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From heat racism and heat gentrification to urban heat justice in the USA and Europe

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Extreme and prolonged heat has gained traction as an important driver of unequal vulnerability and adaptive capacity. In the Global North, urban planners and policymakers are paying increased and concerted attention to urban heat in the context of social, and especially race-based, determinants of heat inequality (1,2). Meanwhile, in the Global South, although heat and heat planning seem to remain for the most part normalized or overshadowed by other priorities, civic initiatives for heat assessment and monitoring in informal settlements are helping to document how legacies of segregation and underinvestment shape extreme and prolonged heat exposure (3,4). In 2023, in the USA alone, 15 cities experienced record-breaking heat streaks at or above 38 °C, including a period of 53 consecutive days in Tucson (https://www.climatecentral.org/climate-matters/us-summer-2023-in-review). In Europe, 61,000 deaths were calculated to be heat-attributable in 2022 (5). Recent research has demonstrated that older residents (especially in temperate areas and high-income countries), infants and residents with chronic diseases are at particular risk during extreme heat, in a continuum of heat exhaustion, heat stroke, lower livability thresholds and eventual death (6). Social vulnerability to heat is, however, shaped by context and structure, including occupational exposure, class and/or income, and race (7–9). For example, unhoused residents are particularly vulnerable to extreme heat because they tend to have to prioritize locational stability over access to cooling, and also because of pre-existing and often untreated health conditions (10,11). In general, people of color of any age in the USA and Europe are the most exposed to heat effects, and race is—as in other environmental injustices—the ultimate marker of inequality; 71% of all counties in the USA show that significant racial urban heat inequalities persist even when adjusting for income (12,13). Clark et al. demonstrate that adult residents of color in the US Northeast experience six more days of heat islands than white adults, and older residents of color experience 1.1 more heatwaves than white senior adults due to a combination of racial segregation, lower ability to access privatized adaptation measures, and weaker provision of services in their area (14). In this Perspective we do not focus on individual vulnerabilities but rather on neighborhood and built environment characteristics, including housing, and on how urban heat exacerbates existing inequalities in US and European cities.

Research on urban environmental and health justice has shown an urgent need for urban climate researchers— especially planners, geographers, public health personnel and environmental studies scholars—to move beyond heat exposure studies (and biophysical factors) that explore human populations as homogeneous groups, and instead distill how processes such as exclusionary and racist urban development have shaped exposure, vulnerability and risks, and continue to shape them in complex ways. We do not analyze cities in the Global South, where the histories and legacies of racial segregation are quite different. We also do recognize that race constructs and planning practices from the USA do not easily transfer to the European Union (EU) context, and our EU examples tend to illustrate heat gentrification within its own racial context. In what follows, we first parse out the relations between what have been documented as unequal heat effects and the legacy of exclusionary urban planning. We then zoom in on the embodied experiences of heat for the most vulnerable individuals that such planning produces. We then point out the (re)produced injustice pathways linked to heat responses and what we call and operationalize as 'heat gentrification', using some illustrative case examples from our recent empirical research in US and European cities. Finally, we propose research priorities and both general and targeted policy takeaways that are grounded in heat justice and are designed to prevent heat gentrification. Our take on heat justice is that no heat-abatement strategies will be climate-justice-driven if the core focus of planning for heat remains on heat management and designing for heat as a homogeneous external stressor (1,15), while disregarding historic drivers of environmental injustice, racism and housing segregation, and ignoring concurrent patterns of heat injustice and emerging heat gentrification as accelerators of heat vulnerability. We call for researchers and planners in North America and Europe to better integrate housing-justice considerations into heat studies and actions, to consider land speculation and the role of land value in shaping and limiting public and collective action, and to structure possibilities for just heat mitigation planning in the context of displacement risks. Further research evidence would need to be collected before doing the same in the Global South. Finally, we note that this Perspective is mostly driven by research in urban studies and urban environmental planning and may not always speak to specificities of evidence in other fields. However, it intends to trigger an interdisciplinary discussion and debate.

Heat racism and heat gentrification

Heat racism takes place as multiple, overlapping environmental racisms, including through heat gentrification, as described in the following sections.

