

# Future Urban Risk Landscapes: An insurance perspective

November 2021



# Future Urban Risk Landscapes: An insurance perspective

**Kai-Uwe Schanz**

Deputy Managing Director and Head of Foresight & Research  
The Geneva Association

## The Geneva Association

The Geneva Association was created in 1973 and is the only global association of insurance companies; our members are insurance and reinsurance Chief Executive Officers (CEOs). Based on rigorous research conducted in collaboration with our members, academic institutions and multilateral organisations, our mission is to identify and investigate key trends that are likely to shape or impact the insurance industry in the future, highlighting what is at stake for the industry; develop recommendations for the industry and for policymakers; provide a platform to our members and other stakeholders to discuss these trends and recommendations; and reach out to global opinion leaders and influential organisations to highlight the positive contributions of insurance to better understanding risks and to building resilient and prosperous economies and societies, and thus a more sustainable world.

---

Photo credits:

Cover page— Shutterstock.com

---

Geneva Association publications:

Pamela Corn, Director Communications

Hannah Dean, Editor and Content Manager

Petr Neugebauer, Digital Media Manager

Suggested citation: The Geneva Association. 2021.

*Future Urban Risk Landscapes: An insurance perspective.*

Author: Kai-Uwe Schanz. November.

© The Geneva Association, 2021 All rights reserved

[www.genevaassociation.org](http://www.genevaassociation.org)

---

# Contents

<b>Foreword</b>	5
<b>1. Executive summary</b>	6
<b>2. Introduction</b>	8
<b>3. The dynamics of urbanisation</b>	10
3.1 Scale and pace	10
3.2 Determinants	11
<b>4. An integrated assessment of future urban risk landscapes</b>	13
4.1 A conceptual framework of urban risk	14
4.2 Climate change	18
4.3 Smart cities	22
4.4 Socio-economic and demographic shifts	23
<b>5. Harnessing insurance solutions</b>	26
5.1 The drivers of insurance in urban areas	26
5.2 Property and casualty insurance and urbanisation	28
5.3 Life and health insurance and urbanisation	31
5.4 Challenges to insurance solutions for urban areas	32
<b>6. Conclusions and recommendations</b>	33
<b>References</b>	37

## Acknowledgements

This publication is a product of the Socio-economic Resilience work stream of The Geneva Association, co-sponsored by Christian Mumenthaler, CEO of Swiss Re, and Markus Riess, CEO of ERGO.

We would like to thank the members of the Working Group, established in support of our Socio-economic Resilience research activities, namely: Manuel Aguilera (MAPFRE), Matthew Blakely (RGA), Olivier Desbiey (AXA), Paul DiPaola (AIG), Naomi Graham (IAG), Arne Holzhausen (Allianz), Thomas Holzheu (Swiss Re), Kei Kato (Tokio Marine), Mehul Mehta (Chubb), Gisela Plassmann (ERGO), Gonzalo de Cadenas Santiago (MAPFRE) and Clarence Wong (Peak Re). In addition, we are very grateful to Juliette Prieur (AXA Research Fund) and Lauren Sorkin (Resilient Cities Network) for their support in connecting us to senior experts.

Our special thanks go to the following contributors to this publication:

- Deborah Balk, Professor, Marxe School of Public and International Affairs, Baruch College, The City University of New York
- William Donner, Associate Professor of Sociology, University of Texas Rio Grande Valley
- Saurabh Gaidhani, Lead Programs, Resilient Cities Network
- Snigdha Garg, Head of Adaptation Research and Performance, *C40 Cities*
- Mike Gillooly, Chief Resilience Officer, City of Christchurch
- Maryam Golnaraghi, Director Climate Change & Environment, The Geneva Association
- Dagmar Haase, Professor of Landscape Ecology, Humboldt University, Berlin
- Mahesh Harhare, Chief Resilience Officer, Pune City, Member of Global Steering Committee, Resilient Cities Network
- Cassidy Johnson, Professor of Urbanism and Disaster Risk Reduction at the Bartlett Development Planning Unit, University College London
- Lykke Leonardsen, Head of Program for Resilient and Sustainable City Solutions, City of Copenhagen
- James F. Murley, Chief Resilience Officer, Miami Dade County
- Alfredo Redondo, Senior Advisor, Diplomacy and Engagement, Coalition for Urban Transitions
- Debra Roberts, Head of the Sustainable and Resilient City Initiatives Unit in eThekweni Municipality in Durban, South Africa.

# Foreword

The world's population continues to grow, and that growth is essentially centred in cities. By 2050, over two thirds of the world's population is expected to live in urban environments, up from just under a third in 1950. Cities bring huge economic and social benefits, but they are also complex and vulnerable ecosystems that are exposed to an exponential rise in risks.

The future urban risk landscape will be shaped on multiple fronts. Climate change threatens to bring more extreme weather events, such as floods, heatwaves and harsh winters; human density accelerates the speed at which infectious diseases spread, while social inequality can exacerbate the risks of social unrest and crime. Smart cities have the potential to create efficiencies and build resilience, but they also increase dependency on technology and complex infrastructure, adding to risk complexities and interdependencies.

How will cities cope with this evolving risk landscape? What will this mean for vulnerable city dwellers? With climate change at the front of all our minds, how will larger urban populations manage the impact of extreme heat and potential water scarcity on top of more frequent, and more severe natural disasters? This report sets out to understand how the urban risk landscape is changing and examine insurers' potential contribution to mitigating emerging risks and vulnerabilities.

Urbanisation will in all likelihood increase demand for insurance, as individuals, businesses and municipal authorities look for ways to mitigate urban risks. However, left unchecked, urbanisation challenges the fundamental principles of insurability, especially when climate change and pandemics are added into the mix. The challenge is formidable; collaboration between the public and private sectors, as well as concerted risk management strategies and insurance innovation, could go a long way toward managing the changing urban risk landscape.



Jad Ariss  
Managing Director, The Geneva Association





# 1. Executive summary

Today's urban areas are complex and vulnerable ecosystems made up of a wide range of components, from infrastructure, transportation and health to distinctive economic and social features. These components are increasingly interconnected and interdependent. **All drivers of risk have grown exponentially, in particular those relating to hazard, vulnerability and exposure.** Some risks, such as natural disasters, are well-established. Others, such as rising sea levels and the vulnerability of smart power grids, are growing at a rapid rate.

Going forward, urban risks are expected to be driven by **three main underlying trends**: first, **climate change** and a rising frequency and severity of extreme weather events; second, **smart urbanisation** and the risk of systemic and catastrophic disruptions; and third, **socio-demographic shifts** such as income and wealth inequality and the rapid ageing of rich-world populations and infrastructures. These trends have the potential to adversely affect multiple critical parts of a city's operations, putting the health, lives, livelihoods and assets of inhabitants at risk.

**Urban risks are expected to be driven by three main underlying trends: climate change and extreme weather events, smart urbanisation and socio-demographic shifts.**

Man-made climate change is a well-researched major contributor to disaster risk in cities. It not only directly affects the frequency and severity of weather-related hazards but also brings longer-term shifts such as sea level rise, water scarcity and quality issues, as well as sustained higher temperatures and heatwaves. These changes may render existing social and physical systems in cities ineffective, e.g. infrastructure in the face of more frequent storm surges or snow storms, and exacerbate social vulnerabilities.

Most cities are characterised by significant inequalities in economic, social and living conditions. Urban populations are more likely to include displaced people and those with low socio-economic status. Informal settlements, like slums, are the most pronounced manifestation of inequality and continue to be a growing feature of the urban landscape and a persistent risk for municipal authorities, exacerbating the risk of disease outbreaks, as well as civil unrest, riots, crime and violence. However, by facilitating socio-economic mobility and helping overcome gender discrimination, which is typically more severe in rural areas, cities can also contribute to mitigating inequalities. In addition to socio-economic characteristics, demographic shifts impact future urban risk landscapes, notably the rapid ageing of mature market urban populations and the rise of middle-class populations in emerging economies.



Smart urbanisation is characterised by a move to technology-based urban infrastructures aimed at delivering city services more efficiently and effectively, with the ultimate objective of fostering urban resilience and sustainability in a time of rapid population increases and growing environmental and socio-economic challenges. However, the expected benefits such as convenience and sustainability can be accompanied by unintended consequences, e.g. an increasing exposure to catastrophic scenarios such as space weather and heightened security and criminal risks.

**Cities have a bigger need and scope for insurance than rural areas. With the rise of city-level risk management, insurance is also set to become more relevant to urban risk mitigation strategies.**

The high concentration of people and economic values amplifies the loss potential from disasters caused by natural hazards, but also from man-made industrial disasters, terrorism or infectious diseases. Therefore, given their higher exposure to economic loss, cities have a bigger **need and scope for insurance** than rural areas. This includes personal lines insurance such as motor, home and life savings products but also commercial insurance in industrialised urban areas, with increased trade and commerce, concentration of business and infrastructure investment as well as a larger formal employment sector. With the rise of city-level risk management, insurance is also set to continue to become more relevant to urban risk mitigation strategies.

However, a number of **insurance-specific challenges** need to be addressed, too, primarily arising from population density and asset accumulation as well as the interconnectivity of risks. These characteristics have always presented major issues for **risk accumulation and modelling underlying risk exposures**. Uncertainty surrounding climate change and the increased frequency and severity of weather-related natural catastrophes adds to the list of long-standing challenges. In addition, as demonstrated by COVID-19, increased mobility and high population density can drive pandemic risk.

Fiscal constraints on all levels of government were significantly exacerbated by emergency responses to the pandemic. These constraints will soon make themselves felt. Federal governments may be less inclined to step in as 'insurers of last resort' for municipalities, and governments at all levels are set to look differently at private-sector insurers as potential risk takers.

Based on our expert interviews and own research, we have made the following four **recommendations** for insurers and public authorities to consider. Two recommendations require close collaboration between the public and private sectors while the remaining two are more in the court of insurers and municipal authorities, respectively.

First, **deploy concerted public-private efforts in risk management**, e.g. through targeted government investments in resilience-building infrastructure and insurers supporting authorities in city planning, as well as in the development and implementation of risk management strategies, based on their technical expertise and access to vast pools of data.

Second, **harness insurance investment funds for building urban resilience**. Only a tiny fraction of the industry's USD 36 trillion pool of investable assets is allocated to infrastructure projects. More investments should be geared towards capital spending in emissions reduction and improving resilience, which would ultimately contribute to the protection of insurers' balance sheets. As public budgets come under strain, attracting more private money into the modernisation and greening of urban infrastructure is crucial for sustainable growth worldwide. Governments need to mitigate political risks associated with private long-term investments, improve the legal frameworks (such as removing tax rules that put private investors at a disadvantage in funding and operating projects) and review existing solvency regulations specific to insurance that discourage investments.

Third, **explore innovation in risk transfer**, for example through parametric insurance, which, in combination with advanced technologies such as the Internet of Things (IoT), could also help address the major insurance protection gap afflicting those families living in informal settlements. Another innovative approach is insurance that rewards municipal resilience building through premium reductions for residents. Other non-conventional insurance solutions could be geared to shaping individual behaviours, e.g. through multi-year policies that incentivise investments in upgrading resilience post-disaster ('building back better').

Fourth, **address barriers preventing cities from engaging with insurers**. Insurers should communicate with municipal authorities about insurance products in terms of coverages and pricing approaches. Authorities should overcome the tendency to work in silos, with no integrated approach to risk management across health, finance, environment, housing, planning, construction and security departments. This fragmentation hinders overall risk awareness and presents insurers with major barriers to interacting with municipalities.



## 2. Introduction

Cities are home to more than half of the world's population. In 1950, less than a third of the world's population was urban but this is projected to rise to more than two thirds by 2050 with all expected population growth expected to be in urban areas, almost exclusively in emerging markets.<sup>1</sup>

**In 1950, less than a third of the world's population was urban but this is projected to rise to more than two thirds by 2050.**

COVID-19 has cast doubt on such projections. Some experts argue that lasting shifts in working patterns and forms of social interaction will reduce urban centres; others believe that the pandemic will not derail urbanisation but that it will continue to remain vital for industries to cluster together, boosting efficiency and productivity by sharing knowledge and expertise.<sup>2</sup> Most experts agree, however, that the trend towards megacities is likely to stop but the trend toward 'smart cities' will increase, leveraging connected technology and data to improve the efficiency of municipal services and enhance the quality of life and prosperity for residents and businesses. The flipside is an increased exposure to cyber risk.

Urbanisation<sup>3</sup> entails fundamental socio-economic change such as a higher population density and concentration of values, the need for massive infrastructure investments and environmental protection safeguards (especially against air and water pollution), an accelerated pace of industrialisation in the developing world and a loosening of traditional family ties.

These changes present formidable challenges to socio-economic resilience and have significant risk management and insurance implications, both as opportunities and as challenges. Rising incomes in urban areas in developing countries will favour personal lines such as motor and homeowner insurance. Infrastructure investments need insurance cover both during the construction phase and post-construction. The life and health insurance sector will also benefit from the socio-economic changes associated with urbanisation, such as higher levels of social mobility, education opportunities and formal employment.

<sup>1</sup> United Nations 2019.

<sup>2</sup> The Geneva Association 2021a. Author: Kai-Uwe Schanz.

<sup>3</sup> There is no standard definition of 'urbanisation'. It is generally understood to be the transformation of rural areas into cities. It also includes the expansion of cities into 'megacities' with more than 10 million inhabitants as well as the linking of cities into urban 'clusters' (e.g. the Yangtze River Delta region in China).

However, larger urban areas present major challenges for insurers, too. More populous cities with a rising concentration of assets are more prone to large losses from major natural and industrial disasters and vulnerable to health hazards such as epidemics or pandemics.

Against this backdrop, this report offers an integrated perspective on the link between urbanisation and the dynamics of risk landscapes, covering property, cyber, human health and life risks, both in advanced and developing countries. On that basis, the report examines insurers' potential contribution to mitigating some of the arising vulnerabilities.

Urbanisation entails fundamental socio-economic change, which presents formidable challenges to socio-economic resilience and has significant risk management and insurance implications.





