by
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URBAN H

housing | heat | health

Future policy needs to triangulate the 'triple-H' to help marginalised urban populations.

The urban heat island effect generates disproportionately high temperatures in urban settlements compared to non-urban ones, leading to increased heat-related illnesses and mental health issues, especially among vulnerable and marginalised populations living in poorly-planned or -resourced areas.

The Urban-H research agenda by Boston University's Initiative on Cities focuses on the interconnected effects of housing, heat, and health (triple-H) to develop a resilience index for cities.

The proposed global Urban-H Index could help cities worldwide address the triple-H crisis by guiding policymakers to craft equitable, as well as socially and environmentally just policies for their most vulnerable and marginalised populations.

n 2023, heat records were broken on all continents and the world saw the highest global temperatures in over 100,000 years.[1] With buildings and roads retaining heat and creating urban heat islands, warmer cities have not only become increasingly uncomfortable but are also posing health risks such as heat exhaustion and respiratory disorders to their inhabitants. In the US, the 175 largest cities—which account for 65 percent of the total population—have seen a disproportionate number of heat-related deaths in the past 15 years.[2]

Studies have also shown that exposure to extreme heat, especially during heatwaves, can have detrimental effects on mental health.[3] Such exposure can increase stress, anxiety, and irritability, while high temperatures can disrupt sleep patterns and exacerbate existing mental health conditions, such as depression and bipolar disorder.[4,5,6] Quality housing is key to mitigating the worst physical and mental effects of scorching weather, but it is sometimes unaffordable or even unavailable, thereby contributing further to a vicious cycle of stress, anxiety, and even depression.

This triumvirate of Housing/Heat/Health is what we call the 'triple-H' and it has been incorporated into a research agenda called Urban-H (refer to Figure 1) at Boston University's Initiative on Cities (IoC). Our review of research to date has found numerous studies establishing causal links between housing and heat, housing and health, heat and health, but little to no studies on them as a tripartite. By studying triple-H issues in cities at the same time, we hope to mitigate and even solve the different social justice and other issues. The IoC hopes to develop a global 'Urban-H Index' for cities based on the triple-H that measures the resilience of cities in relation to these three global threats.

WHY TRIANGULATING TRIPLE-H IS IMPORTANT

As average temperatures continue to rise, the frequency, duration, and intensity of heatwaves are expected to increase.[7] 'Urban heat islands' describe how cities experience higher temperatures compared to their non-urban counterparts, mainly due to infrastructure

The Initiative on Cities' Urban-H: Housing, Heat, Health

Cross-Cutting Concerns
Vulnerable and Marginalized Populations, Urban Policy and Practice, and Social Justice

HOUSING

Focus
AFFORDABILITY

Key Issues
- **Precarity:** Gentrification & Displacement, Evictions, Informal Settlements, Homelessness, Overcrowding
- **Housing Markets:** Barriers to Growth, Supply, Zoning & Land Use, Equity/Ownership
- **Urban Governance and Urban Sustainability**
- **Social Sustainability**

HEAT

Focus
EXTREME HEAT

Key Issues
- **Measuring, Mapping, & Forecasting Urban Heat**
- **Urban Heat Impacts:** Wildfires, Flooding, etc.
- **Nature-based Solutions & Ecosystem Services**
- **Adaptation & Mitigation:** Climate Action Planning