Exclusionary development and racism

In the USA, but also in Europe, unequal heat exposure is part of a legacy of environmental racism and exclusionary development that has created landscapes of thermal inequity (16,17) and uneven heat vulnerability, as has been demonstrated by research on the institutional violence and social production of heat lying behind thermal inequity and insecurity (18). In the USA, redlining—a process of exclusionary, racially discriminatory development that purposely segregates minority groups to low-environmental-quality neighborhoods—has endured as a practice (even after segregation was outlawed) and is associated with under-investment, environmental exposure to toxins and, more recently, exposure to climate-change effects (19–23). Today, in Baltimore, Dallas, Kansas City and Phoenix, redlined neighborhoods tend to register greater contamination, higher

land-surface temperatures (24,25), more impervious surfaces, little green space and a sparser tree canopy (25) (the latter two have a role in reducing surface and air temperature), as well as a greater number of poorly insulated buildings (17). Neighborhoods given the worst grade during redlining tend to have a particularly poor normalized difference vegetation index (NDVI) and are, on average, 2.6 °C warmer than their Grade A neighbors (26). In general, low-graded neighborhoods also have poorer access to public green space (26,27) and have little urban greening (for example, nature-based infrastructure) that could serve as climate shelter during heatwaves and reduce urban heat islands. US neighborhoods that today host higher percentages of Latinx and Black residents in areas such as Los Angeles, New York City, Chicago and Greater Boston are also consistently associated with higher urban biophysical risks (for example, impervious surfaces, low or 'maladaptive' greening with little cooling effect) and social risks (for example, working-class residents)—with acute climate and health effects and inequalities, especially those related to heat (22,28). When zooming in on the embodied experiences of thermal inequities, in our qualitative research in US and European cities we found that many minority residents, especially Black Latinx families, do not have private yards, nor retrofitted or affordable air-conditioned (AC) homes. In fact, even those residents owning AC report living in homes that are too hot because the AC does not meet their cooling demands in often poorly insulated homes or because of their inability to pay for cooling utility bills. Some report 'putting towels on the couch to avoid sweating, using fans to cool rooms and bodies down while saving money on AC, or opening windows for greater breeze and shades drawn for sun protection' (empirical data collected as a part of the C-Heat 2021 Photovoice/Fotovoz, Chelsea and East Boston project (https://www.c-heatproject.org/photo-voice)). In fear of eviction, non-white residents also report not raising the issue of heat with their landlords. These experiences show how AC, although a common cooling resource, does not solve the ultimate challenge of poorly insulated homes, increased energy use and outdoor temperature increases. Outdoor adaptation infrastructures, such as green spaces, may be particularly valuable as cooling resources (29), and a number of cities have already built networks of climate refuges and shelters, as in Cornellà, next to Barcelona. However, outdoor spaces have their limits—in high minority cities such as Everett (next to Boston), Latinx participants in workshops we co-organized reported poor-quality green spaces and playgrounds with 'metal where kids can burn themselves in summer'. This caused them stress and anxiety (30). Indeed, public spaces of refuge can end up as spaces of health risk rather than nature-based shelters. In Europe, unequal heat vulnerability is similarly reflected in the historic cores of many Mediterranean cities. It especially affects racialized and/or migrant residents from the Global South who are living in dense neighborhoods with little access to green space, in cramped apartments with poor ventilation and low energy efficiency (although quantitative studies on the relationship between migration status or race and heat exposure and effects are missing in Europe, as noted in the latest 2023 Lancet Europe report (31)). In such homes, inability to afford adequate cooling in the summer (by installing or running an AC unit) is becoming a critical issue in terms of energy poverty. Residents in these neighborhoods often face additional socioeconomic challenges, such as direct discrimination in housing access (32). Up to 40% of residents live below the poverty line, and most are unable to move out to often more pricey, less dense and greener neighborhoods. In the qualitative Photovoice workshops we led in the Raval, Barcelona (https://www. bcnuej.org/projects/raval-resilient/), residents from Pakistani and Moroccan origins described being trapped in homes that were uninhabitable during extreme temperatures and with limited options for heat relief outside (P.K.

et al., manuscript in preparation). They perceived public spaces—such as squares, parks, public pools and libraries—as scarce, crowded, insufficiently shaded, economically inaccessible or unwelcoming. For many, these were also coded as white spaces and exclusionary of their own sociocultural practices, identities and uses of public spaces. In terms of health effects, European neighborhoods with a high share of racialized or migrated residents tend to exhibit higher heat-related risk, higher mortality rates and more emergency room visits during heatwaves (33).