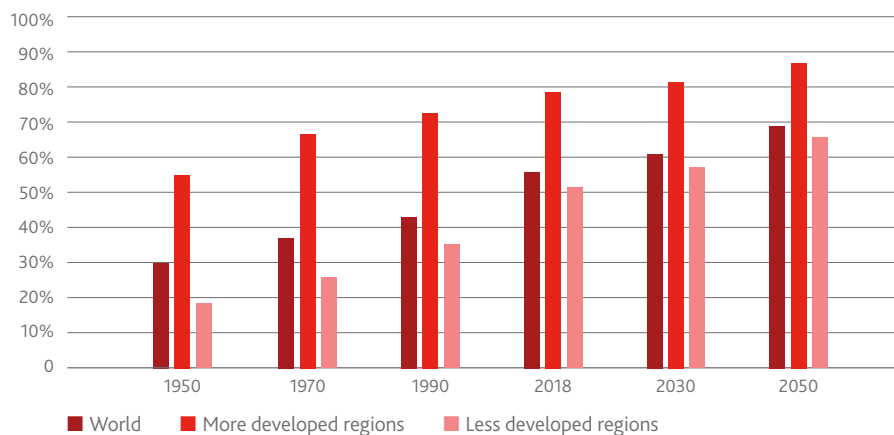
## 3. The dynamics of urbanisation

### 3.1 Scale and pace

Urbanisation transforms formerly rural areas into urban settlements and shifts the distribution of populations accordingly. It covers **changes to occupations, lifestyle, culture and behaviour**. As such, it reshapes the demographic and social structure of both urban and rural areas,<sup>4</sup> with profound implications for the (insurable) risk landscape.<sup>5</sup>

About 55% of the world's population currently lives in urban areas, up from 30% in 1950.<sup>6</sup> Most projections suggest that the future growth of the human population will be almost entirely driven by city dwellers. By 2050, 68% of the world's population is projected to be living in urban areas, fuelled by continued **migration (both domestic and international)** and a surplus of births over deaths in urban areas (see Figure 1).<sup>7</sup>

**Figure 1: Percentage of urban population (1950–2050)**

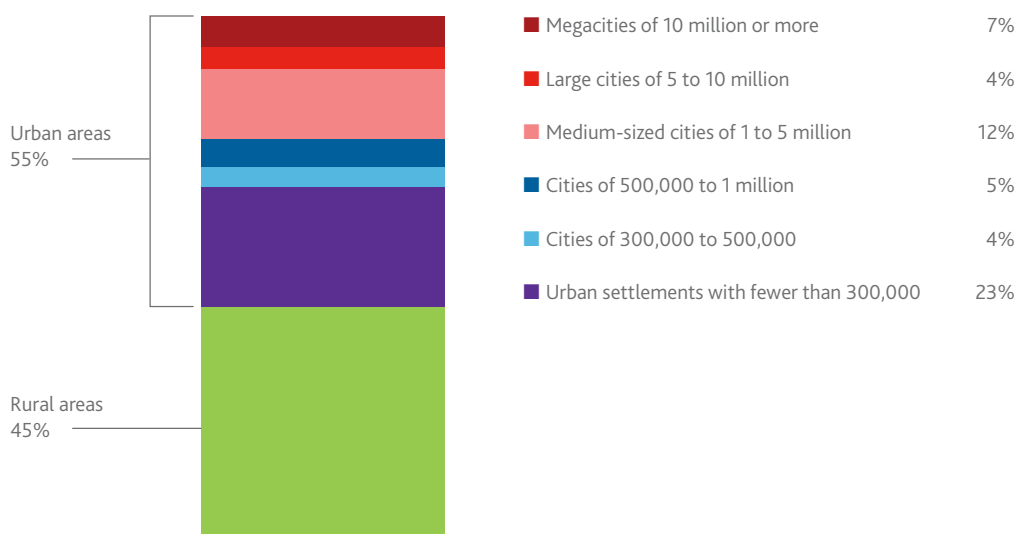


Source: UN<sup>8</sup>

Figure 2 describes the distribution of today's urban population: the largest of the categories at the top end of the 'urban hierarchy' are megacities with 10 million inhabitants or more. Thirty-three megacities in Africa, Asia, Europe, Latin America and North America accounted for 7% of the world's total population in 2018.<sup>9</sup>

4 UN 2019.  
5 See section 4 of this report.  
6 Ibid  
7 Lerch 2017.  
8 UN 2019.  
9 Ibid.

**Figure 2: World population by area of residence and size class of urban settlement, 2018**



Source: UN<sup>10</sup>

### 3.2 Determinants

There are only a few studies focusing explicitly on the factors that drive urbanisation rates. An early empirical study uses Indian census data to track urbanisation rates using population density, industrialisation (as measured by non-agricultural employment), literacy rate and population growth.<sup>11</sup> The study found a significant positive effect of **mechanisation in agricultural production** at the beginning of India's urbanisation cycle, which reduced employment in rural areas and pushed it towards metropolitan areas.<sup>12</sup>

Another paper worth mentioning specifically with respect to the importance of knowledge accumulation in cities found a correlation between individual city sizes in the U.S. and **human capital accumulation**, as measured by the percentage of college-educated workers in the labour force.<sup>13</sup> Expanding education systems in urban areas is easier and less costly than in rural areas. Therefore, returns to education are generally found to be higher in urban than rural areas.<sup>14</sup>

Another study to examine the causal mechanisms of urbanisation and productivity growth<sup>15</sup> found a significant

correlation between urbanisation and **productivity growth** (growth of output per worker). The paper shows that there is an optimal degree of urban concentration, in terms of maximising productivity growth, and this degree varies with the level of development and country size. To some extent this reflects agglomeration economies, i.e. benefits that come when firms and people locate near one another in cities and industrial clusters.<sup>16</sup>

A more recent paper provides new evidence on the impacts of **economic growth**, education and industrialisation on a country's urbanisation rate.<sup>17</sup> The authors argue that the direction of causality runs from growth to urbanisation, rather than, as generally suggested before, vice versa. As shown in earlier papers, urbanisation and growth go hand-in-hand: no country has ever reached middle-income status without a significant population shift into urban areas. And, as Hofmann and Wan suggested,<sup>18</sup> urbanisation is necessary to sustain or even drive growth, especially in developing countries. Urbanisation implies an accumulation of people and businesses that reduces production and transaction costs as well as facilitates specialisation among firms.

10 UN 2019.

11 Pandey 1977.

12 More recent studies on urbanisation explore major new drivers of urbanisation in India, such as investments in information technology services and structures (International Growth Centre (IGC) 2016).

13 Black and Henderson 1999.

14 Arouri et al. 2014.

15 Henderson 2003.

16 Glaeser 2010; OECD 2015; OECD/European Commission 2020.

17 Hofmann and Wan 2013.

18 Ibid.





Urbanisation and growth go hand-in-hand: no country has ever reached middle-income status without a significant population shift into urban areas.

Hofmann and Wan also established a significant positive causal effect of **education and industrialisation** on the urbanisation rate.<sup>19</sup> Historically, in advanced economies, urbanisation was linked to the shift from agriculture to manufacturing in the 19th century. More recently, urbanisation and a transition to the service sector have typically occurred in tandem.<sup>20</sup>

19 Hofmann and Wan 2013.

20 OECD/European Commission 2020.



## 4. An integrated assessment of future urban risk landscapes

Today's urban areas are complex and vulnerable ecosystems that are increasingly interconnected and interdependent.

Prior to the industrial revolution, cities may have been simple accumulations of people. Today's urban areas, however, have evolved into complex and vulnerable ecosystems made up of a wide range of components, from infrastructure, transportation and health to distinctive economic and social features. These components are increasingly interconnected and even interdependent. All drivers of risk – hazard, vulnerability and exposure – have increased exponentially. Shocks now have the potential to impact urban systems at large and, as a result, entire economies, given the concentration of economic output in cities. Some risks such as the compounded effects from disasters caused by natural hazards are well-established features but new risks, such as rising sea levels and the vulnerability of smart power grids, are growing at a rapid rate.<sup>21</sup>

All drivers of risk have increased exponentially and shocks now have the potential to impact urban systems at large and, as a result, entire economies.

<sup>21</sup> UNEP 2007.



Urban vulnerabilities are determined by a few key factors: firstly, the exposure itself, such as the fact that coastal areas are disproportionately home to cities and urban populations and these cities and their inhabitants are prone to climate-related risks including sea level rise, tidal flooding and coastal storms. Secondly, socio-economic characteristics of city dwellers: while cities tend to have more resources than rural or peri-urban localities, they also harbour large economic and social inequality. Third of all, cities have been growing faster than rural localities, and it seems that coastal cities, at least in the last 25 years, have grown faster than cities in other locations. When combined, these three factors may have a compounding effect on urban vulnerabilities, urban inequality and urban management, and thus collectively on all city dwellers.

In order to better understand and address these vulnerabilities, data and models are needed that allow for a globally consistent collection of city-specific data. Satellite imagery has been very valuable in this context and facilitated some progress, especially when combined with demographic and socio-economic data. But data suited to the urban and neighbourhood scale, along with more policy engagement, is required to enable data-driven policy responses to urban vulnerabilities and to assess their effectiveness. We need to understand who is at risk and where in order to build more equal and equitable urban environments and, ultimately, a less risky future for all of us.

Deborah Balk, Professor, Marxe School of Public and International Affairs, Baruch College, The City University of New York

## 4.1 A conceptual framework of urban risk

### 4.1.1 Urban risk as a function of hazard, vulnerability and exposure

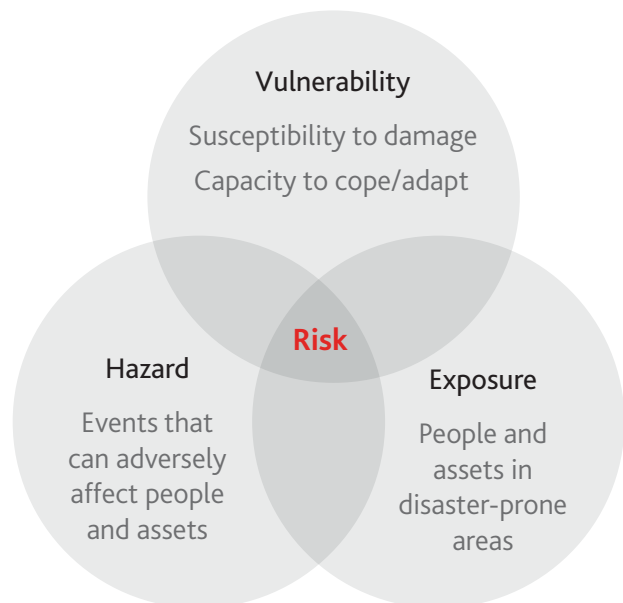
In the urban context, too, risk can be viewed as a function of the frequency of a *hazard* coupled with the degree of vulnerability of people and assets as well as their exposure to hazards. *Hazard* describes the possible, future occurrence of natural or man-made physical events that

may adversely impact vulnerable and exposed people or assets.<sup>22</sup> The intensity or recurrence of hazard events can be partly explained by environmental degradation and human intervention in natural ecosystems, e.g. anthropogenic climate change.<sup>23</sup>

*Vulnerability* is related to predisposition, susceptibilities, fragilities, weaknesses, deficiencies or lack of capacities that increase the likelihood of adverse effects on exposed people and assets.<sup>24</sup> Early views of vulnerability in the context of disaster risk management were based on the physical resistance of engineering structures,<sup>25</sup> but views rapidly expanded to characteristics of social and environmental processes such as climate change. Today's view of vulnerability reflects the physical, social, economic and geographical constraints that limit the ability to prepare for or withstand the impacts of a hazard.<sup>26</sup>

*Exposure* refers to the magnitude of people and assets in an area where hazard events may occur.<sup>27</sup> Therefore, **for a disaster to occur people or assets must be exposed to the hazard and vulnerable to losses** (Figure 3).<sup>28</sup>

Figure 3: The determinants of urban risk



Source: The Geneva Association

22 Cardona et al. 2012.

23 For an early analysis see Lavell 1996.

24 Ibid.

25 UNDHA 1992.

26 Clark-Ginsberg et al. 2020.

27 UNISDR 2004.

28 Clark-Ginsberg et al. 2020.

Vulnerability in the context of urban risk management is a tangible illustration of the **social construction of risk**. Humans, in their interaction with the physical world, construct disaster risk by transforming physical events into hazards through economic and social processes that augment the exposure and vulnerability of population groups, their livelihoods as well as assets. Examples include population growth, excessively rapid urban development, environmental degradation, increases in socio-economic inequalities and failures in governance (e.g. corruption and mismanagement).<sup>29</sup>

*The world is facing imminent risks from an increasing frequency and severity of climate-related natural disasters which threaten the lives and livelihoods of hundreds of millions of urban dwellers. It is therefore critical to safeguard urban infrastructure and service offerings against these physical climate risks to ensure a healthy, safe and thriving society. In response, cities have taken a front seat in addressing these issues through an integrated approach to urban risk. Cities are increasingly focusing on understanding risk, mainstreaming resilience, avoiding maladaptation and reducing systemic risk. Now more than ever, there is a need for urgent action to lead the world towards a green and just recovery.*

**Snigdha Garg, Head of Adaptation Research and Performance, C40 Cities**

#### 4.1.2 A simple typology of urban hazards

The distribution of risks varies greatly between urban areas and within them. For instance, poorer people often face greater vulnerability given their lack of resources in case a disaster strikes.<sup>30</sup> Risks also vary between cities, reflecting differences in geography, topography, climate, wealth and regulations. For instance, relative to other cities, large coastal cities are obviously more directly vulnerable to storm surges and rising sea levels.<sup>31</sup>

Even though urban risk profiles are city-specific, certain hazards are common to virtually all urban areas:

- **Natural hazards** affect all cities, albeit at differing levels of frequency and severity.

- Cities are exposed to **man-made unintentional hazards** such as transportation and industrial accidents or fires.
- Cities face **intentional man-made hazards** such as war, terrorism, rioting and cyberattacks on critical infrastructure, shaped by socio-economic factors such as marginalisation, poverty and unequal economic development.<sup>32</sup>

**Though urban risk profiles are city-specific, certain hazards are common to most urban areas: natural hazards, unintentional man-made hazards such as fires, and intentional man-made hazards such as cyberattacks.**

The line between natural hazards, unintentional and intentional man-made hazards is sometimes blurred. Neglect, negligence, corruption, poor planning and lax enforcement (e.g. building codes) can significantly augment disaster losses triggered by natural hazards. For example, while the destruction of physical assets may have been caused by a natural hazard such as a river flooding,<sup>33</sup> the underlying cause of the disaster may have been intentional human decisions, including building in a hazardous location or the failure to keep building codes up to date.<sup>34</sup>

In combination with vulnerabilities and exposures these hazards develop into **major urban risks, which are augmented by three main underlying trends:**

1. **Climate change** and an increased frequency and severity of extreme weather events such as floods, hurricanes and heatwaves.
2. **Smart urbanisation** and the risk of systemic and catastrophic disruptions.
3. **Socio-demographic shifts** such as more entrenched social inequality and the rapid ageing of rich-world cities and implications for infrastructure development and housing, for example.

<sup>29</sup> Parvina and Johnson 2014; Cardona et al. 2012.

<sup>30</sup> Lewis and Kelman 2012.

<sup>31</sup> Clark-Ginsberg et al. 2020.

<sup>32</sup> Ibid.

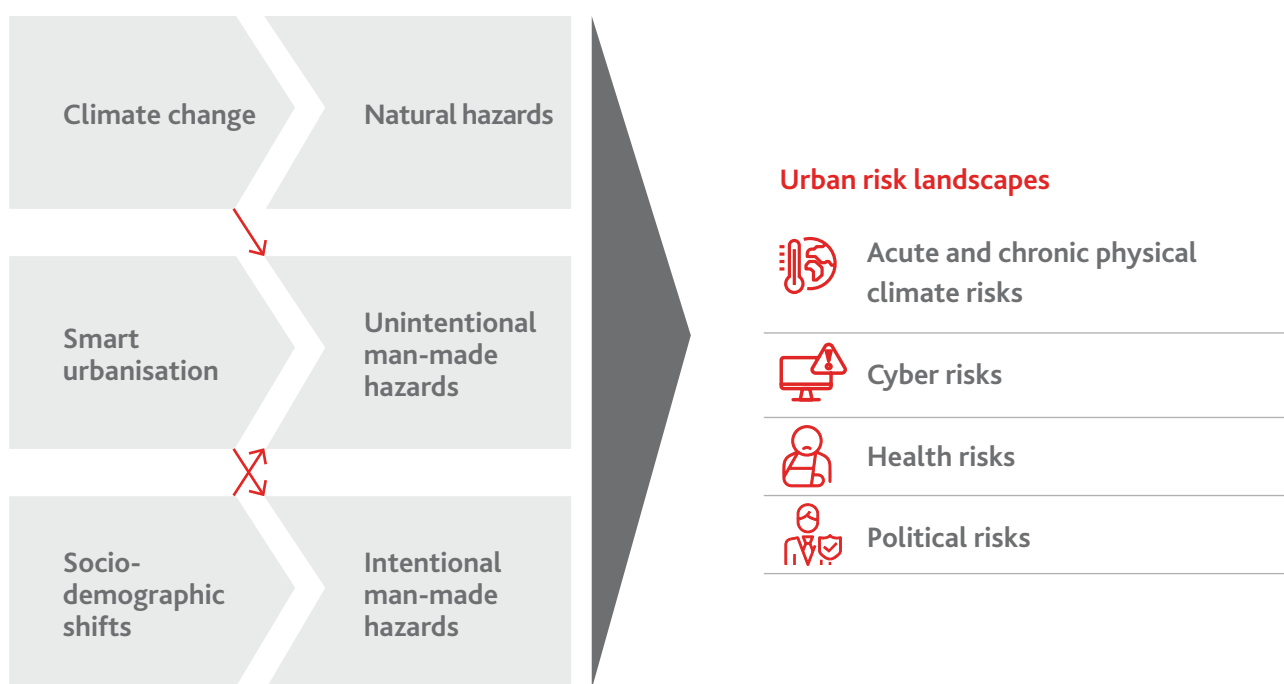
<sup>33</sup> The Geneva Association 2020b. Authors: Maryam Golnaraghi, Swenja Surminski and Carolyn Kousky.