HEALTH

Focus
MENTAL HEALTH

Key Issues
- **Healthy Cities:** Built Environment and Green Space
- **Housing Security/Stability**
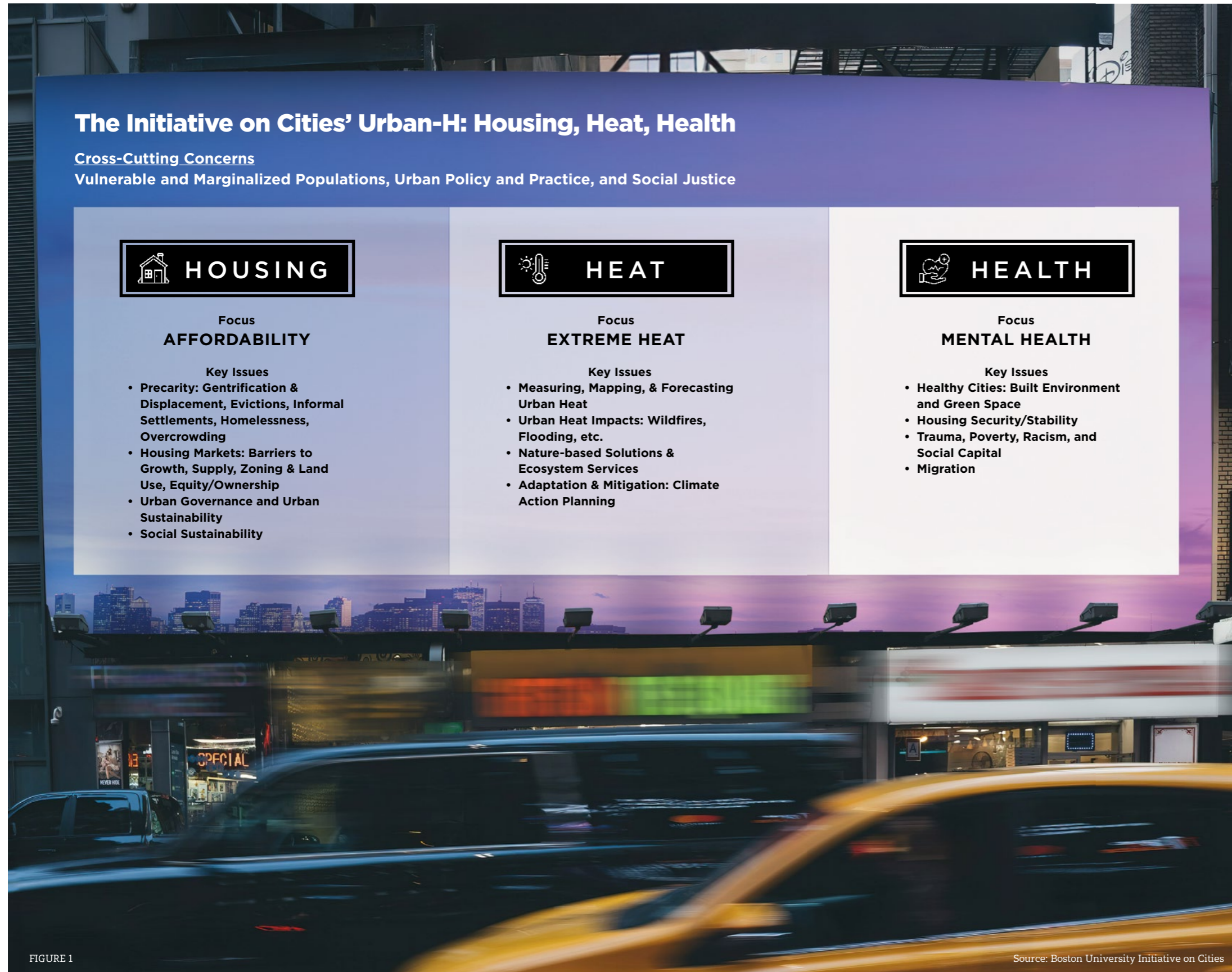- **Trauma, Poverty, Racism, and Social Capital**
- **Migration**

FIGURE 1

Source: Boston University Initiative on Cities

(e.g., roads and buildings) that retain heat within the area. In the US, urban areas are already 10 degrees warmer than surrounding suburban or rural areas.[8] Individuals living within urban heat islands in and around downtown areas are more vulnerable to heat than those residing further out. High temperatures can exacerbate negative health effects that are already present, especially for vulnerable groups. Urban heat-related deaths surpass those from any other US weather-related event and disproportionately occur among marginalised populations.[9,10] According to a study conducted in Europe, overheating due to living in hotter environments can increase the risk of cardiovascular disorders, respiratory disorders, heat stroke, heat exhaustion, and mental illness.[11] In a study conducted in Adelaide, Australia, it was found that hospital admissions for mental and behavioural disorders increased by 7.3 percent during heatwaves.[12]

The quality and stability of housing plays a crucial role in mitigating or worsening the effects of extreme heat on mental health, and the literature highlights the importance of considering both the physical and social aspects of housing in order to understand its impact on health. Living in substandard housing can contribute to stress, anxiety, and depression. Residing in unaffordable housing is directly linked to poorer health outcomes such as worse self-rated health, hypertension, and mental health.[13] Socioeconomic stressors associated with housing displacement and insecurity, such as financial strain, social isolation, and disruption in access to healthcare, can compound the impact of extreme heat on mental well-being.