Lack of equity-centered heat abatement

To reduce heat exposure and effects, recent municipal heat-abatement strategies, such as greening (for example, tree planting, green roofs and greenways), green, blue or gray climate shelters, or financial support to retrofit buildings for energy efficiency, have been shown not to benefit residents equally, nor do they target or fund working-class groups (34). Broader research across the USA shows that although 73% of planners are somewhat concerned about heat, most lack heat-vulnerability maps (35) and operate without an equity perspective (1,24). In practice, in our recent research on urban adaptation and heat, we found that depsite the existence of programs such as the municipal Climate Shelter Program in Barcelona (https://www.barcelona. cat/barcelona-pel-clima/ca/barcelona-respon/accions-concretes/ xarxa-de-refugis-climatics), which includes more than 200 indoor and outdoor (green) spaces, residents from working-class and migrant neighborhoods—with a substantial population from the Global South— were less aware of them and encountered difficulties in accessing or using them (36). Additionally, our findings suggest that the program is poorly designed to address their intersecting needs, including community spaces for recreational and cultural activities and access to nature (36). Furthermore, in Montreal, Canada, where the city constructed a Woonerf green alley to address heat islands in the St Henri neighborhood (at a cost of over Can$1.5 million), we identified that such renaturing projects were geared towards white middle-class residents, leaving local schoolyards exposed to heat, ‘like a prison yard’ (37). In reality, although many nature-based interventions are becoming a global planning orthodoxy (38–40), these examples show that North American and European cities do not tend to develop them while prioritizing social or racial equity. Additionally, municipalities face physical and structural constraints in devising certain heat solutions. Research in Boston has found that the most socially vulnerable neighborhoods have the highest demand for cooling (41), but less space available for tree planting. Higher-efficiency solutions include the conversion of flat black roofs to white roofs (reflective cool roofs) (42,43). Yet, barriers exist in accessing funding for energy-efficient retrofits, with African American residents receiving less assistance compared to their white counterparts, which exacerbates energy insecurity and its associated health effects (44).

Heat gentrification Finally, we argue that heat-responsive strategies such as greening, gray infrastructures and retrofitting are embedded in gentrification and displacement dynamics, creating what we conceptualize as emerging processes of ‘heat gentrification’, which need to be fully tested in empirical studies. Heat gentrification is a subset of ‘climate gentrification’, involving the sociophysical displacement of marginalized residents due to climate effects, and responses related to heat that make some (cooler) homes and neighborhoods pricier and less affordable (45–47). This process relegates working-class and racialized residents into areas with higher heat exposure,

