amsterdam, or Barcelona. There was however a sense that the massive investment of resources – in multiple senses of time, energy, maintenance, and costs – required by resident volunteers to green a neighborhood with so few trees and green spaces as Hunting Park have actually rendered greening a more exclusionary endeavor. This was the case despite (or even because of) the city's and external non-profit's efforts to make greening a more inclusive activity through community involvement. When the Beat the Heat Plan was launched by Philadelphia's Office of Sustainability in 2018, Hunting Park was specifically selected with equity in mind, as a pilot neighborhood due to its high heat index compared to the city's average. The Beat the Heat initiative seeks to encourage community-based decisions for how to best tackle heat disparities, including tree-planting activities, green stormwater infrastructure, and a review of city policies that address heat, among others (OOS, 2020).

In short, in neighborhoods that have both advanced gentrification and more visible extensive greening, perceptions and experiences of physical displacement together with exclusive greening are the most acute.

3.2.2.2. Dissatisfaction with new developments. Furthermore, civic respondents of East Boston and Poblenou expressed most dissatisfaction with urban development plans that also include greening, which made us classify the effect as 'important' in both cases while we ranked this social impact as being 'less relevant' in Hunting Park and Amsterdam Noord (see Table 4). In Boston, residents were unhappy about how the new constructions made green spaces busier and without them being properly maintained and secured. The dissatisfaction also stems from a perceived lack of control or residents' consideration regarding decisions taken on new developments, thus exemplifying exclusionary protection from a procedural standpoint. In East Boston, the engineering and design firm Kleinfelder was hired in 2017 to engage residents around planning the further greening and resilience of the East Boston waterfront. However, according to civic respondents, the agendas of the meetings had been decided by the firm prior to those meetings, and topics such as social resilience and housing were left outside the scope of what could be discussed, despite being very much on the mind of civic groups. Furthermore, civic groups report that the new real estate developments use the new green and blue spaces in East Boston as marketing tools and sales pitch, which is also evidenced by the advertising materials and websites of these luxury waterfront developments. For example, The Eddy claims to be situated in "one of the most beautiful waterfronts in Boston" and advertises its direct access to LoPresti Park as well as numerous nautical activities such as kayaking.[3]

In Poblenou, some interviewees were deeply dissatisfied with the 22@ Plan and its vision for the neighborhood, as well as with some of the new greening interventions, given what they see as poor design, increased insecurity given their proximity to cars, or destruction of spaces to create them. A resident (2019) from Poblenou stated the following referring to the new play area: "I think they could have done this space better. It looks like a jail with all the prison bars around the park, very metallic […]. They removed large, old trees in order to do that, and why?". As in this case, civic groups often regretted the destruction of informal green spaces, including gardens, and their replacement with high-end hotels. One such emblematic case is the destruction in 2021 of the community garden Hort de La Vanguardia, replaced by the "green" entry front of a luxury hotel. In fact, the perception of residents is generally that the

[3] https://eddyliving.com/lifestyle (Retrieved on September 30, 2021).

planning processes of several municipal and private greening interventions have been largely top-down, which could be an additional explanation for their lack of acceptance or feeling of non-belonging in these spaces.

In Amsterdam Noord, although less frequently emphasized, civic groups were disappointed with the new urbanism left up to the market and targeted mainly at wealthy groups. In fact, some community groups actively resisted the development of Noorderpark from the outset and still are critical of the new development. The main criticism or fear is that the park has been designed as a metropolitan park as opposed to a neighborhood one, and so that it will serve the needs of more affluent residents living in other parts of the city. Interviews with nonprofit environmental foundations reflected upon the under-use of the space by racialized residents: "It still puzzles me why for instance all these people, lower income people with small houses, why they don't use the park. There are a lot of people of Mediterranean origin here, Moroccan, Turkish… What stops them from going into the park with their families?" (Activist from non-profit environmental organization, 2019).

In sum, acute concerns about displacement are coupled with critiques of the exclusivity of green infrastructure and new related developments, especially so in Amsterdam, Poblenou, and Boston.