<sup>34</sup> Peters et al. 2019. This example points to the critical role of governance and urban planning in shaping the risk landscape of cities (Dodman et al. 2017).

These trends often interact with each other and have the potential to adversely affect multiple critical parts of a city's operations, putting the assets, health, lives and livelihoods of inhabitants at risk.

Man-made climate change is leading to physical risks (acute and chronic)<sup>35</sup> and transition risks, driven by changes to legislation and policies in the pursuit of net-zero objectives or a failure by cities to invest in climate-resilient infrastructures or unmanaged risks of new technologies.<sup>36</sup> Also, smart urbanisation may give rise to an increase in both unintentional and intentional man-made hazards (such as malicious cyberattacks) and, as a result, increasing levels of cyber risk. Finally, socio-demographic shifts may translate into intentional man-made hazards (such as political violence) and could also favour the spread of high-impact respiratory pathogens. In combination with growing exposures and vulnerabilities, these hazards heighten political and health risks, respectively (see Figure 4).<sup>37</sup>

**Figure 4: A simple typology of urban hazards**



Source: The Geneva Association

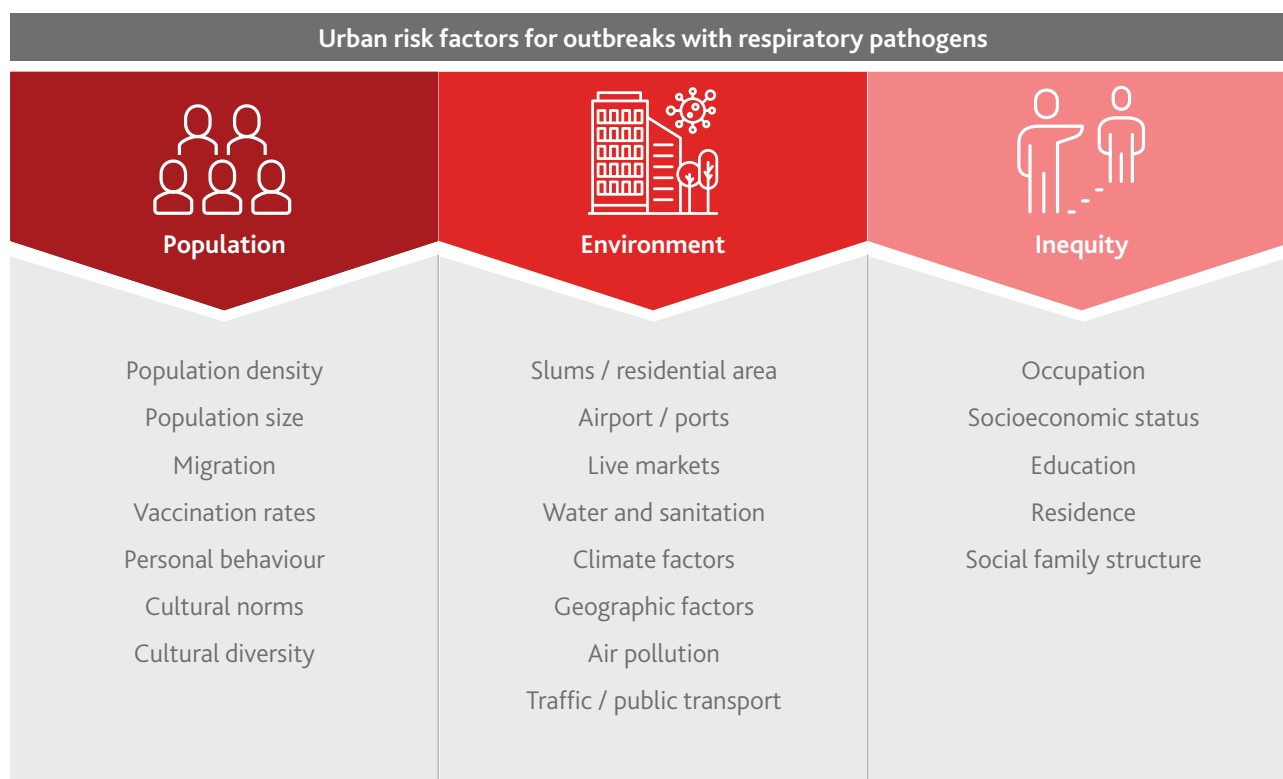
35 TCFD 2017. See also section 4.2 of this report.

36 The Geneva Association 2019. Author: Maryam Golnaraghi. One could even argue that climate change exposes intentional man-made risks, e.g. inadequate building codes in corrupt environments.

37 However, the example of cities like Hong Kong and Singapore suggest that density per se is not an amplifier of such pathogens. Fang and Wahba 2020 offer similar evidence for Mainland China. Also, the lack of medical resources in many rural areas may counter 'natural' advantages in stemming the spread of pandemics.

Epidemics in urban environments present particular public health challenges. There are factors specific to urban areas that favour the spread of high-impact respiratory pathogens (see Figure 5).

**Figure 5: How population, the environment and inequity affect the spread of respiratory pathogens**



Source: Norwegian Institute of Public Health

Population size and density are the most obvious urban risk factors for respiratory pathogens such as influenza and tuberculosis. Crowded urban settings such as events, markets (and wet markets in particular) and transport hubs are hotspots for disease transmission.<sup>39</sup>

Also, urban populations are often disproportionately mobile and tend to commute to work, mostly by public transport. In addition, urban settlements are frequently transport hubs and promote a rapid national and global spread of infectious diseases.<sup>40</sup>

Another risk factor is most urban settings' heterogeneity, with inequalities in economic, social and living conditions, coupled with unequal access to healthcare services.<sup>41</sup> Urban populations are more likely to include displaced populations such as homeless people. In addition, they often include populations living in informal settlements.

Approximately one billion people live in slums, with poor housing quality, overcrowding and inadequate access to safe water and sanitation; conditions which can augment the risk of spread and the severity of disease outbreaks.<sup>42</sup>

Additionally, individuals with lower socio-economic status tend to live in areas with above-average air pollution. These spatial inequities can exacerbate the impact of outbreaks with respiratory pathogens and have led to higher COVID-19 mortality in more polluted areas.<sup>43</sup>

38 NIPH 2020.

39 Boyce et al. 2019. Additional population-specific risk factors include age structure and health status.

40 Alirol 2011.

41 Ibid.

42 Neiderud 2015.

43 Wu 2020.

## 4.2 Climate change

Climate change is a well-researched major contributor to disaster risk in cities, through three main avenues:

- It directly affects the frequency and severity of **acute physical risks** such as storms, hurricanes, typhoons, wildfires, floods and droughts. In addition, it drives **chronic physical risks** such as rising sea levels as well as challenges to water supply and quality and sustained higher temperatures and prolonged heatwaves.<sup>44</sup>
- Changing climate patterns may render existing social and physical systems in cities ineffective (e.g. infrastructure in the face of more frequent storm surges), exposing cities to **transition risk** associated with the need for more resilient infrastructure (energy, transportation, construction, water and waste management, etc.)<sup>45</sup>
- Climate change **exacerbates existing social vulnerabilities** by undermining individuals' and households' ability to cope, for example by exposing socially disadvantaged dwellers to urban heatwaves or adversely impacting farmers' ability to reliably grow crops, which, in turn, could cause disruptions to cities and accelerate rural to urban migration.<sup>46</sup> These perils are increasingly connected, for example, heatwaves lead to increased drought risk and air pollution, exacerbating exposure to risk and economic and human loss.

Climate change contributes to disaster risk in cities through three main avenues: physical risk, transition risk and exacerbation of existing social vulnerabilities.

*The urban poor are disproportionately vulnerable to growing climate risks. From Delhi to Jakarta to Cape Town, poor and marginalised people living on the outskirts of cities face deadly risks during torrential rains and floods. Many informal settlements are built on unsafe sites, such as landslide-prone slopes and floodplains, with substandard materials. Households often lack basic necessities; in Indonesia, for instance, less than 10% of households in the poorest quintile have access to piped water supply, and only a third have access to improved sanitation facilities. The precarity of these poor urban communities makes them highly vulnerable to a wide range of shocks – not just climate impacts or other natural disasters, but also disease outbreaks, as the COVID-19 pandemic has made painfully clear.*

Alfredo Redondo, Senior Advisor, Diplomacy and Engagement, Coalition for Urban Transitions

Among specific chronic physical risk factors, **exposure to sea level rise** is particularly relevant. In 2015, 14% of city dwellers (about 500 million people) were living in a low elevation coastal zone (LE CZ) compared to 6% of the rural population. In cities, those parts of the population have also been growing faster than elsewhere.<sup>48</sup> Chinese cities have the highest city population exposed to sea level rise (128 million people, followed by India with 54 million people). More than 20% of city dwellers in Bangladesh, China, Indonesia, Japan and the Philippines live in such exposed areas. Thailand and Vietnam have 82% and 63%, respectively, of their city population living within a LE CZ (see Table 1).<sup>49,50</sup>

44 IPCC 2014; CDP 2019; TCFD 2018.

45 Clark-Ginsberg et al. 2020. Over 700 major cities have committed to halving their carbon emissions by 2030 and achieving net zero by 2050 (C40 2021). Meeting these targets would require new approaches to land use, building and construction, transportation, infrastructure for energy and water, for example. Such transitions are accompanied by a variety of new risks and uncertainties associated with public policy, market conditions, new technologies and climate litigation against municipal governments, referred to as climate transition risks (TCFD 2018). However, addressing urban risks associated with transitioning to net zero is beyond the scope of this report.

46 Sanchez-Rodriguez 2009.

47 Coalition for Urban Transitions 2020.

48 OECD/European Commission 2020. Low elevation coastal zones are defined as areas below 10-metre elevation and contiguous with the seacoast (MacManus 2019). Of the city population in these zones, one in three city dwellers was living in the zone most exposed to storms and sea level rise (below five metres).

49 Ibid.

50 MacManus et al. 2021.

**Table 1: Top 10 countries ranked by city population/share in low elevation coastal zones 2015**

Ranked by total population living in cities in low elevation coastal zones				Ranked by share of population living in cities in low elevation coastal zones		
Rank	Country	Population (thousands)	%	Country	Population (thousands)	%
1	China	127,792	23	Suriname	200	100
2	India	54,456	8	Belize	69	100
3	Bangladesh	40,286	48	Guyana	224	100
4	Indonesia	34,209	24	Thailand	16,747	82
5	Japan	26,467	32	Bahamas	164	80
6	Vietnam	23,767	63	Mauritania	1,170	80
7	Thailand	16,747	82	Netherlands	5,979	77
8	United States	15,912	10	Djibouti	421	70
9	Egypt	14,038	24	Liberia	1,055	65
10	Philippines	12,763	33	Vietnam	23,767	63

Source: MacManus, based on Florczyk<sup>51</sup>

**Flood risk**, as an acute risk exacerbated by climate change, looms large, too. One in five people living in cities, or more than 800 million people, are exposed to a 100-year flood (see Table 2).<sup>52</sup> Table 2 shows that this exposure is heavily concentrated in a few cities, with the most exposed located in Asia. Climate change is expected to increase the risk of 100-year floods due to more extreme weather.<sup>53</sup>

Land use choices, types of development and the destruction of mangroves and wetlands for the sake of construction further increase flood risk. The use of impervious surfaces, such as concrete and asphalt, prevent water from seeping into the soil and exacerbate the risk of pluvial flooding. As buildings, roads and housing developments replace natural landscapes, water infiltration is inhibited and flood risk grows.<sup>54,55</sup>



51 MacManus 2019; Florczyk 2019.

52 Dottori et al. 2016.

53 OECD/European Commission 2020; The Geneva Association 2020b.

54 Osti 2018.

55 The Geneva Association 2020b.



**Table 2: The 20 cities with the highest population exposed to a 100-year flood, 2015**

City	Country	Exposed population, 2015	Percentage of population exposed, 2015
Shanghai	China	21,503,000	88
Guangzhou	China	17,640,000	43
Kolkata	India	17,164,000	79
Dhaka	Bangladesh	15,269,000	64
Bangkok	Thailand	14,647,000	99
Delhi	India	14,151,000	53
Cairo	Egypt	9,251,000	47
Tianjin	China	6,642,000	100
Wuhan	China	6,338,000	86
Suzhou	China	5,418,000	63
Surat	India	5,330,000	97
Seoul	South Korea	5,268,000	24
Baghdad	Iraq	5,140,000	96
Ho Chi Minh City	Vietnam	4,958,000	43
Osaka-Kyoto	Japan	4,827,000	31
Hanoi	Vietnam	4,533,000	85
Jieyang	China	4,425,000	42
Mexico City	Mexico	4,398,000	22
Chattogram	Bangladesh	3,418,000	65
Khartoum	Sudan	3,270,000	56

Source: Florczyk<sup>56</sup>

Flood exposure in coastal cities is increasing rapidly, owing to growing populations and assets, and is further exacerbated by changing climate. Hallegatte et al.<sup>57</sup> provide a quantification of present and future flood losses in the world's 136 largest coastal cities. Average global flood losses in 2005 were estimated to be approximately USD 6 billion per year and are projected to increase to an annual USD 52 billion by 2050 based on expected socio-economic change alone. With climate change and subsidence,<sup>58</sup> annual losses could dramatically increase to USD 1 trillion or more, based on existing protection and adaptation measures.

In addition to flood risks, **heatwaves**, equally augmented by climate change, present increasing challenges to urban areas in particular. For example, the heatwaves of 2003 in Europe caused up to 70,000 deaths, especially from respiratory and cardiovascular causes and primarily in urban areas.<sup>59</sup> The recent heatwave in Western North America with record-breaking temperatures also caused a spike in deaths although exact numbers are still unknown.

**The risk of heatwaves is augmented by climate change, and presents increasing challenges to urban areas in particular.**

Rising temperatures generate heat-related stress and very likely increase the short-term mortality rate from heatstroke, not least in developing countries, where urban areas continue to grow rapidly, exposing more people to the risk of heatwaves and heatstrokes as a result of the so-called heat island effect.<sup>60</sup> Overall, from 2000 to 2018, heat-related mortality in people older than 65 years increased by 54% and, in 2018 alone, reached close to 300,000 deaths, the majority of which occurred in Japan, eastern China, northern India, and central Europe (see Box 1 for a mitigation option).<sup>61</sup> A more recent example is the unprecedented heatwave that struck British Columbia (Canada) in June 2021. Some 570 of the 815 sudden deaths recorded during a week of record-breaking heat were directly caused by extreme temperatures.<sup>62</sup>

56 Florczyk 2019.

57 Hallegatte et al. 2013.

58 Land subsidence can be caused, for example, by excessive groundwater extraction, load of constructions and natural consolidation of alluvial soil (Abidin et al. 2015).