creating enduring landscapes of heat racism and thermal maladaptation through four pathways. The first heat gentrification pathway relates to investments towards privatized heat resilience in situ. As part of this process, house values go up after energy-retrofitting, air-conditioning or greening in and around buildings, with an increase in the value of the resulting new cooler homes, which are then affordable only to wealthier and often whiter inmovers (44,48) or those financially well enough to be able to stay put and pay the often increased property taxes. Our research in Boston shows that new luxury housing complexes such as Portside at East Pier, The Mark or Clippership Wharf on the so-called Resilient East Boston waterfront are equipped with energy-efficient, private cooling infrastructure, but their prices are out of reach of Latinx residents. They are marketed as green, sustainable and resilient, but only for privileged residents who have moved into East Boston, not for the Latinx residents living in or moving into the same neighborhood. The second heat gentrification pathway involves public or social housing retrofits geared toward greater insulation and energy efficiency, but these investments can lead to (re)commodification of the retrofitted public or social housing. Rather than staying affordable, such units, even those managed by the non-profit sector, become appropriated by higher-income tenants. For example, in Vienna, housing retrofits in public housing are sponsored by Wohnfonds Wien, the Vienna Housing Fund, and renovations are eventually shrinking the number of units available for public housing. When poorer tenants, especially migrants, sign a contract for renovated units, they are often unable to afford the new, higher rents and are forced to move to lower-quality, often non-retrofitted units. Heat gentrification also takes place as working-class residents are faced with unaffordable cooling expenses, forcing them to choose between thermal comfort and other essential needs (18,24), and often resulting in their relocation to cheaper, more affordable areas. Furthermore, in Vienna, the allocation of affordable housing through the Living Ticket (Wiener Wohn Ticket) requires a two-year registered residency in Vienna, effectively excluding many migrant residents and leaving them with precarious (and hotter) living conditions. The third heat gentrification pathway concerns heat-related green gentrification through neighborhood-level greening for climate adaptation. Extensive research on green gentrification has shown that greening interventions such as those for heat abatement and/ or flooding reduction contribute to increased housing prices, thus displacing lower-income residents. Furthermore, when greening is developed privately as part of new real-estate development, it tends to be underpinned by green grabbing for the profit of investors, as shown by recent studies we conducted in Atlanta, Dallas, Washington DC, Austin, Montreal, Dublin and Glasgow (49). Green grabbing refers to the appropriation of land and natural resources for environmental purposes (for example, greening in the context of climate resilience). It often results in the displacement and marginalization of local communities through the private capture of a green ‘gap’—increased land value due to a combination of greening and high-end development— often in formerly redlined or segregated neighborhoods (50). In such situations, planners rezone former industrial areas as residential, grant permits to developers, and often have few checks in place to prevent land speculation. Our other research in London showed that the new Elephant Park project, built on the site of the former Heygate council estate and advertised as the UK’s first ‘climate positive development’, with the largest new green space in central London, displaced over 3,000 low-income (including many minority) residents (https://justspacelondon.files. wordpress.com/2014/06/staying-put-web-version.pdf). The new apartments were initially sold off to wealthy investors (51). In other research conducted in Philadelphia, between 2000 and 2016, we also found that the deployment of

green climate infrastructure increased past and future climate gentrification—including heat gentrification as one form of climate gentrification—within those greened neighborhoods (52,53). Research elsewhere is also emerging on increases in housing prices in locations where parks and other green infrastructure demonstrate higher cooling performance (48,54). Concurrently, the same research in Philadelphia revealed that African American and Hispanic residents are gentrified out towards census tracks north of the city that rank high on the heat vulnerability index (for example, Hunting Park). Elsewhere, UCLA's Urban Displacement Project has revealed that poor residents from Los Angeles County are being displaced to Riverside and San Bernardino counties, areas that are hotter and lack green space (55). Both were under heat advisories during the June 2024 heatwave, with high temperatures from 98 °F (37 °C) to 105 °F (close to 41 °C) combined with higher levels of ozone. In short, the affordable areas (both suburban and within the same city) to which poorer and non-white residents are displaced tend to be hotter and exposed to heat. The fourth pathway operates via wealthier, whiter residents moving to less urbanized, often more rural, peri-urban areas or greener areas of a metropolitan area. This outmigration tends also to drive up prices in local areas that might not be branded as climate-adaptive but are cooler and have access to heat relief. New residents 'capture' heat relief benefits while also pushing for new urbanization as these peri-urban areas rise in value. The Cerdanya district, a mountainous and cooler area in northern Catalonia, has seen greater population growth (+5%) between 2020 and 2022, but a 5.6% decrease in its foreign population, especially in its largest—South American—group of migrants (a decrease of 8%) (56). Many migrants report finding the Cerdanya increasingly unaffordable. In just one year (2023), home sale prices increased by 12.9% (compared to 2.4% in the Barcelona province as a whole) (57). At the same time, the Barcelonés (Barcelona's district) lost 1.4% of its population56. In addition to long-term outmigration, wealthier Barcelona residents tend to move to secondary homes during the summer (for example, the coast of the Maresme, Costa Brava or La Cerdanya itself), leaving behind a city of mass tourism and precarized, working-class communities with few options to deal with increasing heat. Land prices in the peripheries of Spanish cities have indeed doubled over the past decade, putting further strain on the housing market. Furthermore, privileging resilience investments in higher-income areas and gentrifying peri-urban areas also 'hollows out' interest and political power from more disinvested neighborhoods where racialized groups remain, many of which are not on the radar of green gentrification because they are too gray or too poor. Across all heat gentrification pathways, poor and racialized residents are not just physically displaced; those who stay are indirectly displaced as they lose social networks and community resilience support systems, weakening their adaptive capacity. Our research shows that public and health services and access are increasingly jeopardized and thinned in gentrifying areas, including those that can act as climate refuges and that are used by unhoused residents (most of whom are minority residents). They thus face a 'trauma machine' of constant displacement and displaceability for themselves and the services they need (58).