3.2.3. Sustained environmental dichotomies and inequities

3.2.3.1. A complex relationship between greening and gentrification. While most civic respondents highlight greening as not equally benefiting residents in the future and mention gentrification as a threat or trend in their neighborhood, interviewed civic groups do not directly mention "green gentrification" as a social impact per se, except in Hunting Park, where civic respondents seem aware of the process and terminology. Civic groups of Hunting Park do consider green gentrification per se as `highly important´ (see Table 4). In European cities and neighborhoods, green gentrification is only more recently emerging and being adopted as a concept in policy and activism networks, including Barcelona and Amsterdam. In East Boston, Amsterdam Noord and Poblenou, civic groups are aware of the process and hold some negative perceptions around greening, but gentrification is 'less relevant' as a social effect associated with green climate projects. For example, in East Boston, activists are indeed cautious about using "green gentrification" per se as a term out of concern that talking about green gentrification would serve to justify cuts to future greening projects in a neighborhood that has historically been contaminated and a space of environmental injustices.

Furthermore, several civic interviewees express a significant culture of mistrust and resistance around trees and greening for resilience for four reasons that have some historical roots: racialized residents' historic lack of trust in institutions; the responsibilities of caring for street trees that appear too costly for the expected socio-environmental benefits; the history of displacement that Latinx residents in Philadelphia have experienced in previous neighborhoods; and the awareness by civic groups that environmental improvements can lead to gentrification and thus might not take place. A member of the non-profit Philadelphia's Horticultural Society (2019) described this feeling as follows: "People don't want to plant trees because they don't want to be priced out of [their] neighborhood". Here, the fear of future gentrification might be slowing down the much-needed greening in historically green-deprived neighborhoods. Therefore, there are not only normative reasons for addressing green gentrification, but also instrumental ones.

3.2.3.2. Enduring unequal distribution of/access to green spaces and their benefits. Civic respondents report indeed perceptions of enduring unequal access to green spaces, especially so for the two American cities in our sample. This effect is classified as 'relevant' in East Boston and Hunting Park, yet as 'less relevant' in Amsterdam Noord and Poblenou (see Table 4). Many civic groups in East Boston seem unsatisfied that green spaces in the neighborhood lack access points, are impacted by restrictive rules on park hours and conditions, and that new developments are creating a barrier for residents that live in the interior of the neighborhood and who cannot easily access the greened and climate-protected waterfront areas. A Harborkeepers activist (2019) complained about this difficult real access and the need to build greater ownership of new green spaces for working class groups: "you can look at the water and that's it. We're asking for more than that. We're asking for this coastal community to be allowed to be coastal, which means interacting with the water, which means learning about the environment, which means accessing any place". In addition to Harborkeepers, civic groups such as Greenroots are organizing weekly Caminatas Verdes ("Green Walks") for Latiné residents that help them learn the environmental history of the East Boston waterfront. Additionally, despite increasing municipal attention and green funding in Hunting Park, many civic interviewees criticized the overall lack of investment in northern Philadelphia, in contrast with rapidly gentrifying central and western areas. In their views, they do not have access to enough green spaces, owing to the unequal distribution throughout the city and to a legacy of racial segregation and low environmental investment in neighborhoods of colour.

This emphasis on the disproportionate lack of green spaces or access to them is less prominent in the European cases of Amsterdam Noord and Poblenou. In Amsterdam Noord, civic groups did not report an unfair distribution or access, and in Poblenou they were generally pleased with the number of green spaces available and those that are planned for the future. Such different perceptions between North American and European cities might be due to the legacy of well-known unequal access to green space and green injustice and to long-term activism for green space equity in historically marginalized neighborhoods in the US (Anguelovski et al., 2019a, 2019b; Connolly and Anguelovski, 2021).

3.2.3.3. Disruption of social cohesion around green spaces. Last, some interviewees report a perception that drug abuse, misbehavior and crime increase after gentrification and thus undermines access to newly greened spaces, mostly in East Boston, where this effect is categorized as `relevant´, whereas in the other three cases, it falls into the `less relevant´category (see Table 4). Although interviewees in East Boston did speak of witnessing drug issues in the neighborhood before gentrification processes were clearly manifest, they complained about the behavior of newcomers: the drug consumption in the luxury buildings, the speed at which they drive their

expensive cars, and the drunk people that would hang around the neighborhood.

In Poblenou, reference to poor social behavior in greened spaces was linked to either young people and/or tourists hanging around the new picnic tables in the Superblock or around the green corridor in Cristóbal de Moura, but not to the same extent of poor social behavior as in East Boston. In Hunting Park and Amsterdam Noord this issue was not mentioned as an impact of gentrification or greening, although the stigma associated with the prevalence of substance and alcohol abuse in Amsterdam Noord was used as a motive for redevelopment of probleemwijken (problem neighborhoods) in the 1990s.