59 Robine et al. 2008.

60 Costello et al. 2009.

61 Watts et al. 2021.

62 CBC 2021.



*Extreme heat is one of the planet's clearest signals of global warming. However, it remains an invisible threat, a 'silent killer'. The impact of extreme heat is particularly severe in large cities and their 'heat islands'. In the U.S., heatwaves now cause more deaths than any other climate-driven natural disaster. With that in mind, and as part of the Extreme Heat Resilience Alliance's City Champions for Heat Action initiative, Miami-Dade County Mayor Daniella Levine Cava has recently appointed its first-ever Chief Heat Officer. As the impacts of heat grow in the county, they are further compounded by hurricanes, floods and sea level rise. And extreme heat does not impact people equally – poorer communities and Black and Hispanic people bear the brunt of the public health impacts.*

**James F. Murley, Chief Resilience Officer, Miami-Dade County**

Furthermore, the slow-onset impacts of climate change on **water resources** are receiving increasing attention. In addition to changes in precipitation intensity and variability, which will augment the risk of floods and droughts in many areas, changes to water quality and quantity will be experienced. Disruption to water supplies will pose risks to economic production chains and urban food supplies.<sup>63</sup> Current urban water management practices may not be robust enough to cope with the anticipated impacts of climate change.<sup>64</sup>

### Box 1: A 'green sponge' for smart and climate-adapted cities<sup>65</sup>

Climate change affects all parts of the planet's surface, including urban landscapes. It raises not only risks and challenges but also offers opportunities.<sup>66</sup> Heatwaves and an increase in morbidity and mortality rates among the most vulnerable urban residents force cities to 'green invest' in both the built environment and public spaces. Green infrastructure such as trees, parks, rooftops or living walls helps to buffer heat and to keep air cool.<sup>67</sup> However, green infrastructure and its underlying ecosystems are living systems and need water to grow. In this context, we face possibly the most important trade-off between all types of nature - based solutions and the availability of water. Water shortage is the key risk factor in most urban landscapes of today – and even more so in the future.<sup>68</sup> This trade-off calls for investments in research on the implementation of the 'sponge city'. Compared to pure flood risk measures, the sponge city can keep water while lowering flood peaks. It is a novel urban concept for inclusive flood management, strengthening both green-blue infrastructure and drainage systems. The sponge city can alleviate a city's waterlogging and water resource shortages. At the same time, it supports local biodiversity by absorbing and capturing rainwater. Effective water absorption techniques can also be utilised to mitigate flood risk. Importantly, green space watered by the sponge can improve the quality of life and air as well as reduce urban heat islands, also in times of water shortage.<sup>69</sup>

What is more, the more equal the spatial distribution of green spaces across a city, the lower the risk of harmful climate change impacts. This will in the long run reduce municipal health costs as an overall healthier population copes better with climate change.<sup>70</sup>

Digital and social media infrastructure can support linking data and information flows about water amounts and balances and thus the flows of benefits and burdens during heatwaves, droughts and flood events. Leveraging technology can smooth the path towards smarter ways of urbanisation – together with an eye on distributional justice – which accept climate change as a key component of the urban risk landscape.

Source: Contributed by Dagmar Haase, Professor of Landscape Ecology, Humboldt University, Berlin

63 Hurlimann and Wilson 2018.

64 Bates et al. 2008.

65 In 2014, China launched its 'sponge city' strategy, which requires that 80% of all urban land is capable of absorbing or reusing 70% of storm water by retrofitting cities so that they can absorb water. Concrete measures include permeable pavements, artificial ponds and rain gardens to capture excess rainfall in underground storage facilities (Zevenbergen et al 2018). Hong Kong is a relatively advanced example of the sponge city concept (Drainage Services Department (DSD) of Hong Kong 2017).

66 Egerer et al. 2021.

67 Kabisch et al. 2021.

68 Elmqvist et al. 2021.

69 Pauleit et al. 2019.

70 Haase et al. 2017.

However, climate change should not obstruct the view of major non-weather related disaster risks, first and foremost earthquakes. If any previous major earthquake event happened today, it would be much more momentous than at the time. This is a direct consequence of rapid urbanisation, a tremendous increase of population and infrastructure, economic development and commercial interdependence, making urban areas much more sensitive to earthquake impact.<sup>71</sup>

### 4.3 Smart cities

Since the beginning of the 21<sup>st</sup> century, there has been a move to technology-based urban infrastructures aimed at delivering city services more efficiently and effectively. This trend is epitomised by the notion of smart cities and their ambition to transform urban governance and living with the ultimate objective of fostering urban resilience and sustainability in a time of rapid population increases and growing environmental and societal challenges.<sup>72,73</sup> Since very recently, from the lens of technology, urban risks have been viewed more holistically, as a 'quantum city'. This concept seeks to harness new technologies and platforms, like machine intelligence, IoT, distributed ledger technologies (such as blockchain) and big data, to provide new risk insights.<sup>74</sup>

**Smart cities aim to transform urban governance and living, with the ultimate objective of fostering urban resilience and sustainability.**

However, the expected benefits from smart cities (convenience and sustainability in particular) can be accompanied by unintended consequences. One example is **an increasing exposure to catastrophic scenarios such as space weather** knocking out satellite communications, causing wide-spread power outage and threatening essential infrastructure.<sup>75</sup> Another example is **heightened security and criminal risk** (e.g. software bugs, data errors, network viruses and hacks) that come with networked computation, and IoT in particular.<sup>76</sup> Objects that used to be 'dumb', such as thermostats, domestic appliances, security cameras and lighting systems, are

increasingly becoming networked and 'smart', generating information about their use and becoming controllable (and manipulable) remotely.<sup>77</sup>

**However, the expected benefits can be accompanied by unintended consequences such as increased exposure to catastrophic scenarios and heightened security risk.**

*The pandemic has highlighted the need for and value of decentralised structures, from distribution of vital goods, to workplaces and education. In India's IT hubs, remote working is here to stay, reducing workers' vulnerability to risks associated with urban mobility and health, for example. Similarly, parts of education will shift online for good, with equally beneficial effects on vulnerability. Risk reduction through decentralisation could ultimately help the insurability of urban exposures in emerging markets, for individuals/households, businesses and the public sector alike.*

**Maresh Harhare, Chief Resilience Officer, Pune City, Member of Global Steering Committee, Resilient Cities Network**

More generally, cyberattacks exploit at least one of four major vulnerabilities of digital technologies that are pivotal to smart city systems: weak software security and data encryption; the use of insecure legacy systems and poor ongoing maintenance; the complexity and size of smart city systems, with many interdependent attack surfaces and the spectre of cascade effects across multiple parts of a city's infrastructure; and multiple vulnerabilities arising from human error and deliberate malfeasance of disgruntled (ex)employees.<sup>78</sup>

These vulnerabilities are exacerbated by a lack of clarity on who is responsible for maintaining security across complex

71 Bostenaru et al. 2014.

72 White 2016.

73 Swiss Re 2021.

74 Swiss Re 2019.

75 Lloyd's 2020.

76 Little 2010.

77 CSIS 2016; Lloyd's 2018.

78 Kitchin and Dodge 2019.

systems and in situations where city administrations are under pressure for year-on-year 'efficiency' savings.<sup>79</sup>

Given the mass adoption of networked technologies for city management, existing vulnerabilities are likely to increase in the future. Mitigation strategies need to keep pace with these dynamics and may include more systemic interventions (such as security-by-design or the formation of core security and computer emergency response teams).<sup>80</sup>

*Across Asia, digital governance will continue to accelerate, with additional spending on digital infrastructure. In the same vein, the pandemic has hastened the adoption of digital technologies even among small businesses. Everyone will have a digital face in the not-too-distant future. This is set to enable significant progress in delivering urban services such as healthcare and education. However, this shift may increase risks of digital exclusion. Social cohesion may weaken if digital divides are growing, a risk that would affect all businesses operating in urban areas.*

Saurabh Gaidhani, Lead Programs, Resilient Cities Network

*In Africa, the process of urbanisation is different to that previously experienced in the global North. The continent is urbanising rapidly in the absence of widespread industrialisation and as a result Africa's cities are often characterised by a high degree of informality. Poor and vulnerable people are building settlements that respond to their needs and resources and therefore the drive to 'formalise the informal' by both the public and private sector is often not contextually or culturally appropriate. Insurers, too, are called upon to acknowledge urban informality – and to find ways to enable risk management as they have been doing in poor rural and agricultural settings. The key question is: how can insurance empower informal communities to better manage the acute and chronic risks to which they are exposed, and to build back better?*

Debra Roberts, Head of the Sustainable and Resilient City Initiatives Unit in eThekweni Municipality in Durban, South Africa

#### 4.4 Socio-economic and demographic shifts

Most cities are characterised by **significant inequalities in economic, social and living conditions**. Urban populations are more likely to include displaced populations and those with low socio-economic status.<sup>81</sup> Informal settlements, as the most pronounced manifestation of inequality, continue to be a growing feature of the urban landscape and a persistent risk for municipal authorities.<sup>82</sup>

Socio-economic disparities in urban centres conjure up a host of risks: poor housing quality, overcrowding and inadequate access to safe water and sanitation can exacerbate the risk of spread and the severity of disease outbreaks. Also, civil unrest, riots, crime and violence undermine the long-term sustainability of urban development.<sup>83</sup> These risk factors are compounded by reduced social cohesion, changing family structures and the relaxation of traditional cultural norms, which yield new and riskier patterns of individual behaviours.<sup>84</sup> Indeed, the World Economic Forum's (WEF) 2021 Global Risks Report, a global survey of business leaders, identified the **eroding social cohesion** in urban areas as a major risk facing economies today.<sup>85</sup> Box 2 explores the contribution of informal social networks to strengthening the resilience of (underrepresented) groups in urban society.

**Most cities are characterised by significant inequalities in economic, social and living conditions, which conjure up a host of risks.**

79 Cerrudo 2015.

80 Kitchin and Dodge 2019.

81 Boyce et al. 2019.

82 Politico 2017.

83 NIPH 2020; Lloyd's 2020.

84 Alirol 2011.

85 WEF 2021a.

In addition to socio-economic disparities, loosening family ties as a result of urbanisation present major challenges as informal safety nets in rural areas need to be replaced by more formal ones in cities.<sup>86</sup>

## Box 2: Informal urban networks in disaster

Operating outside of official institutions, such as governments, informal social networks play an important role in the development of resilient urban communities. In addition to emergency management and media, friends, family, co-workers, community associations, clubs and religious groups – all considered informal institutions – act as additional channels through which disaster information circulates within and between communities. As a rule, community members connected to social networks tend to receive more reliable information more quickly. On the other hand, members poorly integrated into the informal institutions of the community may miss out on information critical to the warning and preparedness process.<sup>87</sup>

Indeed, the role of social networks during disasters cannot be overstated. Following a gas explosion in Israel, it was found that a majority of victims sought information and assistance through informal social networks rather than directly through authorities: 45% sought out information from immediate neighbours, whereas only about 13% called the police.<sup>88</sup> Similar patterns were observed following a flood event in Australia where a majority (55%) of respondents reported receiving alerts first through informal sources followed closely (40%) by formal sources.<sup>89</sup> Frequent interaction of family members,<sup>90</sup> strong community or network involvement<sup>91</sup> and regular association with a subculture or voluntary association<sup>92</sup> has also been shown to facilitate the transmission of information during crises. Indeed, access to social networks among communities otherwise isolated from formal networks could mean the difference between life and death when disaster arrives. In an analysis of the deadly 1995 Chicago heatwave, mortality was linked to an “increase in the number and proportion of people living alone, including seniors who outlive or become estranged from their social networks.”<sup>93</sup> In addition to older adults, such seclusion from conventional networks may place other groups at risk, including, but not limited to, recent immigrants, tourists, the disabled and the homeless. It would be a mistake to regard informal networks as simply filling in the gaps missed by formal warnings. Rather, informal warnings play a core role in the warning process itself. Thinking to the future, social media holds the potential to change how informal networks operate during a disaster in the areas of rumour,<sup>94</sup> crowdsourcing<sup>95</sup> and confirmation behaviour.<sup>96</sup>

Source: Contributed by William Donner, Associate Professor of Sociology, University of Texas Rio Grande Valley

86 See section 5.

87 Scanlon and Frizelli 1979.

88 Kirschenbaum 1992.

89 Molinari and Handmer 2011.

90 Lardy and Rogers 1982.

91 Rogers and Nehnevajsa 1987.

92 Perry et al. 1981.

93 Kleinenberg 2001.

94 Chua et al. 2017.

95 Ripberger et al. 2014.

96 Wood et al. 2018.



Having said this, urbanisation generally contributes to economic growth and to overall poverty alleviation.<sup>97</sup> Cities provide opportunities for many rural migrants in terms of better job prospects and higher salaries. However, socio-economic disparities, especially in low-income countries, can jeopardise such benefits.<sup>98</sup>

In addition to growing socio-economic imbalances, **demographic shifts** impact future urban risk landscapes. In mature economies in particular, cities are increasingly facing a major demographic challenge to their future prosperity. Global population growth is slowing as fertility rates decline. At the same time, the pace of rural-to-urban migration is waning in many parts of the world. As a result, urban populations have started to shrink in some of the developed world's largest cities. These shifts have ramifications for a wide range of urban policies, from the accessibility of infrastructure and housing to health and social care.<sup>99</sup>

**Demographic shifts impact future urban risk landscapes. Urban populations have started to shrink in some of the developed world's largest cities, with ramifications for a wide range of urban policies.**

In most emerging countries, on the other hand, urban populations keep increasing. Larger middle-class populations in cities have significant environmental and social implications. Naturally, the carbon footprint per person will rise as the middle class with elevated consumption patterns, including housing, nutrition and mobility, expands. Two factors could mitigate these risks. First, middle-class growth is associated with rural-to-urban migration and, for a given level of income, households in urban areas tend to have a smaller carbon footprint than households in rural areas (primarily driven by transport). Second, middle-class households tend to invest more in their children's education, which could further reduce fertility rates and help put global population growth on a more sustainable trajectory.<sup>100</sup>

97 See section 3 of this report.

98 Alirol 2011.

99 McKinsey 2016.

100 Kharas 2017.



## 5. Harnessing insurance solutions

### 5.1 The drivers of insurance in urban areas

Urban areas tend to be more affluent, with a **higher density of personal and commercial assets** and people than rural zones.<sup>101</sup> At the same time many large cities are located in coastal areas particularly prone to weather-related disasters. The high concentration of people and economic values amplifies the loss potential from disasters caused by natural hazards, but also from man-made industrial disasters, terrorism or infectious diseases. Therefore, cities offer a bigger need and scope for insurance. This includes personal lines insurance such as motor, home and life savings products but also commercial risk solutions in industrialised urban centres, with increased trade and commerce, concentration of business and (infrastructure) investment as well as a larger formal employment sector. With the rise of city-level risk management, insurance is also set to become more relevant to urban risk mitigation strategies as municipal chief resilience officers are tasked to look beyond departmental boundaries and adopt a more holistic view of urban risk.<sup>102</sup>

**With the rise of city-level risk management, insurance is set to become more relevant to urban risk mitigation strategies.**

In addition, urbanisation is associated with profound **social changes such as reduced intergenerational or family support and improvements in longevity**, creating a need for old-age health, long-term care and pension products. In emerging markets, there is the additional challenge of providing migrants with access to basic needs, also with a view to mitigating the threat of social unrest.<sup>103</sup>

At the same time, alongside higher financial literacy, **consumerism** tends to grow as urbanisation progresses, with implications for liability insurance. Another important social change relates to **city lifestyles**, which give rise to 'urban diseases' such as diabetes, cardiovascular diseases and cancer, partly driven by environmental issues such as air and water pollution, which must be reflected in insurance product offerings.<sup>104</sup>

Beyond economic and social factors **technology** is a distinguishing feature of urban centres. The pace of innovation and adoption is significantly faster than in rural areas, making **cyber risks** more pertinent to cities and creating a need for specific risk mitigation approaches, including insurance.<sup>105</sup> Figure 6 summarises the key drivers of insurance in urban areas.