Future research

These trends of heat racism, unjust heat-abatement strategies, and heat gentrification in North American and European cities require new research, data and indicators on the interactions between heat, the health effects from heat and gentrification, infrastructure for heat resilience, and the

contextual, social and economic factors of vulnerability, including urban (re)development and gentrification. Overall, future research should start from a measure of heat resilience that goes beyond biophysical factors and spatial mapping. Researchers must identify and map the social variables, individual lived experiences and perceptions, availability of social networks (59), as well as neighborhood change characteristics behind heat vulnerability. Although urban climate maps still rarely reflect social vulnerabilities, and there is much inconsistency in the models and indicators (60), increasing efforts are being made to refine them by bringing together layers of data to include socioeconomic variables in heat vulnerability mapping (for information about Boston, see www.c-heatproject.org/datadashboard). Such mapping has taken place in cities such as Vancouver, Portland, Helsinki and Barcelona (6,61–63), and can help to guide policy and planning action. Similarly, climate-change impact assessments on health should be more justice-centered (64) and incorporate individual, community and structural drivers of injustice. Such analyses must not only look at current manifestations, but should also try to predict future patterns of vulnerability driven by historical trends of unequal urban redevelopment, land speculation, residential movements and gentrification, drawing on mixed methods approaches.

Quantitative approaches

Building on recent studies of climate gentrification (53), which use three traditional sets of indicators for vulnerability (exposure, sensitivity and adaptive capacity), future studies should identify trends and track changes in heat gentrification through a quantitative index that would bring indicators of vulnerability as part of heat gentrification analyses. Vulnerability to heat gentrification would be operationalized as (i) exposure to heat gentrification, which would include outdoor climate exposure to heat (using high-resolution surface temperature data and air pollution interaction; for example, heat island effects), residential exposure to heat (household energy efficiency, indoor thermal comfort, presence (or not) of cooling infrastructure or upgrades, and other building characteristics), and access to potentially neighborhood gentrifying cooling resources (as described above), such as green and blue infrastructure (for example, proximity to parks and waterfronts, NDVI and new planned green spaces). The operationalization would also include (ii) sensitivity to heat gentrification (with data tracking recent gentrification and neighborhood change and identifying potential green-grabbing practices), new areas of economic activity (such as redevelopment areas and opportunity zones) and the intersectionality of vulnerable sociodemographic factors (such as age, income, educational attainment, gender, race, migratory status, tenure status, household composition (including people living alone or in overcrowded conditions) and energy poverty. Finally, vulnerability to heat gentrification would be operationalized through indicators for (iii) (social) adaptive capacity to heat gentrification (such as climate centers, community services, social and cultural centers, and public and affordable housing), which can mitigate exposure and sensitivity to gentrification via heat. Such analysis of the areas most vulnerable to heat gentrification would hopefully incorporate expertise from policy and civic groups to help to discard or validate indicators and assist in weighting and prioritizing them. Projects such as Climate Justice Ready (https://www.bcnuej.org/projects/climatejusticeready/) are centered on such analyses. To further explore the relationship between heat justice and gentrification, environmental studies and planning research should assess the extent to which heat-resilient infrastructures, such as climate shelters, are

distributed in ways that respond to the heat-justice needs of racialized or low-income groups while also accounting for gentrification. For instance, is the distribution of climate shelters in a city according to needs? Do they act as gentrifying infrastructures? And what barriers exist to equitable access to climate shelters and other heat-resilience infrastructure among marginalized communities? Analyses of heat-justice needs should include environmental, social and neighborhood variables such as ambient temperature, ambient air pollution, housing characteristics, population characteristics and neighborhood greening.