Some people are better able to adapt to extreme heat than others due to the characteristics of their built and socioeconomic environments. The physical and social conditions of homes and neighbourhoods can support or harm individual and community health in many ways and across different health outcomes. To measure how heat impacts residential areas, researchers have developed the Heat Vulnerability Index (HVI), which has been widely used as an indicator for researchers and local governments to determine which neighbourhoods and communities are most affected by heat.[14]

In metropolitan areas such as New York City, there were higher HVI scores in boroughs or districts such as the Bronx and Brooklyn which are predominantly

non-white.[15] A study of over 100 urban areas in the US revealed that 94 percent of cities with the highest temperatures were in previously redlined areas, reflecting the legacy of past planning policies.[16] Historically, racist urban planning practices that redlined black neighbourhoods have left a lasting impact on marginalised communities, leaving them more vulnerable to health problems from heat than wealthier neighbourhoods within the same city.[17] This discriminatory practice, typically in areas with predominantly minority residents, has led to the systematic disinvestment and socioeconomic decline of such neighbourhoods.

Poorly designed urban environments with limited green spaces and high concentrations of heat-absorbing surfaces can intensify heat exposure and contribute to thermal discomfort, particularly for residents in densely populated neighbourhoods with inadequate infrastructure. Unaffordable, insecure, or substandard housing also significantly exacerbates an individual's vulnerability to extreme heat. Understanding housing conditions, such as housing age, crowding ratio, and roof conditions, can help predict the risk of heat-related illness. Poorly insulated or ventilated housing can trap heat indoors, leading to higher indoor temperatures during heatwaves. Inadequate access to air conditioning or cooling systems can increase heat exposure and discomfort, particularly for vulnerable populations such as the elderly, children, and low-income individuals.

The connection between heat and housing underscores the importance of addressing both environmental and social determinants of health to promote resilience and well-being in the face of climate change. Research and policy coordination will increasingly be needed as the impacts of climate change and the housing affordability crisis worsen around the world.

IoC research triangulating urban triple-H

The IoC recognises the importance of conducting interdisciplinary, transdisciplinary, and translational Urban-H research (refer to box story). It has just co-authored a paper with the Barcelona Urban Lab in Spain on heat racism, heat gentrification, and urban heat justice that is under review. We argue that extreme and prolonged heat has recently gained traction not only as an 'invisible killer', but also as a visible amplifier of unequal vulnerability and adaptive capacity. In our paper, we call for urban climate researchers to move beyond heat exposure studies, and individual or environmental biophysical factors, and not to treat human populations as homogenous groups. Instead, they ought to distil the relations between unequal heat impacts and the legacy of exclusionary urban planning, to point out how injustice is (re)produced through heat-response measures and heat gentrification, and propose new research priorities, and policy and planning takeaways that are grounded in heat justice.

Specifically, we argue that no heat abatement strategies can be climate justice-driven if the core focus is on heat management as an apolitical heat response strategy that does not account for, nor address, concurrent patterns of heat racism,[18] and emerging trends of what we term 'heat gentrification'

as some of the most acute and structural forms of heat injustice. 'Heat gentrification' occurs when lower income populations are displaced from urban heat islands because they cannot afford to keep cool, and are replaced by wealthier in-movers who can, or when lower income populations are displaced out of parts of the city that are less hot, which become more desirable to higher income groups as extreme heat escalates.

Our takeaway is that the trends of heat racism and heat gentrification require new research on the interactions among heat, its health impacts, infrastructure for heat resilience, and the social factors of vulnerability. From a practice standpoint, we argue that planning for urban heat in an equity-driven manner requires a variety of tools and innovative practices as detailed in Figure 2.