101 Barrese et al. 2016.

102 AXA Research Fund 2018.

103 Swiss Re 2013.

104 Willwert-Pascutiu 2018.

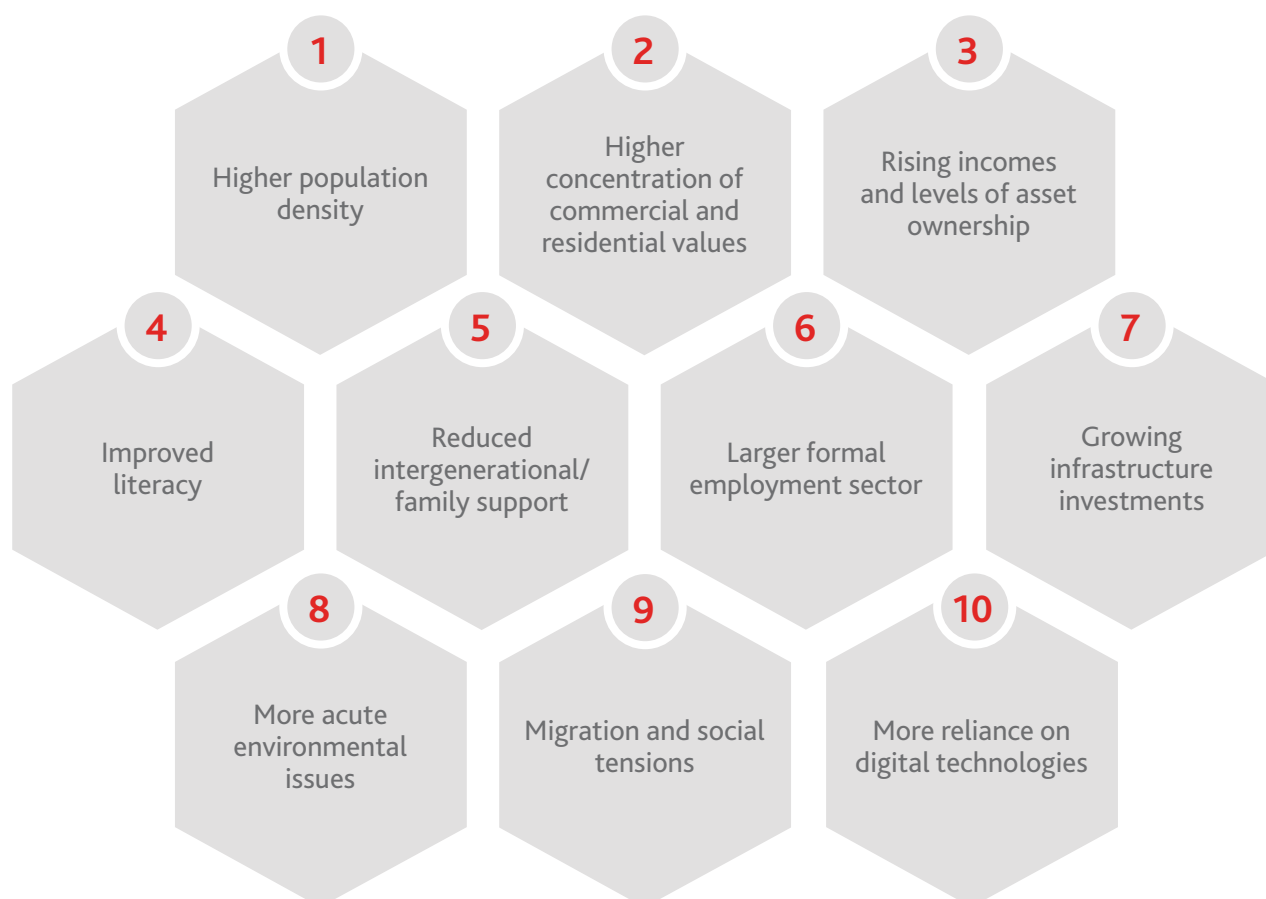
105 Fifita and Grossi 2016.



Insurance has the power to influence nature-based, technological and societal hazards by encouraging households and businesses to adopt measures that reduce their exposure and/or mitigate vulnerability. For example, insurers already set risk-based prices for home insurance, which discourage people from moving to catastrophe-prone areas; insurers could also incentivise investments in resilience, which make residential and commercial property less vulnerable.

Insurance has the power to influence nature-based, technological and societal hazards by encouraging households and businesses to adopt measures that reduce their exposure and/or mitigate vulnerability.

**Figure 6: The drivers of insurance in urban areas**



Source: The Geneva Association



## 5.2 Property and casualty insurance and urbanisation

### 5.2.1 Personal lines

Urbanisation is associated with higher disposable incomes and aspirations for improved ways of living. Personal lines insurance both supports and benefits from the **accumulation of personal assets, such as homes, personal vehicles and other consumer goods.**

Motor insurance generally increases in tandem with car ownership, a phenomenon frequently observed in emerging markets. In China, for example, the motor line of business accounts for more than 60% of all property and casualty (P&C) insurance business, which is largely generated in urban areas.<sup>106</sup>

Going forward, the changing spatial growth patterns of urbanisation in emerging markets will affect motor insurance. Mid-size cities often expand at a faster pace than the megacities, which increasingly face congestion and pollution challenges, prompting local authorities more often than not to actively discourage car ownership.<sup>107</sup> Parking challenges and spiralling repair costs, in combination with improving public transportation networks, have similar effects.<sup>108</sup> On the other hand, **car sharing and autonomous mobility** may offer different and new opportunities for motor insurers.<sup>109</sup>

Homeowner insurance is also becoming more prevalent in emerging markets, partially driven by governments making cover mandatory in order to satisfy the rights of mortgage creditors.<sup>110</sup>

More generally, the demand for personal lines insurance is affected by the **specific needs of millennials**, who account for a significant share of urban populations, especially in emerging markets. To meet their needs, insurers may have to revisit how their policies are constructed, e.g. through innovative bundling or temporary contracts. In the age of the sharing economy and on-demand delivery, millennials expect their insurers to cover them 'now' and for the period of time they 'need' protection.<sup>111</sup>

In the least developed countries' urban centres, **inclusive insurance propositions**, aimed at the excluded or underserved market, could make an important contribution to allaying social tensions.<sup>112</sup> Most urban growth in those countries is uncontrolled, calling for the integration of risk management and risk funding within sustainable development. For precarious urban informal settlements a combination of collective voluntary insurance, housing retrofits financed by low-interest loans and covered by insurance (in order to reduce physical vulnerability) and parametric insurance could be a viable approach.<sup>113</sup>



106 Swiss Re 2020a.

107 Peak Re 2021.

108 Chen and Zhang 2012; Swiss Re 2013.

109 Gatzert and Osterrieder 2020.

110 Zurich 2015.

111 Munich Re 2017.

112 Center for Financial Inclusion and Institute of International Finance (IIF) 2018.

113 Sarmiento and Torres-Muñoz 2020, also for case examples. See section 6 for further elaboration.

### Box 3: Insurance for low-income and informal urban areas in developing countries – what research is needed?<sup>114</sup>

In urban centres in developing countries, those who are living and working in informal or low-income areas of the city are more at risk to being adversely affected by a range of hazards. They are often located on steep slopes, along water bodies or low-lying land parts of the city. This coupled with a lack of basic infrastructure and precarious housing quality makes people living and working in these areas more vulnerable to disasters. At the same time, slow onset events such as water and heat stress make life more difficult and can lead to health problems and loss of working days. Many of these sudden and slow onset events are made worse by climate change, and COVID-19 has potentially resulted in new forms of economic marginalisation and vulnerability.<sup>115</sup>

In general, those working and living in low-income or informal areas of cities suffer greater risk of (1) absolute loss from damage to physical structures and other assets, (2) impacts on health and (3) impacts on livelihoods. Thus, what is needed is to understand how insurance in informal and low-income urban environments could encompass the triple aspects of assets, health and livelihoods in a holistic way to increase the well-being of families affected by disasters.<sup>116</sup>

Efforts to use insurance-based approaches in these urban contexts are still nascent. Microinsurance has had some successes. However, there is a strong body of research showing that trust, information about risk, risk perceptions, gender blindness and cost all play a part in the low uptake and renewal rates for microinsurance.<sup>117</sup> This limits the incentive for the private sector to innovate. Climate risk insurance is a growing area of practice, although most applications are still in rural areas.<sup>118</sup> However, there are also ethical issues – should people who have no spare money be paying for insurance, especially for events caused by climate change? Should the state embrace insurance as a form of social protection? The COVID-19 pandemic has increased social protection programmes, however, more evidence is needed to know if social protection is really effective in supporting poor urban households, and how effective insurance might be in supporting states to provide social protection.

There are some promising experiences with meso-level organisations (such as cooperatives or community-based organisations) that have managed to break the trust barrier,<sup>119</sup> but more work is needed to figure out how the market can support these local initiatives to scale up. There is also a need for stronger data about informal and low-income urban areas. Citizen science and community-generated data could be interesting pathways that make data more robust and at the same time more open and transparent.<sup>120</sup> There is a potential role for insurers to collaborate with meso-level organisations and local governments to innovate on both data and product design, as well as means for delivery for people who lack formal documents, identity and banking service access.

Source: Contributed by Cassidy Johnson, Professor of Urbanism and Disaster Risk Reduction at the Bartlett Development Planning Unit, University College London

114 Johnson 2021.

115 UN 2020.

116 Hallegate et al. 2016.

117 Platteau et al. 2017.

118 Clarke and Dercon 2016.

119 Mahila Housing SEWA Trust (MHT) 2018; All India Disaster Mitigation Institute (AIDMI) 2015.

120 Hillier 2018.

### 5.2.2 Commercial lines

The build-up of commercial assets goes hand-in-hand with demand for a range of commercial insurance products, covering **fire and natural catastrophe risk**, for example. Likewise, the construction of manufacturing, logistics and commercial facilities requires the support from **construction-all-risk and erection-all-risk insurance**. Workers' compensation and **employers' liability insurance**, too, play an important role in facilitating the formalisation of employment and the de-risking of industrial risk landscapes in urban areas.

The build-up of commercial assets increases demand for commercial insurance products. Workers' compensation and employers' liability insurance also facilitate the formalisation of employment and the de-risking of industrial risk landscapes in urban areas.

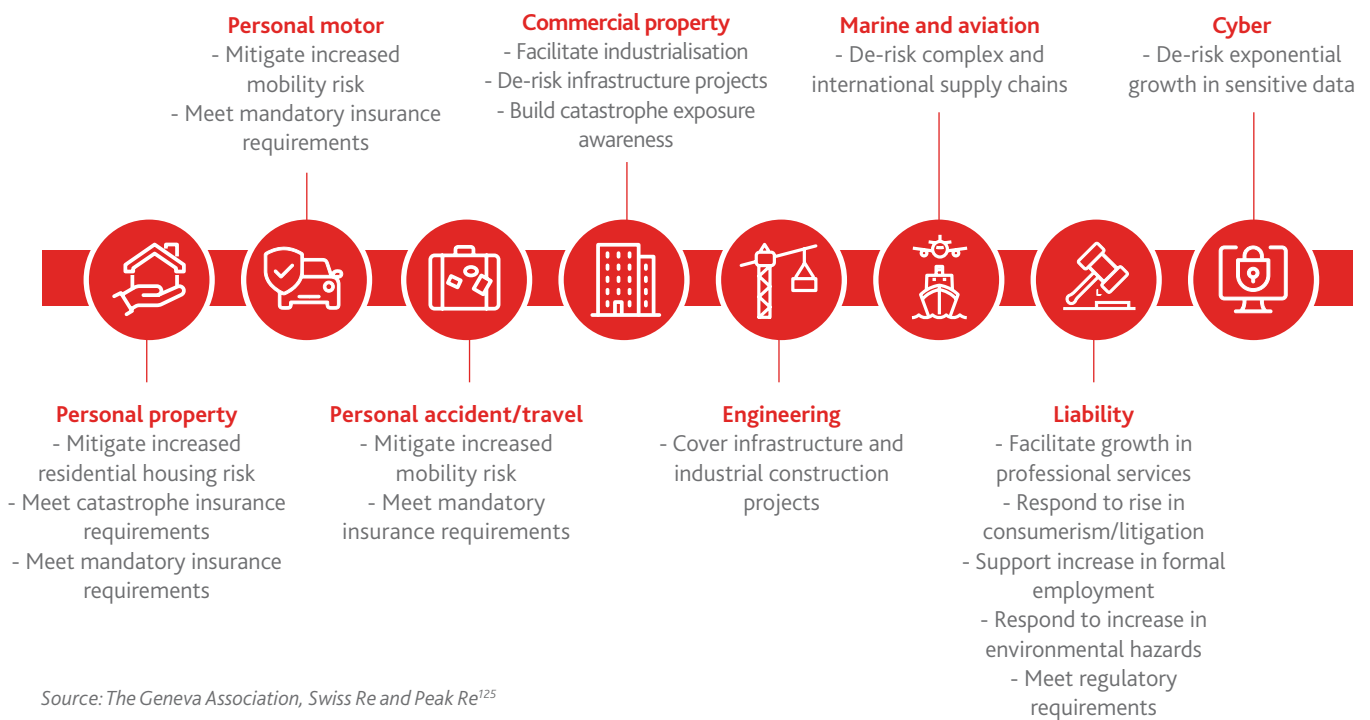
In terms of commercial and public mobility in cities, insurance can also make contributions, e.g. by covering large-scale logistics services, public transportation needs and car-sharing schemes.<sup>121</sup>

**Increased infrastructure spending** and the subsequent growth in economic assets will further add to the relevance of commercial insurance, also after completion of building in the form of property coverage. State ownership of infrastructure assets is an important determinant of the extent of opportunity for the insurance sector, especially in emerging markets. Historically, the take-up rate of insurance for state-owned infrastructure has been low, with risks fully retained by the public sector.<sup>122</sup> This may change in light of the fiscal dislocation suffered by a number of emerging markets as a result of COVID-19.<sup>123</sup>

With the ascent of the service and knowledge-based economy comes a **rise in cybersecurity, intellectual property and other intangible risks**. Corporations, including SMEs, increasingly buy insurance against security breaches, for example, in order to mitigate potential financial and reputation losses resulting from data leakage.<sup>124</sup>

Figure 7 summarises the specific roles of various P&C insurance classes in mitigating urban risk.

Figure 7: How P&C insurance helps mitigate urban risk



Source: The Geneva Association, Swiss Re and Peak Re<sup>125</sup>

121 Ampudia et al. 2020.

122 SEADRIF 2017.

123 BSI 2020.

124 Peak Re 2021.

125 Swiss Re 2013; Peak Re 2021.

### 5.3 Life and health insurance and urbanisation

Urbanisation entails socio-economic changes that affect health and life. The spectrum ranges from a greater chance of pandemics and the erosion of informal social safety nets to an increased exposure to pollution.