Qualitative approaches

Taking into account that low-resource settings, socioeconomic deprivation and poor housing are strong indicators of vulnerability (65), it is also important to qualitatively understand how these interact with intangible aspects such as risk perception (including of gentrification and green grabbing), social capital and trust towards state institutions, especially for marginalized and minority groups. The adoption of protective measures towards heat at the neighborhood or individual levels might contradict or actually invisibilize people's subjective views around risk and how to adapt, and thus lead to misinterpretation and desensitization. Moreover, as our recent research with migrant residents in the gentrifying Neukölln neighborhood in Berlin reveals, the places and situations that ensure emotional comfort and feelings of safety and belonging often do not coincide with places of heat comfort due to underlying intersectional exclusions and oppressions in public spaces. To examine such tangible and intangible indicators of heat vulnerability and the structural drivers and overlapping processes that drive intersectional injustices in relation to heat, research drawing on qualitative and participatory methods (for example, Photovoice and bodymaps) needs to center the embodied experiences and situated concerns and knowledge of marginalized and racialized groups, and pay attention to residents' identity, self-perception and positionality in intersectional ways (66), linking the bodily with the environmental, the personal with the systemic, and the physical with the emotional. This research can also link to recent studies on achieving climate justice through ownership of change, including neighborhood change (67).

Anti-racist and just heat planning

From a practice standpoint, we argue that planning for urban heat in the context of heat racism and heat gentrification requires new tools and innovative practices. We focus specifically on recommendations that address this urban heat equity intersection, rather than on existing general recommendations related to mitigating urban heat (including the heat island effect) or reduction of indoor temperatures at home—although we do build on them (2,68–70).

Housing security and heat resilience

From a distributional justice standpoint, planners must first prioritize green and gray infrastructure in heat-vulnerable working-class and minority neighborhoods while supporting existing and new programs for more resilient affordable working-class homes and public housing stock that should be protected from further commodification. Initiatives should include funding for public housing and working-class housing retrofits, green walls and reflective roofs, as well as permeable and cooling pavements, tree planting and resilient parks in public spaces (2,68), both in low-income and

gentrifying areas suffering from heat islands. In the fight against heat, as social determinants of health tell us, we must first and foremost tackle housing inequalities. For example, in terms of structural housing improvements, in Phoenix, Arizona, the Cool Roofs initiative helps to reduce indoor air temperature and cooling infrastructure energy costs, by providing funding and resources specifically to low-income neighborhoods to install cool roofs, helping to alleviate the financial burden on working-class residents. It is also partnering with nonprofits to identify and assist households that would benefit most from cool roofs. In Boston, the City is focusing on 'environmental justice neighborhoods' in its fight against heat (71). In terms of resilient nature-based infrastructure, Cleveland is addressing historic inequities in heat islands and tree-canopy cover through the Tree Plan (72). The City of Philadelphia has partnered with civic groups in the most heat-exposed neighborhoods to improve tree cover and other green infrastructure, with a pilot project in Hunting Park, a neighborhood with 60% Latinx residents and 75% of land cover being impervious surfaces (53).