The IoC has also seed-funded three new Urban-H projects which are being undertaken by inter-disciplinary research teams at Boston University this year.[19]

Project 1, *Building Resilience after Redlining: Understanding the Cumulative Impact of Heat Vulnerability Factors in Massachusetts,* argues that to implement effective interventions against extreme heat exposure in urban areas, we need a better and more granular understanding of how the built environment, as well as social, demographic, and individual vulnerability factors combine to exacerbate or reduce health risks. The team responsible for this project noted that decades of racial and economic residential segregation and disinvestment have produced redlined neighbourhoods characterised by poor housing stock, and residents with few resources available for adaptation to the impacts of extreme heat. Using high-resolution geographic, demographic, and healthcare utilisation data from across Massachusetts, including all-cause, acute heat-related, and mental health-related hospital visits, they will examine the influence of historical redlining on the risk of emergency room visits on hot days, and the increased risk of hospital visits on hot days associated with the combined risk of multiple intersecting built environments and sociodemographic vulnerability factors.

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THE IMPORTANCE OF INTERDISCIPLINARY, TRANSDISCIPLINARY, AND TRANSLATIONAL URBAN–H RESEARCH

The IoC has appointed three Urban-H leads. Each one is a Boston University faculty specialising in political science, earth and environment, and public health, respectively. They are leaders in their fields who have a commitment to interdisciplinary, transdisciplinary, and translational urban research, and are working with cities and communities. These leads are working separately and together to undertake and catalyse Urban-H research. Briefly, interdisciplinary research bridges, integrates, and harmonises the knowledge between disciplines, while transdisciplinary studies are a result of different disciplines working together to create new conceptual, theoretical, and methodological knowledge beyond discipline-specific approaches. As for translational efforts, these involve converting scientific discoveries from research to directly benefit humans through means such as policy interventions and medical treatments.

The IoC, as also Singapore Management University's (SMU's) Urban Institute, are somewhat unique in that they are both university initiatives that are not tied to any particular discipline or department. This is important for it allows and enables them to be properly inter- and trans-disciplinary as they do not have to answer to or situate themselves in a particular discipline, be it urban planning or another. This makes for a more open research team that is able to think outside the box and be nimbler in its research and actions. Translational Urban-H research that is for the public good, and which has real-life impact in terms of policy and practice, has to be the way forward in terms of mitigating and managing the coming together of these three global crises–housing, heat, and health.

Project 2, *Coping with Extreme Heat: Intersecting Vulnerabilities Related to Urban Heat Islands, Homelessness, and Serious Mental Illness,* seeks to better understand how homeless adults with serious mental illness manage during periods of extreme heat, and the unique barriers they face in adapting to this increasingly common aspect of climate change. For example, they may not have consistent access to reliable shelter, air-conditioned spaces, cool showers, or other common methods for adapting to heat. The unhoused population is at heightened risk of the negative effects of extreme heat, and they already have higher rates of serious mental illness than the general population. Drawing on qualitative interviews with homeless adults who are receiving psychiatric emergency services in a community crisis stabilisation centre that serves Boston neighbourhoods identified as urban heat islands, the results will directly inform the development of novel interventions and policies which address the needs of those most vulnerable to the health impacts of climate change.

Project 3, *Housing and Neighbourhood Determinants of Sleep and Mental Health in Low-Income Toddlers and Their Parents,* is using geocoding to assess neighbourhood-level factors, including housing and heat island severity, and spatial analyses to examine these factors in relation to actigraphs (wearable devices that measure rest/activity) and parent-reported indices of toddler sleep and mental health in Denver

FIGURE 2

Source: Isabelle Anguelovski et al., "From Heat Racism and Heat Gentrification to Urban Heat Justice". (In review)

and Boston. The main aim is to understand the contributions of poverty-related disparities in the neighbourhood and housing to sleep and mental health problems in early childhood. The researchers are drawing on data from an ongoing randomised controlled trial, the Parent and Toddler Health (PATH) project, which focuses on low-income families with toddlers experiencing co-morbid sleep and mental health problems, and interviews with the participants to assess family-level rent burden, housing stability, and overcrowding.

Effects of triple-H on Southeast Asian cities: Singapore and Jakarta as examples
Singapore seems to be ahead of its regional neighbours in terms of climate resilience. Experiencing increased urban heat, it has established its National Climate Change Secretariat (NCCS) which ensures that the country's climate resilience strategies remain up to date. The NCCS sits in the Prime Minister's Office, the pinnacle of policymaking in the country. That said, there may yet be issues for the marginalised populations in Singapore, and mental health has received less attention than physical health to date.