**Urbanisation entails socio-economic changes that affect health and life, such as a greater chance of pandemics, the erosion of informal social safety nets and increased exposure to pollution.**

#### Health protection

Urban living generally comes with **lifestyle changes** such as lower levels of physical activity, increased consumption of fast and processed foods and mental stress from various sources. At the same time, smaller household sizes in cities tend to be associated with **reduced intergenerational and family support** and a higher need for third-party healthcare services (e.g. for cardiovascular and cancer-related diseases to lifestyle changes).<sup>126</sup>

High population density can also facilitate the outbreak and transmission of **respiratory diseases**<sup>127</sup> and heightens the relevance of critical illness insurance as well as other forms of relatively easily accessible private health insurance in cities, also in light of the limited capacity of public health services and the higher rate of medical cost inflation in urban areas.<sup>128</sup>

#### Mortality and retirement protection

With urbanisation, mortality protection gaps tend to grow as the **cost of living increases** and, as a result, also the level of income for surviving dependents. Such gaps are particularly acute in emerging markets' urban centres where life insurance offerings are mostly geared towards savings and asset accumulation rather than protection against premature death. The **ongoing shift towards protection** products should benefit middle-class urban dwellers in particular.<sup>129</sup>

Another momentous effect of urbanisation is the **dilution of traditional family bonds**.<sup>130</sup> In cities, the need for long-term care<sup>131</sup> as well as pension insurance could increase as a result. This challenge is particularly pronounced in emerging countries where the influx into towns and cities adds to the burden of providing social security. Given the limited capacity and capabilities of the public sector, migration could open up opportunities for affordable private insurance solutions covering a broad spectrum of risks, from mortality protection to mitigating the risk of old-age poverty. However, evidence of affordable insurance schemes for developing countries' urban low-income communities is limited. The main hurdles include an excessive reliance on government and donor subsidies, a lack of local distribution channels and the inadequate financial literacy of communities.

**Urbanisation also dilutes traditional family bonds, particularly in emerging countries, where opportunities for affordable private insurance solutions covering a broad spectrum of risks could open up.**

*Risk-based insurance pricing is a vital contribution to enhancing resilience. Putting a price tag on risk is an effective way of helping homeowners and other insureds to better understand their individual exposures. Price signals can be the catalyst for decisions to invest in risk reduction particularly around climate-related risks as well as other hazards. For municipal authorities as well, such signals are useful in assessing the risk profile of specific urban areas.*

**Mike Gillooly, Chief Resilience Officer, City of Christchurch**

126 Flies et al. 2019.

127 See Boyce et al. 2019 and Carozzi et al. 2020 for an analysis in the context of COVID-19. See also page 17 in this report.

128 Swiss Re 2013.

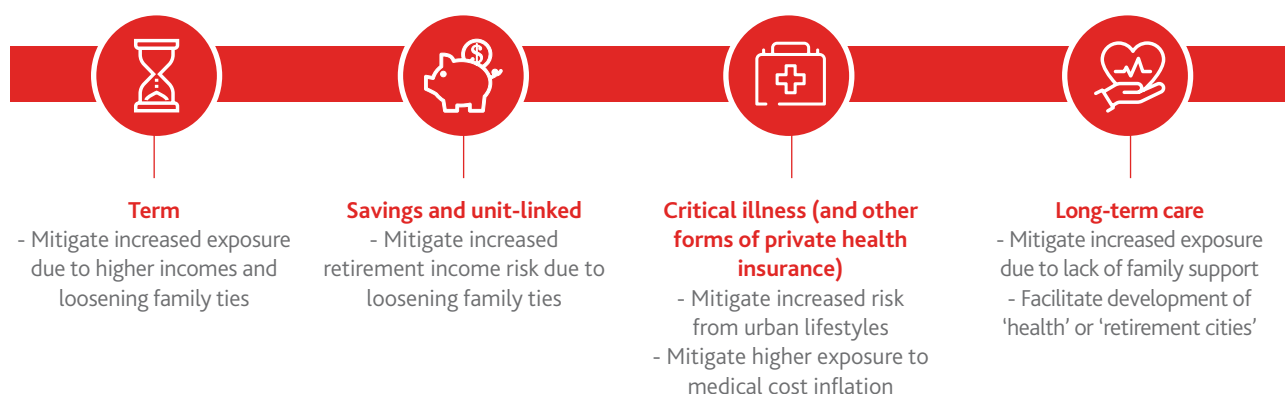
129 McKinsey 2017.

130 Trask 2020.

131 Insurers can also facilitate the establishment of 'health and retirement cities', blending home and community care (Swiss Re 2020b).

Figure 8 summarises the specific roles of life and health insurance classes in mitigating urban risk.

**Figure 8: How life and health insurance helps mitigate urban risk**



Source: The Geneva Association, Swiss Re<sup>132</sup>

## 5.4 Challenges to insurance solutions for urban areas

As discussed in the previous sections, urbanisation offers plenty of opportunities for insurers to prove their relevance to economies and societies. However, a number of specific challenges need to be addressed, too, primarily arising from population density and asset accumulation.

### 5.4.1 Risk management

Urban agglomerations have always presented major challenges in managing risk accumulation and modelling underlying risk exposures. The uncertainty surrounding climate change and the increased frequency and severity of weather-related natural catastrophe events add to those long-standing challenges, especially in light of a lack of data around hazard sites.<sup>133</sup>

Similarly, smart cities might be prone to systemic risks. Connected critical infrastructure such as transportation systems, energy systems (power supply), finance, communication systems (including navigation systems), water supply and health systems may defy the basic principles of insurability due to the underlying accumulation potential.<sup>134</sup>

In addition, as demonstrated by COVID-19, increased mobility and high population density can raise pandemic risk.<sup>135</sup>

### 5.4.2 Informal urbanisation

If urbanisation is not well managed, or even left unmanaged, the ramifications threaten to impair insurance and insurability. Examples include inadequate or non-enforced building codes, a lack of clean water, sanitation and high pollution levels. Such deficits generally occur in developing countries that urbanise without industrialising.<sup>136</sup> Insurance claims across a broad spectrum of lines of business are set to rise and, more generally, risk pricing becomes more challenging. This latter issue is of significant importance to local insurers in light of their typically lower levels of geographic risk diversification. The resultant need for risk-based pricing is difficult to meet given poor data quality on historic losses.<sup>137</sup>

**If not well managed or left unmanaged, urbanisation threatens to impair insurance and insurability.**

132 Adapted from Swiss Re 2013.

133 Swiss Re 2020c.

134 The Geneva Association 2020a. Author: Kai-Uwe Schanz.

135 The insurability implications were known well before COVID-19. See CRO Forum 2007.

136 Sandoval and Sarmiento 2019.

137 Swiss Re 2013.





## 6. Conclusions and recommendations

COVID-19 has greatly influenced the way key trends are perceived to be shaping future urban risk landscapes. Societal awareness of climate risk as a potential existential risk has risen across the globe. Even more tangibly, the pandemic has accelerated hazards, vulnerabilities and exposures associated with the growing reliance on digital technologies and widening social disparities. Fiscal constraints on all levels of government were significantly exacerbated by emergency responses, some of them of a 'whatever it takes' nature. These constraints will soon make themselves felt. Federal governments may be less inclined to step in as 'insurers of last resort' for municipalities. And governments at all levels are set to look differently at private-sector insurers as potential risk takers.<sup>138,139</sup>

Though not triggered by COVID-19, the four recommendations put forward below, based on in-depth expert interviews and our own research, have to be seen against this overarching backdrop. Some of these recommendations are based on close collaboration between the public and private sectors,<sup>140</sup> others primarily fall in either the court of the insurance industry or municipal authorities.

### **1. Deploy concerted public-private efforts in urban risk management**

Policymakers and insurers need to collaborate with a view to facilitating their vital roles in understanding, managing and transferring ever more complex and interconnected urban risks. For instance, governments need to invest in infrastructure and social security in order to accommodate the growth of urban areas and, in developing countries, the challenges presented by migrants from rural areas. Poorly-managed urbanisation, especially in the absence of social security for migrants, heightens the risk of social instability and discourages the provision of insurance services.

138 Insurance is a central component for protecting public assets against disaster risk and for enhancing governments' financial resilience through risk transfer, especially in emerging economies with little fiscal leeway and buffer. A number of governments have been pioneers in setting up innovative and comprehensive public asset insurance programmes, among them Mexico. See IDF 2019.

139 Germany is another case in point: state governments are increasingly requesting insurance of municipal assets as a condition for receiving additional government disaster relief payouts in case of a flood. This increases the pressure on local authorities to insure their assets against flood losses. See The Geneva Association 2020b.

140 The Geneva Association 2021 offers an in-depth discussion of different types of public-private partnerships.

## Policymakers and insurers need to collaborate to understand, manage and transfer ever more complex and interconnected urban risks.

Insurers can play their part by supporting authorities, e.g. in city planning, as well as in the development and implementation of risk management strategies, which includes contingency planning as highlighted by COVID-19. Reinsurers, for instance, can bring to the table rather unique global technical expertise in geophysical disaster risks and their mitigation. Also, as data is becoming more ubiquitous and cities are increasingly relying on it for developing their risk retention and risk transfer strategies,<sup>141</sup> there is an opportunity for insurers who sit at the centre of data collection: by sharing data and risk insights and analytics, insurers could significantly deepen and broaden their relationships with municipal authorities.<sup>142</sup>

Finally, in terms of risk underwriting, insurers should continue to seek a dialogue with governments on how to shape policyholder behaviour, e.g. through risk-based pricing that encourages better construction standards or discourages building in catastrophe-prone areas.<sup>143</sup> Going forward, the lessons learned from partnerships in natural catastrophe risk management might also facilitate public-private sector collaborations in areas such as health and cyber risks.<sup>144</sup>

*Insurers can play a very important role in strengthening urban resilience: first, by sharing data they could enable cities to improve the robustness of their own risk modelling. Second, insurers can help boost the return on resilience building by economically incentivising city dwellers and businesses to invest in their own resilience. And, third, insurers could be faster to reward progress in resilience building on the municipal level, by adjusting premium levels to a safer risk landscape. This could, potentially, set in motion a virtuous circle of continued investment in resilience by municipal authorities.*

**Lykke Leonardsen, Head of Program for Resilient and Sustainable City Solutions, City of Copenhagen**

*Another important area for future public-private partnerships is cities' pursuit of net-zero carbon emission targets. New technologies, systems and infrastructure need to be developed and deployed to enable this transition. Such new technologies and the infrastructure utilising them are accompanied by a variety of operational, safety, environmental, legal and climate change-related risks, which need to be assessed and managed. Resilience is a precondition for an effective technology-enabled transition. Therefore, insurers will have an important role to play in de-risking cities as they transition to net zero, requiring research and innovation.*

**Maryam Golnaraghi, Director of Climate Change and Environment, The Geneva Association**

## 2. Direct insurer investments towards urban resilience

The global insurance industry manages assets of more than USD 36 trillion.<sup>146</sup> Fundamentally, infrastructure investments, for example in energy, transport or broadband projects, align well with life insurers' long-term liabilities and frequently come with an illiquidity premium. Local infrastructure investments also offer insurers a natural hedge against currency risk. If such investments are geared towards capital spending in emissions reduction and improving resilience they also contribute to the protection of insurers' balance sheets.<sup>147</sup>

However, the share of insurance assets directly invested in infrastructure, mainly through equities, bonds or loans, remains low. EU insurers are estimated to invest less than 0.3% of their EUR 10 trillion assets portfolio in infrastructure projects.<sup>148,149</sup>

Public budgets, also at municipal level, are under strain everywhere and will only be able to cover a fraction of future investment needs, not least in light of the rapidly growing need for climate-resilient infrastructure investments. The private sector, and insurers in particular, will have to step in. For this to happen, national governments need to mitigate political risks to private long-term infrastructure investments, improve the legal frameworks (e.g. by removing tax rules that put private investors at a structural disadvantage in funding and

141 ICLEI 2017.

142 Denmark offers an example: Access to insurance company (loss) statistics and information has proven beneficial to municipalities and their work on climate risk. In 2011, for instance, during the Copenhagen cloudburst event, the insurance industry was instrumental in informing post-disaster resilience planning (CICERO Climate Finance 2018).

143 Lloyd's 2017.

144 The Geneva Association 2021b (forthcoming).

145 The Geneva Association 2019; OECD/The Geneva Association 2021.

146 TheCityUK 2021.

147 Carter 2020.

148 EU Commission 2021.

149 NAIC 2021 applies a wider definition of US insurers' exposure to infrastructure. Including corporate bonds financing economic infrastructure and municipal bonds total U.S. insurance industry exposure to economic infrastructure is estimated at about USD 566 billion, more than 5% of US life, health and P&C insurers' invested assets.



operating projects)<sup>150</sup> and review existing insurance (solvency) regulations that discourage investments.<sup>151,152,153</sup>

**Public budgets are under strain everywhere and will only be able to cover a fraction of future investment needs. The private sector, and insurers in particular, will have to step in.**

### 3. Explore innovation in risk transfer

A possible innovative insurance approach to the widely distinct exposures confronting urban areas could be parametric insurance. Parametric insurance lends itself, for example, when a heterogeneous mix of assets (as is typical of informal urban settlements) would be too complex to underwrite via traditional, indemnity-based insurance.<sup>154</sup> Parametric insurance products pay out based on a specific measure of physical hazard rather than an assessment of loss. Such policies could, for example, be triggered by the magnitude of an earthquake, wind speed or rainfall amount within a predefined area. Parametric insurance establishes payouts and provides post-event liquidity much faster and cheaper than traditional indemnity products, which typically require on-the-ground damage and loss assessments.<sup>155</sup> Another advantage of parametric insurance is its non-reliance on historical loss data from natural hazards, which makes it particularly suitable for urban areas in developing countries.<sup>156</sup> The main drawback of parametric insurance is basis risk. The payout amount may differ from the actual losses encountered on the ground.<sup>157</sup> To minimise basis risk, the design of the triggers can be refined, e.g. by using more precise location data for each asset insured.<sup>158</sup> Regulatory challenges are another obstacle, e.g. the difficult distinction between insurance and derivative features.<sup>159</sup>

Parametric insurance, in combination with advanced technologies such as IoT, could also help address a major insurance protection gap afflicting those families living in informal settlements. They have little to no access to insurance, not only because of unaffordability but also in light of insurers' difficulty in quickly locating their homes, assessing the value of their assets, and validating and paying claims.<sup>160</sup>

**Parametric insurance is a possible innovative insurance approach to the widely distinct exposures confronting urban areas. They provide payouts much faster and cheaper than traditional indemnity products and do not rely on historical loss data.**

Another innovative approach is insurance that rewards municipal resilience building through premium reductions for residents. For example, Avalon, NJ, a small city in the U.S., has adopted extensive resilience measures resulting in tangible insurance savings for residents.<sup>161</sup>

Other non-conventional insurance solutions could be geared to shaping individual behaviours. Resilient reinstatement policies, for example, would encourage urban property owners to invest in upgrading resilience following a loss. This may well cost more in the short term but is likely to offer better value to the policyholder over the long term through reduced future claims and lower premiums. With existing short-term (12 months) insurance contracts, there is little incentive for policyholders to choose the resilient reinstatement option. Multi-year insurance policies tied to the property, rather than one-year insurance policies tied to the property owner, might be a solution.<sup>162</sup> More generally,

150 Edwards 2013.

151 Allianz 2014.

152 The Geneva Association 2019

153 Gatzert and Kosub 2017.

154 Ceres 2013.

155 SCOR 2019.

156 IDF 2020.

157 Singer 2019.

158 Swiss Re 2017.

159 IAIS/AII 2018.

160 See Sarmiento 2020 for a comprehensive examination of potential risk transfer options for precarious and marginal urban communities to protect themselves from future damages and losses from socio-natural hazards and disasters at the individual and community levels.