4. Discussion

In this paper, we aimed to uncover to what extent and how urban green interventions for climate adaptation produce perceived and/or experienced negative social effects for historically marginalized residents. First, the analytical lens of this study offers a unique operationalization of the variety of perceived social impacts and experiences from green resilient infrastructure and improved resilience. Second, the qualitative analysis contributes to a much-needed international comparative analysis on green, climate-related gentrification, as called for by Anguelovski et al. (2019a, 2019b), by providing a wider perspective of the processes and impacts of gentrification in greening cities across different socio-political contexts.

In short, civic respondents' in-depth reporting of negative impacts in the context of urban greening for climate adaptation shows that green infrastructure benefits are feared to be temporary and partial, undermined by new climate injustices related to the exclusivity of unequal urban redevelopments, triggered by or accompanying climate-adaptive green projects. Green climate gentrification is thus both a threat and an already experienced process of exclusionary climate protection through three dynamics we identified: (a) multiple displacement linked to GRI planning, (b) privileged green adaptive investments, and (c) sustained environmental dichotomies and inequities. The framing of our results through the lens of exclusionary protection is one of the key conceptual contributions of this paper.

First, we did find that green urban infrastructure is highly valued in all four cities for health and environmental benefits, aesthetics, connectivity, and an increased perception of safety. This finding furthers existing literature on the positive effects of green spaces (Aerts et al., 2018; Anguelovski et al., 2019a, 2019b; Shokry et al., 2020; Mees and Driessen, 2011; Cole et al., 2020). Yet the analysis also shows that all four cities are simultaneously experiencing real,imminent physical displacement and that civic groups perceive future displacement as an important threat. Thus, our findings contradict the existing literature on nature-based strategies being "win-win" solutions for urban residents (Al Sayah et al., 2021). This raises the following question: 'How do greening interventions lead to contradictory effects, that include both the discussed positive benefits but also those opposite effects?' The answer is simple and yet complex: When green adaptive planning overlooks or is unable to tackle more structural and/or historic equity issues, risks of new or worsened gentrification and its impacts emerge.

Findings also show that green gentrification can result in an overuse or underuse of public green spaces by some groups over others, as shown particularly by the case of East Boston or Amsterdam Noord where our analysis revealed an elite-captured use of green resilient infrastructure and spaces. Data also confirms the link between gentrification and disrupted social cohesion, explored by Oscilowicz et al. (2020) in a study in Barcelona and now further exemplified in the findings of this research. Moreover, the effects have not only been previously noted in Barcelona but also in East Boston (Anguelovski et al., 2021a, 2021b). Finally, our findings corroborate the potential risks of green climate adaptation measures resulting in maladaptive and inequitable outcomes found by Shokry et al. (2020) due to their implementation alongside exclusionary redevelopment in longtime disinvested neighborhoods. Yet, while civic groups feel displacement to be a real risk or experience it first-hand, and also report that greening interventions are not targeted at historically marginalized residents, they do not necessarily make the leap in use of the term *green* gentrification. This is especially visible in European cities where the concept of green gentrification has been not been integrated into activist and urban planner lexicons.

Our analysis also further distinguishes nuances in regards to perceptions and experiences between American and European cities and between cities where gentrification is more or less acute. In US and European neighborhoods (East Boston, Amsterdam Noord and Poblenou) with both advanced gentrification and more visible extensive climate-adaptation greening, physical displacement experiences and threats together with exclusive greening are the most acute. In American cities such as Philadelphia and Boston, civic groups further expressed regret for the legacy of unequal access to green space and their fear that gentrification might prevent them from securing more equally greened neighborhoods. Displacement per se is also mentioned in a much more severe way in the neighborhood where gentrification is most intense —East Boston— and where few policies and regulations are in place to limit the power and profit of real estate developers. To be additionally noted, similar trends of weak public control over developers have increasingly gained popularity in European cities historically known for their progressiveness such as Amsterdam Noord and Poblenou (Anguelovski et al., 2021a, 2021b; Oscilowicz et al., 2022). As this study demonstrated, civic groups in neighborhoods where large-scale, green developments are found —such as in Poblenou (Barcelona) with the green corridor of Cristóbal de Moura, Amsterdam Noord with Noorderpark, or other upcoming green projects including the future transformation of the Noordholland Canal area set to become one landscape park— expressed negative perceptions about new green and resilient developments. Those negative perceptions exist in spite of claims made by the Municipality of Barcelona that the goal of this new green space is to create more (inclusive) public space, ensure better air quality, and guarantee stormwater management through the SUDS system. Lastly, in the neighborhood where gentrification is nascent and green adaptive measures quite prominent, as is the case of Hunting Park, some civic groups are already aware of the possible displacement awaiting them and refer to "green gentrification" directly.