To fund equity-driven heat resilience, planners and policymakers should integrate heat-management solutions into subsidies, tax and land-redevelopment schemes that can support subsidized home retrofits and improved home ventilation for marginalized groups. For example, the City of Boston has launched the Building Emissions Reduction and Disclosure Ordinance's (BERDO) Equitable Emissions Investment Fund, financed by fines and payments from building owners, to improve energy efficiency, prioritizing Boston's Environmental Justice Populations. Additionally, the Healthy and Green Retrofit Pilot program funded by the Mayor's Office for Housing provides eligible owner-occupants of two- to four-unit homes financial support of up to US $50,000 per unit under the condition that, for a period of ten years, tenants in good standing will not be displaced from their units by soaring rents. The Boston based C-Heat Project (2023) has made further recommendations to the City of Boston, including passing municipal ordinances that would enforce access to cooling in rental units, combined with changes to the state sanitary code to include weatherization and passive and active cooling requirements in rental properties. C-Heat is also calling for the expansion of Massachusetts LIHEAP grants to include funding for residential cooling and changes to residential energy efficiency programs such as WAP or MassSave to serve landlord and tenants' needs. Beyond retrofits, financial support for heat relief should be broadened and include subsidies, direct payments and tax breaks for poorer households who cannot afford to use AC even if they have access to it. The same C-Heat project in Boston has called for the expansion of MassHealth coverage of AC for medical reasons and extending coverage to private insurance. In its Beat the Heat program, the City of Philadelphia has distributed heat-relief resources such as AC and fans. Relatedly, North American and European cities must account for the new heat gentrification pressures that greener and cooler homes and neighborhoods produce on land and home rental or sale values, and thus on the displacement and new segregation risks faced by low-income and minority groups moving into hotter areas. Here, countering heat gentrification involves crafting policies, regulations and zoning mechanisms in green and cooled neighborhoods that address displacement linked to real-estate speculation, luxury resilient and privatized housing developments, and housing vulnerability more broadly. Those policies must be real-estate- and gentrification-data driven, and not only use heat data such as the availability of shade or ground temperature (70). Such planning also requires extensive cross-sectoral collaboration (2,68,69). In the USA, cities such as Boston, and in Europe cities such as Barcelona, are beginning to work on this, and some of us are currently involved with them in

developing anti-displacement tools to prevent gentrification-induced displacement. More broadly, our research in 25 cities across the USA and Europe has identified various anti-gentrification and anti-displacement tools that can also be used towards heat justice—with a focus on addressing housing inequalities. These include high inclusionary zoning requirements such as those in Nantes, where 56% of new units are public and social housing; community land trusts for areas under threat of (heat) gentrification; the transfer of taxes or large-scale real-estate development taxes to finance public and social housing; grants and subsidies to housing cooperatives and community-development corporations to create affordable housing or regulations that address the combined drivers of gentrification (73). For example, in 2024, the municipality of Barcelona announced that it will no longer grant apartment licenses for tourist rentals and will not renew existing ones in 2028, thus bringing more than 10,100 units into the regular rental market and eliminating one of the core drivers of gentrification in addition to greening—tourism (74).

Heat abatement as care infrastructures

From a relational justice standpoint, planners and policymakers must also consider public heat-protection infrastructure as an essential community infrastructure of care that can support social relations, health and wellbeing. Climate shelters are becoming an essential urban facility, especially for historically marginalized neighborhoods and unhoused residents or those facing eviction. Shelters should function as places where everyday life can continue and people's basic needs are fulfilled in the face of extreme temperatures, and thus be considered infrastructures of care and support of community networks. Shelters must have specific public services and equipment that can act as cooling spaces (2,68), as not all green spaces have infrastructures that support the thermal needs and uses of a diversity of residents. In the Metropolitan Area of Barcelona, the network of more than 350 climate shelters includes libraries, civic centers, schools and parks. It provides the population, especially those most vulnerable to extreme heat, with free-to-access suitable spaces equipped with seating areas, drinking water and toilets. However, addressing challenges such as public awareness, staff training for heat emergencies, limited opening hours and ensuring inclusivity for minority groups is crucial for ensuring that the network effectively supports the community in coping with heatwaves and other extreme weather events (36). Heat shelters should also be easily connected to, and in communication with, social services and public healthcare centers in case of emergencies. In Phoenix, the Heat Relief Network acts as a partnership between the municipality, nonprofit organizations and businesses to provide cooling centers and hydration stations to vulnerable populations during extreme heat. Although many cities are now implementing community cooling centers, the ways in which they might need to be expanded and adapted to the needs of racialized groups, migrants, working-class residents, children and older individuals need much more attention. Other public infrastructures such as schools, public transit and even bus stops should also be prioritized and retrofitted for cooling. Public schools in Europe and North America are often used as subsidized or free summer camps for children, yet few have been adapted to extreme or prolonged periods of heat. Recognizing this in the summer of 2024, the City of Barcelona installed aerothermal equipment and photovoltaic panels in 24 centers, out of the 170 it plans to air-condition by 2029, which will serve as public summer camps in subsequent years. Several cities have levied a tourism or