161 Martucci 2020.

162 University of Cambridge Institute for Sustainability Leadership (CISL) 2016.

by fostering resilience, more urban assets are likely to become insurable, which would help the insurance industry's credentials as society's risk manager.<sup>163, 164</sup>

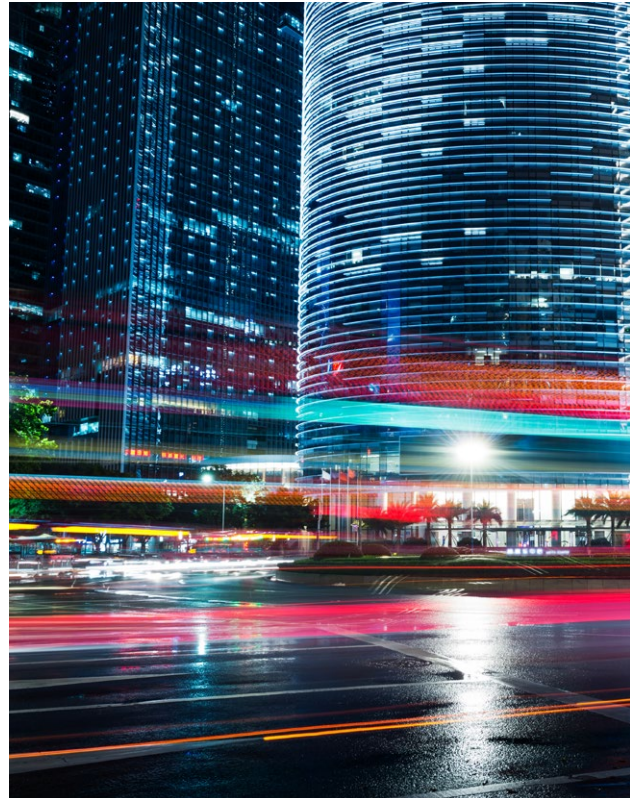
Other non-conventional insurance solutions could be geared to shaping individual behaviours. Resilient reinstatement policies, for example, would encourage urban property owners to invest in upgrading resilience following a loss.

#### 4. *Address barriers preventing cities from engaging with insurers*

First, there are cultural and institutional barriers between cities and insurers that need to be overcome. The public sector mainly self-insures the risks it faces. The notion of transferring risks to third parties such as professional insurance carriers is not yet developed, especially among local authorities. Also, municipal departments frequently work in isolation with no integrated approach to risk management across health, finance, environment, housing, planning, construction and security departments, for example. This fragmentation hinders overall risk awareness and presents insurers with major practical barriers to interacting with municipalities.<sup>165</sup>

Second, especially in developing world municipalities, there is a lack of knowledge about risk management, let alone risk transfer. Therefore, insurers need to raise their game and provide more clarity about available insurance products in terms of coverages and pricing approaches. The latter is particularly important as governments face complex budgeting procedures and constraints, and, at the same time, need to plan for emergency responses to disasters.<sup>166</sup>

Third, tendering processes in the public sector are a major obstacle to developing long-term collaborative relationships with insurers. This 'cost' needs to be weighed against the benefits of tendering such as transparency, equal access to information and fairness.<sup>167</sup>



The notion of transferring risks to professional insurance carriers must be developed in the public sector, insurers need to provide more clarity about products in terms of coverage and pricing, and long-term collaborative relationships between insurers and the public sector need to be forged.

<sup>163</sup> Surminski 2017.

<sup>164</sup> More conventional approaches to offering insurance-based incentives for green construction are already well established. See The Geneva Association 2018. Author: Maryam Golnaraghi.

<sup>165</sup> Lloyd's 2020.

<sup>166</sup> Ibid.

<sup>167</sup> Ibid.

# References

- Abidin, H., H. Andreas, I. Gumilar, and J. Brinkman. 2015. Study on the Risk and Impacts of Land Subsidence in Jakarta. *Proceedings of the International Association of Hydrological Sciences* 372: 115–120.
- AIDMI. 2015. *Risk Insurance and Adaptation: Managing Urban Risks*. [www.preventionweb.net/publications/view/44793](http://www.preventionweb.net/publications/view/44793)
- Alirol, E. 2011. Urbanisation and Infectious Diseases in a Globalised World. *The Lancet Infectious Diseases* 11 (2): 131–141.
- Allianz. 2014. *Investments in Greener Cities – Mind the Gap*.
- Ampudia-Renuncio, M., B. Guirao, and C. Molina-Sánchez. 2020. Understanding the Spatial Distribution of Free-floating Carsharing in Cities: Analysis of the New Madrid Experience Through a Web-based Platform. *Cities* 98. <https://doi.org/10.1016/j.cities.2019.102593>
- Aroui, M., A.B. Youssef, C. Nguyen-Viet, and A. Soucat. 2014. Effects of Urbanisation on Economic Growth and Human Capital Formation in Africa. *Harvard School of Public Health Working Paper No. 119*.
- AXA Research Fund. 2018. *Resilient Cities*.
- Barrese, J., P. Wang, and J. Zhang. 2016. The Effects of Urbanisation on Insurance Consumption—The Experience of China. *Risk Management and Insurance Review* 19: 285–306. <https://doi.org/10.1111/rmir.12063>
- Bates, B.C., Z.W. Kundzewicz, S. Wu, and J.P. Palutikof. 2008. Climate Change and Water. *Technical Paper of the Intergovernmental Panel on Climate Change; IPCC Secretariat*.
- Black, D., and J.V. Henderson. 1999. A Theory of Urban Growth. *Journal of Political Economy* 107 (2): 252–284.
- Bostenaru D., I. Armas, and A. Goretti (Editors). 2014. *Earthquake Hazard Impact and Urban Planning*.
- Boyce, M.R., R. Osman, and R. Katz. 2019. *A Research Agenda for Urban Pandemic Preparedness: A Call to Action*.
- BSI. 2020. *Fiscal Policies in Emerging Countries as a Response to Covid-19*. <http://www.bsi-economics.org/1217-fiscal-polities-emerging-countries-response-covid19-af>
- C40. 2021. 700+ Cities in 53 Countries Now Committed to Halve emissions by 2030 and Reach Net Zero by 2050. [https://www.c40.org/press\\_releases/cities-committed-race-to-zero](https://www.c40.org/press_releases/cities-committed-race-to-zero)
- Cardona, O.D., M.K. van Aalst, J. Birkmann, M. Fordham, G. McGregor, R. Perez, R.S. Pulwarty, E.L.F. Schipper, and B.T. Sinh. 2012. Determinants of Risk: Exposure and Vulnerability. In: *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*, ed. C.B. Field et al., 65–108. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC). Cambridge, U.K., and New York, NY, USA: Cambridge University Press.
- Carozzi, S., S. Provenzano, and S. Roth. 2020. Urban Density and Covid-19. *CEP Discussion Paper No 1711*.
- Carter, L. 2020. Mobilizing Insurance Investment in Sustainable Infrastructure: The Role of the United Nations. *Invest4Climate Knowledge Series*. United Nations Development Programme, New York, NY, USA.
- CBC. 2021. 70% of Sudden Deaths Recorded During B.C. Heat Wave Were Due to Extreme Temperatures, Coroner Confirms. <https://www.cbc.ca/news/canada/british-columbia/bc-heat-dome-sudden-deaths-570-1.6122316>
- CDP. 2019. *Cities at Risk: Dealing with the Pressures of Climate Change*. <https://www.cdp.net/en/research/global-reports/cities-at-risk>
- Center for Financial Inclusion and IIF. 2018. *Inclusive Insurance: Closing the Protection Gap for Emerging Customers*.
- Ceres, The Next Practice Ltd., and The University of Cambridge Programme for Sustainability Leadership. 2013. *Building Resilient Cities – From Risk Assessment to Redevelopment*.

- Cerrudo, C. 2015. An Emerging US (and World) Threat: Cities Wide Open to Cyber Attacks. Securing Smart Cities. <http://securingsmartcities.org/wp-content/uploads/2015/05/CitiesWideOpenToCyberAttacks.pdf>
- Chen, X., and H. Zhang. 2012. Evaluation of Effects of Car Ownership Policies in Chinese Megacities: Beijing and Shanghai. *Transportation Research Record* 2317 (1): 32–39. Doi: 10.3141/2317-05.
- Chua, A., C. Tee, A. Pang, and E. Lim. 2017. The Retransmission of Rumor and Rumor Correction Messages on Twitter. *American Behavioral Scientist* 61: 707–723.
- CICERO Climate Finance. 2018. *Flood Risk for Investors – Are You Prepared?* <https://pub.cicero.oslo.no/cicero-xmlui/bitstream/handle/11250/2497350/Flood%20risk%20for%20investors-final-rev-080518.pdf?sequence=1&isAllowed=y>
- CISL. 2016. *Investing for Resilience*.
- Clark-Ginsberg, A., J.S. Blake, and K. Patel. 2020. Disaster Risk Reduction in Cities: Towards a New Normal. *RAND Working Paper*.
- Clarke, D.J., and S. Dercon. 2016. *Dull Disasters? How Planning Ahead Will Make a Difference*. Oxford University Press.
- Coalition for Urban Transitions. 2020. *Seizing the Urban Opportunity*.
- Costello, A. et al. 2009. Managing the Health Effects of Climate Change. *The Lancet* 373 (9676): 1693–1733.
- CRO Forum. 2007. *CRO Briefing: Influenza Pandemics*.
- CSIS. 2016. *Managing Risk for the Internet of Things*. [https://csis-website-prod.s3.amazonaws.com/s3fs-public/legacy\\_files/files/publication/160217\\_Lewis\\_ManagingRiskIoT\\_Web\\_Redated.pdf](https://csis-website-prod.s3.amazonaws.com/s3fs-public/legacy_files/files/publication/160217_Lewis_ManagingRiskIoT_Web_Redated.pdf)
- Dodman, D., H. Leck, M. Rusca, and S. Colenbrander. 2017. African Urbanisation and Urbanism: Implications for risk accumulation and reduction. *International Journal of Disaster Risk Reduction* 26: 7–15.
- Dottori, F. et al. 2016. Development and Evaluation of a Framework for Global Flood Hazard Mapping. *Advances in Water Resources* 94: 87–102. <https://doi.org/10.1016/j.advwatres.2016.05.002>
- DSD of Hong Kong. *Sponge City – Adapting to Climate Change*. [https://www.dsd.gov.hk/Documents/SustainabilityReports/1617/en/sponge\\_city.html](https://www.dsd.gov.hk/Documents/SustainabilityReports/1617/en/sponge_city.html)
- Edwards, C. 2013. *Encouraging Private Infrastructure Investment*. Cato Institute.
- Egerer, M., D. Haase, T. McPhearson, N. Frantzeskaki, E. Andersson, and H. Nagendra. 2021. Urban Change as an Untapped Opportunity for Climate Adaptation. *npj Urban Sustainability* 1: 22. <https://doi.org/10.1038/s42949-021-00024-y>
- Elmqvist T. et al. 2021. Urbanisation in and for the Anthropocene. *npj Urban Sustainability* 1: 6. <https://doi.org/10.1038/s42949-021-00018-w>
- EU Commission. 2021. *New EU Rules to Promote Investments in Infrastructure Projects*. [https://ec.europa.eu/commission/presscorner/detail/el/MEMO\\_15\\_5734](https://ec.europa.eu/commission/presscorner/detail/el/MEMO_15_5734)
- Fang, W., and S. Wahba. 2020. *Urban Density Is Not an Enemy in the Coronavirus Fight: Evidence from China*. <https://blogs.worldbank.org/sustainablecities/urban-density-not-enemy-coronavirus-fight-evidence-china>
- Fifita, S., and E. Grossi. 2016. *Smart Cities Development: What is the Role of Insurance?* <https://meetingoftheminds.org/smart-cities-development-role-insurance-16473>
- Flies, E.J., S. Mavoa, G.R. Zosky, E. Mantzioris, G. Williams, R. Eri, B.W. Brook, and J.C. Buettel. 2019. Urban-associated Diseases: Candidate Diseases, Environmental Risk Factors, and a Path Forward. *Environment International* 133 (Part A). <https://doi.org/10.1016/j.envint.2019.105187>
- Florczyk, A. 2019. *GHSL Data Package 2019 (database)*. <http://dx.doi.org/10.2760/062975>
- Gatzert, N., and T. Kosub. 2017. The Impact of European Initiatives on the Treatment of Insurers' Infrastructure Investments Under Solvency II. *The Geneva Papers on Risk and Insurance—Issues and Practice* 42 (4): 708–731
- Gatzert, N., and K. Osterrieder. 2020. The Future of Mobility and its Impact on the Automobile Insurance Industry. *Risk Management and Insurance Review* 23 (1): 31–51.
- Glaeser, E.L. 2010. *Agglomeration Economics*. National Bureau of Economic Research: The University of Chicago Press.
- Haase D. et al. 2017. Greening Cities – To Be Socially Inclusive? About the Paradox of Society and Ecology in Cities. *Habitat International*. <https://doi.org/10.1016/j.habitatint.2017.04.005>
- Hallegatte, S., C. Green, R.J. Nicholls, and J. Corfee-Morlot. 2013. Future Flood Losses in Major Coastal Cities. *Nature Climate Change*.



- Hallegatte, S. et al. 2016. Unbreakable: Building the Resilience of the Poor in the Face of Natural Disasters. *World Bank Publications*. <https://documents.worldbank.org/en/publication/documents-reports/documentdetail/512241480487839624/unbreakable-building-the-resilience-of-the-poor-in-the-face-of-natural-disasters>.
- Henderson, J.V. 2003. The Urbanisation Process and Economic Growth. The So-what Question. *Journal of Economic Growth* 8: 47–71.
- Hillier, D. 2018. *Facing Risk: Options and Challenges in Ensuring that Climate/Disaster Risk Finance and Insurance Deliver for Poor People*. Oxfam. <https://policy-practice.oxfam.org/resources/facing-risk-options-and-challenges-in-ensuring-that-climatedisaster-risk-financ-620457/>
- Hofmann, A., and G. Wan. 2013. Determinants of Urbanisation. *ADB Economics Working Paper Series*.
- Hurlimann, A., and E. Wilson. 2018. Sustainable Urban Water Management under a Changing Climate: The Role of Spatial Planning. *Water* 10: 546. Doi: 10.3390/w10050546.
- IAIS/All. 2018. Report of the 26th A2ii – *IAIS Consultation Call Index Insurance Status and Regulatory Challenges*. [https://a2ii.org/sites/default/files/2019-07/index\\_insurance\\_-\\_status\\_and\\_regulatory\\_challenges\\_consultation\\_call\\_report.pdf](https://a2ii.org/sites/default/files/2019-07/index_insurance_-_status_and_regulatory_challenges_consultation_call_report.pdf)
- ICLEI. 2017. *Resilient Cities Report 2017*. [https://resilientcities2018.iclei.org/wp-content/uploads/2017/11/RC2017\\_Report\\_Online\\_26102017\\_Final-compressed.pdf](https://resilientcities2018.iclei.org/wp-content/uploads/2017/11/RC2017_Report_Online_26102017_Final-compressed.pdf)
- IDF. 2019. *IDF Practical Guide to Insuring Public Assets*.
- IDF. 2020. *Technology and Innovation: Tools to Help Close the Protection Gap in Microinsurance Markets*.
- IGC. 2016. *Urbanisation, Demographic Transition, and the Growth of Cities in India, 1870–2020*.
- IPCC. 2014. *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*.
- Jean-Baptiste, N., V. Olivotto, E. Porio, W. Kombe, and A. Yulo-Loyaga. 2018. Housing and Informal Settlements. In *Climate Change and Cities: Second Assessment Report of the Urban Climate Change Research Network*, ed. C. Rosenzweig, W. Solecki, P. Romero-Lankao, S. Mehrotra, S. Dhakal, and S. Ali Ibrahim.
- Johnson, C. 2021. *Think Piece on Risk and Insurance in Low-income and Informal Urban Environments. A Review Paper Prepared for the United Kingdom Research and Innovation*. Unpublished.
- Kabisch, N., R. Kraemer, O. Masztalerz, J. Hemmerling, C. Pueffel, and D. Haase. 2021. Impact of Summer Heat on Urban Park Visitation, Perceived Health and Ecosystem Service Appreciation. *Urban Forestry & Urban Greening* 60: 127058. <https://doi.org/10.1016/j.ufug.2021.127058>
- Kharas, H. 2017. *The Unprecedented Expansion of the Global Middle Class – An Update*. Brookings.
- Kitchin, R., and M. Dodge. 2019. The (In)Security of Smart Cities: Vulnerabilities, Risks, Mitigation, and Prevention. *Journal of Urban Technology* 26 (2): 47–65. <https://doi.org/10.1080/10630732.2017.1408002>
- Kirschenbaum, A. 1992. Warning and Evacuation During a Mass Disaster: A Multivariate Decision Making Model. *International Journal of Mass Emergencies and Disasters* 10: 91–114.
- Kleinenberg, E. 2001. Dying Alone: The Social Production of Urban Isolation. *Ethnography* 2: 501–531.
- Lardry, T., and G. Rogers. 1982. *Warning Confirmation and Dissemination*. Pittsburgh, PA: Center for Social and Urban Research, University of Pittsburgh.
- Lavell, A. 1996. Degradación Ambiental, Riesgo y Desastre Urbano. Problemas y Conceptos: Hacia la Definición de una Agenda de Investigación. In *Ciudades en Riesgo*, ed. M.A. Fernandez, 21–59. Lima, Peru: La RED-USAID.
- Lerch, M. 2017. International Migration and City Growth. *Population Division Technical Paper* 2017/10.
- Lewis, J., and I. Kelman. 2012. The Good, the Bad and the Ugly: Disaster Risk Reduction (DRR) versus Disaster Risk Creation (DRC). *PLoS Currents* 4.
- Little, R.G. 2010. Managing the Risk of Cascading Failure in Complex Urban Infrastructures. In *Disrupted Cities: When Infrastructure Fails*, ed. S. Graham, 27–39. London: Routledge.
- Lloyd's. 2017. *Future Cities: Building Infrastructure Resilience*. <https://www.lloyds.com/news-and-risk-insight/risk-reports/library/society-and-security/arup>
- Lloyd's. 2018. *Networked World: Risks and Opportunities in the Internet of Things*. <https://assets.lloyds.com/assets/pdf-networked-world-2018/1/pdf-networked-world-2018.pdf>