A triple-H issue that may deserve attention is the emergence of Singapore as a climate haven, given its ambitious climate change policies. Climate refugees may well be the new normal and a significant challenge for the country. Fleeing extreme heat that is not managed well elsewhere,

they will no doubt put pressures on housing and health services in Singapore. Such an existential threat underlines the importance of not only cooperating with other cities and states beyond Singapore's borders, but also taking the interplay of triple-H seriously.

Jakarta, Indonesia, like other Southeast Asian cities, has also started developing and implementing its climate mitigation strategies. For example, low-income neighbourhoods in Jakarta, which have limited green spaces, have become heat islands that disproportionately affect the health of people living and working in them because of higher temperatures than surrounding areas and the lack of access to cooling devices. The Indonesian capital has regulations that highlight the importance of equal distribution of green spaces across the city, but studies have found the city is still far from reaching its goal of providing adequate and fair access to open green spaces for all its residents.[20]

Meanwhile, Jakarta has built a number of child-friendly public places (RPTRA), which have the potential to be used as cooling spaces, but they have been criticised for being exclusionary to low-income populations.[21] Like in many cities around the world, green spaces in Jakarta are more likely to be found in high-income neighbourhoods, both old and new. New-build developments are often branded/advertised with plush green spaces (called 'green gentrification' in Euro-America and 'bourgeois environmentalism' in India).[22] Many cities, especially dense and poorer ones, posit limited space and budget as the reason for not building more green spaces in their urban environs. But limited space is not always a barrier if you are up to the challenge as Singapore appears to be.

DEVELOPING AN URBAN-H INDEX
The IoC and the SMU Urban Institute are currently in discussion on developing an Urban-H Index.

There are already numerous urban and city-related indexes–from global city indexes to creative city indexes to sustainable city indexes, and so on. We have looked at the history of such indexes and their links to competitive city rankings, in relation to what we are planning for our Urban-H Index.

There has always been an interest in ranking and comparing cities, but the city rankings we are familiar with today date back to the 1970s. As Euro-American cities moved into a new post-industrial phase and new forms of globalisation based on new technology emerged, models and indexes were developed to guide investment decisions in cities. For example, Swiss bank UBS released its first Prices and Earnings Survey in 1970 that compared the consumption power of citizens in 72 cities globally. Interest in city rankings increased throughout the 1980s and 1990s and they were more often developed to support the newly globalising, neoliberal economy. Examples include those produced by the Economist Intelligence Unit and Mercer for multinational companies.

In 2008, the *Foreign Policy* journal noted that "the world's biggest, most interconnected cities help set global agendas, weather transnational dangers, and serve as the hubs of global integration. They are the engines of growth for their countries and the gateways to the resources of their regions".[23] It published a ranking of global cities based on consultation with urban sociologist Saskia Sassen and urbanist Witold Rybczynski.[24]

The ranking was based on 27 metrics across five dimensions: business activity, human capital, information exchange, cultural experience, and political engagement. Universities have also increasingly weighed in on the global ranking of cities. For example, UK-based Loughborough University's Globalisation and World Cities Research Network is known for organising cities into alpha, beta, and gamma tiers based on their integration into the global network.[25]

Over time, city indexes and rankings became of interest not just to businesses, but also city and national governments. Consulting firms, think tanks, and universities have all got in on the act. An example would be American urban studies theorist Richard Florida's Creative City Index. Meanwhile, new city indexes using different data, methodologies, and with increasing levels of sophistication are being developed and these are evolving all the time.

Our Urban-H Index will be different from other urban indexes as it will be the first socially and environmentally just index for cities globally that has been developed. It will measure the complex interplay of triple-H in 3D space using World Health Organization (WHO) and other national health data, global climate remote sensing data, UN Habitat, and national and city-wide housing data. We will use cloud computing and machine learning to map 'actual liveability' at the neighbourhood and city level. The goal of the Urban-H Index rankings is to identify cities, large and/or

small, that could serve as havens in the face of a triple-H crisis, so as to inform policy and promote intercity learning globally.

MOVING FORWARD ON THE TRIPLE-H CRISIS
In developing mitigations, if not solutions, for the triple-H crisis, global, national, and local governments, policymakers, and practitioners need to triangulate research and evidence that intersects housing, heat, and health. Given that marginalised urban populations are the most overexposed to the triple-H crisis, they deserve particular attention. The development of an Urban-H Index that ranks cities globally in terms of how well they do in dealing with the intersection of housing, heat, and health would be the icing on the cake.◾

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