hotel tax (for example, Barcelona, Paris, Amsterdam, Venice, Los Angeles, Santa Monica and San Francisco) to finance new green spaces and other heat-island effect and heat-stress-reducing projects.

Community-centered responses to risks

Last, from a participatory and epistemic justice standpoint, community-centered planning is critical in terms of identifying problems and solutions on the ground and empowering vulnerable communities towards addressing heat injustice and related risks. Careful planning is needed to ensure that vulnerable communities are not merely provided with investment, but are also incentivized and supported to take ownership of heat programs; this is critical to their long-term sustainability in effectively moderating heat risk and promoting equity (75–77). The Verde collaborative in Portland, Oregon (78), involves community members in the planning and building of environmental investments, ensuring working-class and people of color benefit directly. As part of their social enterprise, they also directly hire Latinx members from the community in affordable housing and climate resilience projects. More broadly, planning for equitable heat management requires heat infrastructure to be deployed in relation to other environmental, climate and health risks in a process of policy Integration (68), including pushing for the decontamination and lowering of emissions from transport and industry in cities (72). Planners need to better account for the additional risk burdens suffered by, and identified by, socially vulnerable groups when exposed to air pollution and extreme heat concurrently. The People's Justice40+ Community Benefit Playbook by the Emerald City Collaborative in the USA is an interesting guide that empowers BIPOC (Black, Indigenous and people of color) communities to leverage the Justice40 Initiative and the climate, economic and infrastructure investments of the Inflation Reduction Act (among others), to ensure that frontline communities can address climate resilience, build shared wealth models and reduce health vulnerabilities. Some of their work is focused on large-scale energy retrofits of community infrastructure and affordable housing. In Europe, the Social Climate Fund is similarly meant to support vulnerable communities by providing financial assistance for energy-efficiency upgrades and cooling systems and bringing in civic groups and cooperatives to ensure a participatory and equitable deployment of the fund. In such initiatives, the collection and integration of data from civic groups themselves into participatory planning processes is key in helping to identify and address the compounding climate health risks residents face, including those of displacement, while guaranteeing the components of participatory justice.

Conclusion

There is increased interest in heat racism, with heat gentrification as a newly emerging topic, and articulating both when moving towards urban heat justice is critical. We do this here by drawing on our own and other research on North American and European cities. Although race relations and constructions differ in the two contexts, comparable historic and current marginalization patterns produce substantial levels and instances of heat racism and heat gentrification, as highlighted in our analysis. Our claims are grounded not only in climate justice, but also in racial and social justice and housing and land justice, and are thus inspired by research in urban studies and planning, with great relevance for health inequity. We propose new research priorities and strategies, provide policy and planning takeaways, and highlight examples from equity-centered heat-planning practice to look to for inspiration. Although the political and financial feasibility of policy and planning measures

remains at times fragile, as we have discussed, many programs are beginning to be deployed, leveraging major acts and policy initiatives, and then replicated in a growing number of cities, where they serve as pilots for municipalities seeking to further heat justice in a context of escalating heat and pervasive structural racism and classism. More broadly, the diversity of practices and the measures of financial compensation, policy reforms and community investments presented here can help to achieve what many climate-justice groups are calling for: reparations for racialized and other excluded groups in the context of fights for heat justice. If not further deployed, heat racism and heat gentrification in European and North American cities will continue unabated, and new cycles of racial segregation and thermal maladaptation will be reproduced. The risk is indeed that the wellbeing and health benefits that can be drawn from heat adaptation and resilience will be limited to privileged groups and perpetuate climate health injustices.

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