- Lloyd's. 2020. *Cities at Risk: Building a Resilient Future for the World's Urban Centres*.
- MacManus, K. 2019. *Population and Land Area at Risk of Coastal Hazards: New Estimates of the Low Elevation Coastal Zone Along an Urban-rural Continuum, 1990–2015*.
- MacManus, K., D. Balk, H. Engin, G. McGranahan, and R. Inman. 2021. Estimating Population and Urban Areas at Risk of Coastal Hazards, 1990–2015: How Data Choices Matter. Paper currently under review for publication in *Earth System Science Data*. <https://essd.copernicus.org/preprints/essd-2021-165/>
- Martucci, J. Avalon Residents to Save \$1.6 Million on Flood Insurance in 2020. *The Press of Atlantic City*. 4 February 2020. [https://pressofatlanticcity.com/news/local/avalon-residents-to-save-1-6-million-on-flood-insurance-in-2020/article\\_fd748d60-6bbc-52a3-9ad5-441c5a62850a.html](https://pressofatlanticcity.com/news/local/avalon-residents-to-save-1-6-million-on-flood-insurance-in-2020/article_fd748d60-6bbc-52a3-9ad5-441c5a62850a.html)
- McKinsey. 2016. *Urban World: Meeting the Demographic Challenge in Cities*. [https://www.mckinsey.com/~media/McKinsey/Featured%20Insights/Urbanisation/Urban%20world%20Meeting%20the%20demographic%20challenge%20in%20cities/Urban-World-Demographic-Challenge\\_Full-report.ashx](https://www.mckinsey.com/~media/McKinsey/Featured%20Insights/Urbanisation/Urban%20world%20Meeting%20the%20demographic%20challenge%20in%20cities/Urban-World-Demographic-Challenge_Full-report.ashx)
- McKinsey. 2017. *Global Insurance Industry Insights*.
- MHT. 2018. *Submission to the Executive Committee of the Warsaw International Mechanism for Loss and Damage Associated with Climate Change Impacts (Executive Committee) on the Type and Nature of Actions to Address Loss and Damage for which Finance May be Required*. [https://unfccc.int/files/adaptation/workstreams/loss\\_and\\_damage/application/pdf/inputs\\_to\\_wim\\_unfccc\\_mht\\_february\\_2018.pdf](https://unfccc.int/files/adaptation/workstreams/loss_and_damage/application/pdf/inputs_to_wim_unfccc_mht_february_2018.pdf)
- Molinari, D., and J. Handmer. 2011. A Behavioral Model for Quantifying Flood Warning Effectiveness. *Journal of Flood Risk Management* 4: 23–32.
- Munich Re. 2017. *Tapping the Millennials Market*.
- NAIC. 2021. *Can Insurance Company Investments Help Fill the Infrastructure Gap?* <https://content.naic.org/sites/default/files/cipr-report-infrastructure-gap.pdf>
- Neiderud, C.J. 2015. How Urbanisation Affects the Epidemiology of Emerging Infectious Diseases. *Infection Ecology & Epidemiology* 5.
- NIPH. 2020. *Urbanisation and Preparedness for Outbreaks with High-impact Respiratory Pathogens*.
- OECD/European Commission. 2020. *Cities in the World: A New Perspective on Urbanisation*. *OECD Urban Studies*. Paris: OECD Publishing. <https://doi.org/10.1787/d0efcbda-en>
- OECD/The Geneva Association. 2021. *Future-Proofing Technological Innovations for a Resilient Net-Zero Economy*. <https://www.youtube.com/watch?v=eaoGhZxclMg>
- Osti, R. 2018. Integrating Flood and Environmental Risk Management: Principles and Practices. *ADB East Asia Working Paper Series*.
- Pandey, S.M. 1977. Nature and Determinants of Urbanisation in a Developing Economy: The Case of India. *Economic Development and Cultural Change* 25 (2): 265–278.
- Parvina, A., and C. Johnson. 2014. Disaster Vulnerability in the Policy Context of Bangladesh: A Critical Review. *Handbook of Climate Change Adaptation*.
- Pauleit, S., E. Andersson, B. Anton, A. Buijs, D. Haase, R. Hansen, I. Kowarik, J. Niemelä, A.S. Olafsson, and S. Van der Jagt. 2019. Urban Green Infrastructure – Connecting People and Nature for Sustainable Cities. *Urban Forestry & Urban Greening*. <https://doi.org/10.1016/j.ufug.2019.04.007>
- Peak Re. 2021. *Smart Urbanisation to Underpin Asia 'Green' Recovery*. Author: Clarence Wong. <https://www.peak-re.com/insights/smart-urbanisation-to-underpin-asias-green-recovery/>
- Perry, R.W., M.K. Lindell, and M.R. Greene. 1981. *Evacuation Planning in Emergency Management*. Lexington, MA: Lexington Books.
- Peters, K., L.E.R. Peters, J. Twigg, and C. Walch. 2019. Disaster Risk Reduction Strategies: Navigating Conflict Contexts. <https://www.odi.org/sites/odi.org.uk/files/resource-documents/12690.pdf>
- Platteau, J.-P., O. De Bock, and G. Wouter. 2017. The Demand for Microinsurance: A Literature Review. *World Development* 94: 139–156.
- Politico. 2017. *What's the Greatest Risk Cities Face?* <https://www.politico.com/magazine/story/2017/06/30/biggest-challenge-american-cities-policy-experts-215308>
- Ripberger, J., H. Jenkins-Smith, C. Silva, D. Carlson, and M. Henderson. 2014. Social Media and Severe Weather: Do Tweets Provide a Valid Indicator of Public Attention to Severe Weather Risk Communication? *Weather, Climate, and Society* 6: 520–530.



- Robine, J.M., S.L.K. Cheung, and S. Le Roy. 2008. Death Toll Exceeded 70 000 in Europe During the Summer of 2003. *Comptes Rendus Biologies* 331: 171–178.
- Rogers, G.O., and J. Nehnevajsa. 1987. Warning Human Populations of Technological Hazards. In *Radiological Accidents: Perspectives and Emergency*, ed. C. Chester and K.S. Grant, 357–362. Washington, D.C.: American Nuclear Society.
- Sanchez-Rodriguez, R. 2009. Learning to Adapt to Climate Change in Urban Areas. A Review of Recent Contributions. *Current Opinion in Environmental Sustainability* 1 (2): 201–206. <https://doi.org/10.1016/j.cosust.2009.10.005>
- Sandoval, V., and J.P. Sarmiento. 2019. *A Neglected Issue: Informal Settlements, Urban Development, and Disaster Risk Reduction in Latin America and the Caribbean*. [https://www.preventionweb.net/files/66656\\_f447finalrevisedsandovalsarmientoan.pdf](https://www.preventionweb.net/files/66656_f447finalrevisedsandovalsarmientoan.pdf)
- Sarmiento, J.P., and A.M. Torres-Muñoz. 2020. Risk Transfer for Populations in Precarious Urban Environments. *International Journal of Disaster Risk Science* 11: 74–86. <https://doi.org/10.1007/s13753-020-00252-3>
- Scanlon, J., and A. Frizelli. 1979. Old Theories Don't Apply: Implications of Communications in Crises. *Disasters* 3: 315–319.
- SCOR. 2019. *Combining Science and Technology to Enhance Insurability and Spur Innovation*.
- Singer, A. 2019. The Evolution of Parametric Insurance. Risk Management. 1 April 2019. <http://www.rmmagazine.com/2019/04/01/the-evolution-of-parametric-insurance/>
- SEADRIF. 2017. *An Overview of Financial Protection of Public Assets*.
- Surminski, S. 2017. *The Insurance Industry as Society's Risk Manager? Reflections on the Role of Insurers in Supporting Climate Resilience. Presentation to Aon Hazards Conference*.
- Swiss Re. 2013. *Urbanisation in Emerging Markets: Boon and Bane for Insurers*. Sigma No. 5.
- Swiss Re. 2017. *Commercial Insurance – Innovating to Expand the Scope of Insurability*. Sigma No. 5.
- Swiss Re. 2019. *Emerging Technologies Hold the Key to Sustainable Quantum Cities™*. <https://www.swissre.com/institute/research/topics-and-risk-dialogues/digital-business-model-and-cyber-risk/sustainable-quantum-cities.html>
- Swiss Re. 2020a. *China's Motor Insurance Reforms: A Global View*.
- Swiss Re. 2020b. *Healthy Ageing in China: Key Takeaways on Expanding Health Protection for the Middle-age and Elderly*.
- Swiss Re. 2020c. *Natural Catastrophes in Times of Economic Accumulation and Climate Change*. Sigma No. 2.
- Swiss Re. 2021. *Swiss Re SONAR – New Emerging Risk Insights*.
- TCFD. 2017. *Final Report. Recommendations of the Task Force on Climate-related Financial Disclosures*.
- TheCityUK. 2021. *Key Facts About the UK as an International Financial Centre*.
- The Geneva Association. 2018. *Climate Change and the Insurance Industry: Taking Action as Risk Managers and Investors*. Author: Maryam Golnaraghi. January.
- The Geneva Association. 2019. *Investing in Climate-resilient Decarbonised Infrastructure to Meet Socio-economic and Climate Change Goals*. Author: Maryam Golnaraghi. December.
- The Geneva Association. 2020a. *An Investigation into the Insurability of Pandemic Risk*. Author: Kai-Uwe Schanz. October. <https://www.genevaassociation.org/research-topics/socio-economic-resilience/investigation-insurability-pandemic-risk-research-report>
- The Geneva Association. 2020b. *Building Flood Resilience in a Changing Climate: Insights from the United States, England and Germany*. Authors: Maryam Golnaraghi, Swenja Surminski and Carolyn Kousky. June. <https://www.genevaassociation.org/research-topics/building-floodresilience>
- The Geneva Association. 2021a. *The Global Risk Landscape after COVID-19: What role for insurance?* Author: Kai-Uwe Schanz. June. <https://www.genevaassociation.org/research-topics/socio-economic-resilience/risk-landscape-after-covid-role-for-insurance>
- The Geneva Association. 2021b (forthcoming). *Cyber Terrorism, Cyber War and Hostile Cyber Activity: Impact, Quantification and Solutions*. Authors: Rachel A. Carter and Darren Pain.
- The Geneva Association. 2021c. *Climate Change Risk Assessment for the Insurance Industry*. Authors: Maryam Golnaraghi and the Geneva Association Task Force on Climate Change Risk Assessment for the Insurance Industry. February. <https://www.genevaassociation.org/research-topics/climate-change-and-emerging-environmental-topics/climate-change-risk-assessment>

The Geneva Association. 2021d. *Public-Private Solutions to Pandemic Risk*. Author: Kai-Uwe Schanz. April. <https://www.genevaassociation.org/research-topics/socio-economic-resilience/public-private-solutions-pandemic-risk-research-report>

Trask, B. 2020. Mega Trends and Families: The Impact of Demographic Shifts, International Migration and Urbanisation, Climate Change, and Technological Transformations. *Paper presented at the UNITED NATIONS Department of Economic and Social Affairs (UNDESA) Division for Inclusive Social Development's (online) Expert Group Meeting on Families in development*, New York, 16–18, June 2020.

UN. 2019. *World Urbanisation Prospects – The 2018 Revision*.

UN. 2020. *UN Research Roadmap for the COVID-19 Recovery*. <https://www.un.org/en/coronavirus/communication-resources/un-research-roadmap-covid-19-recovery>

UNDHA. 1992. *Internationally Agreed Glossary of Basic Terms Relating to Disaster Management*.

UNEP. 2007. *Cities and Urban Vulnerability*.

UNISDR. 2004. *Living With Risk. United Nations International Strategy for Disaster Reduction*.

Watts et al. 2021. The 2020 Report of The Lancet Countdown on Health and Climate Change: Responding to Converging Crises. *The Lancet* 397 (10269): 129–170.

White, J.M. 2016. Anticipatory Logics of the Smart City's Global Imaginary. *Urban Geography* 37 (4): 572–589.

Willwert-Pascutiu, G. 2018. *Increasing Urbanisation Brings New Challenges to Life Insurers*. <https://www.rgare.com/knowledge-center/media/articles/increasing-urbanisation-brings-new-challenges-for-life-insurers>

Wood, M., D.S. Mileti, H. Bean, B.F. Liu, J. Sutton, and S. Madden. 2018. Milling and Public Warnings. *Environment and Behavior* 50: 535–566.

WEF. 2021a. *The Global Risks Report*. [http://www3.weforum.org/docs/WEF\\_The\\_Global\\_Risks\\_Report\\_2021.pdf](http://www3.weforum.org/docs/WEF_The_Global_Risks_Report_2021.pdf)

WEF. 2021b. *Net Zero Carbon Cities: An Integrated Approach*.

Wu, X. 2020. Exposure to Air Pollution and COVID-19 Mortality in the United States: A Nationwide Cross-sectional Study. *Science Advances* 6: 45.

Zevenbergen, C., D. Fu, and P. Assela. 2018. Transitioning to Sponge Cities: Challenges and Opportunities to Address Urban Water Problems in China. *Water* 10 (9): 1230. <https://www.mdpi.com/2073-4441/10/9/1230>

Zurich. 2015. *Insurance – A Global View*.



By 2050, more than two thirds of the world's population is projected to live in cities. Urbanisation is associated with fundamental socio-economic changes that present formidable challenges to socio-economic resilience and have significant risk management and insurance implications. This report explores the link between urbanisation and the dynamics of risk landscapes and examines insurers' potential contribution to mitigating emerging vulnerabilities.

**The Geneva Association**

International Association for the Study of Insurance Economics

Talstrasse 70, Zurich, Switzerland

Tel: +41 44 200 49 00

[www.genevaassociation.org](http://www.genevaassociation.org)