This research relied on a triangulation of sources (semi-structured interviews, desk research and document analysis), as an effective way to enhance the internal validity of the study. The purposeful selection of the four case studies in the Global North with similar

socio-political and economic contexts, yet with national, regional, city-level and neighborhood-level specificities, allowed us to offer a rich cross-case comparison. In considering limitations however, not all interviews analyzed were specifically from the neighborhood under study (particularly in the case of Philadelphia). Nonetheless, we included a broad array of perceptions from civic/community groups about each specific neighborhood, which also enriched the results. Additionally, the choice of emblematic neighborhoods was purposeful to get a more insightful look at negative effects; future studies could explore the differences in social impacts across gradients of green interventions and of gentrifying neighborhoods in the same municipality as this would help assess if the trends we identified are similar beyond emblematic neighborhoods. In addition, our case studies had unequal sample sizes (Boston had the largest sample size with 23 interviews, while Amsterdam had the least with 11), which we partially remediated through longer and more in-depth interviews. Finally, the dissatisfaction with (new) green spaces by civic groups could, in some cases, also be explained by their lack of participation in the design and development processes of greening projects. This is, for instance, the case of Poblenou, where both the green corridor of Cristóbal de Moura and the Superilla were perceived and reported as rather top-down interventions. If residents had perhaps felt more included in these projects, there would have been less resistance to these interventions and thus different results would have been obtained. That said, even in Hunting Park, a "model" neighborhood for equitable greening in which tree planting to mitigate climate impacts is experimented as a community-led effort with strong municipal oversight, the perceptions we obtained in interviews indicated risks of exclusionary climate protection.

5. Finals remarks

Our findings have key implications for urban climate justice. They highlight how green gentrification is recognized to some extent, but its severity remains to be experienced with the same acuteness in all cases. Interviewees were hesitant to conclusively attribute gentrification impacts such as displacement to green urban interventions, although they recognized the association and role of green interventions as risk factors for creating new injustices in relationship to climate-adaption planning. In total, we noted several different manifestations of green gentrification, and green climate gentrification, in particular. Nearly 30 different negative social effects came up during data analysis. Green climate gentrification reveals a multi-faceted and pernicious process of exclusionary climate protection. Findings also confirm that green gentrification exacerbates existing inequalities – including environmental inequalities – as East Boston, Hunting Park and Amsterdam Noord all have high concentrations of minority –class and/or ethnicity-based– populations that suffer from socioeconomic and racialized sensitivities. These populations are disproportionately affected given the historical neglect and disinvestment of their neighborhoods, mounting threats from climate change, constraints in moving to less vulnerable areas, and now their (climate) gentrification-induced displacement to less climate-resilient areas.

The main environmental and climate justice "solution" repeatedly proposed across all four cities to mitigate gentrifications effects was to increase the share of socially protected housing, especially at city- and neighborhood-levels. Retaining affordable and protected social housing in gentrifying neighborhoods is one tool that can help reduce resident displacement, promote social mix, and guarantee that low-income and vulnerable groups also benefit from new developments such as greening interventions. Their plea is a call to action for national, regional, and municipal governments that have the power to change current housing provisions and regulations and shape greater urban climate justice. Municipalities also need to support a variety of social housing provisions, regulations, and incentives directed to developers, especially large-scale real estate development, who are increasingly shaping the climate resilient city and are already undermining climate justice goals. Otherwise, cities are facing short- and mid-term green climate gentrification that will produce both displacement and exclusionary protection for working-class and racialized residents while privileged residents will continue to capture green, elite security from climate-adaptive infrastructure.

Contribution statement

Aina Planas-Carbonell: conceptualization, methodology, empirical data collection, formal analysis, writing original and editing drafts; Isabelle Anguelovski: original study conceptualization and methodology, empirical data collection, editing draft; Emilia Oscilowicz, Galia Shokry and Carmen Pérez del Pulgar: original study co-conceptualization, empirical data collection, initial coding and analysis, editing drafts.

Declaration of Competing Interest

The authors declare that they have no competing financial interests or personal relationships that could have influenced the work in this paper.

Data availability

The authors do not have permission to share the data used.

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