

# Cities Alive

100 issues shaping future cities

Arup University  
Foresight + Research + Innovation

ARUP

## About Global Planning and Cities

Our global planning business integrates a range of specialist technical and design skills to create inspiring and practical visions which respond to the issues facing cities. We deliver advisory services in planning and strategy development, finance and economics, consultation and operations with design, engineering and implementation services to respond to the unique challenges faced by each city across the globe.

We invest time, effort and resources into the study of cities. With powerful collaborations with some of the leading drivers of city transformation including the World Economic Forum, The C40 Cities Climate Leadership Group and the Rockefeller Foundation, we help cities make their own futures rather than react to those placed upon them.

## About Arup Foresight + Research + Innovation

Foresight + Research + Innovation (F+R+I) is Arup's internal think-tank and consultancy which focuses on the future of the built environment and society at large. We help organisations understand trends, explore new ideas, and radically rethink the future of their businesses. We developed the concept of 'foresight by design', which uses innovative design tools and techniques in order to bring new ideas to life, and to engage all stakeholders in meaningful conversations about change.

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## Cities Alive Workshop Cards

The Cities Alive workshop cards are designed to help stakeholders at all levels — citizens, planners, and officials — prioritise and explore issues that will shape the future of their city and explore the notion of city vitality thinking. They can help start conversations, enhance understanding, facilitate decisionmaking, and build solutions.

The cards highlight 100 urban issues that cities will face in the future. Each card contains an issue title, a short description and an illustration. The issues are organised according to their primary area of influence across the STEEP framework: Social, Technological, Economic, Environmental, or Political. While each issue is assigned to one category, it will always have implications for all five.

Turn this card over for some ideas on how to use the card set in your workshops. The cards are designed to allow you to develop your own activities in a myriad of contexts.

If you want to discuss how to use the cards in your organisation, please contact [foresight@arup.com](mailto:foresight@arup.com).

social

technological

economic

environmental

political

## How to use the Cities Alive Workshop Cards

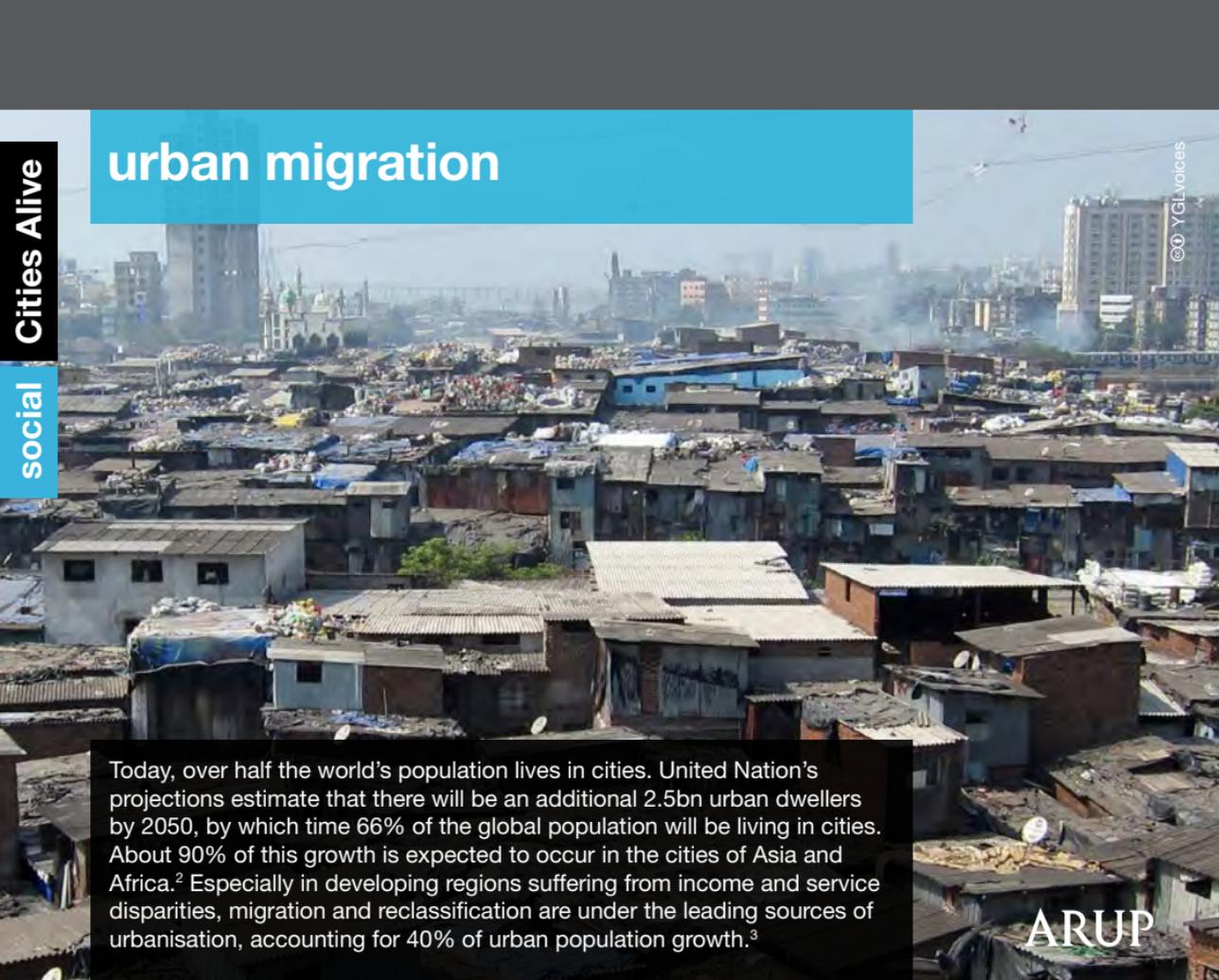
Trends and Implications	Future News	Design Charrettes
<p>Workshop participants are grouped into teams; each team is assigned one STEEP category. The teams are asked to choose five key issues from that category driving change in their city, and to explore future possible implications.</p>	<p>Using the card set for inspiration, workshop participants create a set of five future newspaper headlines representing city-related news and events. As premise, participants are given a topic of particular relevance to the focus city.</p>	<p>Workshop participants are grouped into teams. The facilitator acts as a 'client' and randomly selects five cards for each team. These cards are used as inspiration and constraints during design development for an urban area or set of city systems.</p>
<p>Potential Outcomes:</p> <p>Better understanding of issues shaping the city ecosystem.</p> <p>This exercise is particularly useful for identifying current friction points and methods for enhancing city vitality.</p>	<p>Potential Outcomes:</p> <p>Revealing insights about how urban issues may play out over time.</p> <p>This exercise is particularly useful for detecting and shaping emerging contexts and trends.</p>	<p>Potential Outcomes:</p> <p>Innovative design ideas that promote sustainable urban planning.</p> <p>This exercise is particularly useful for reevaluating and developing existing strategic plans.</p>

# population growth



The global population is expected to reach around 9.7bn by 2050, adding 2.4bn people to the world's population compared to 2015. Not all regions will grow equally; the majority of the projected population growth is expected to occur in developing countries, while the population of developed regions is forecast to change minimally or even decline without population migration from developing countries.<sup>1</sup>

# urban migration



Today, over half the world's population lives in cities. United Nation's projections estimate that there will be an additional 2.5bn urban dwellers by 2050, by which time 66% of the global population will be living in cities. About 90% of this growth is expected to occur in the cities of Asia and Africa.<sup>2</sup> Especially in developing regions suffering from income and service disparities, migration and reclassification are under the leading sources of urbanisation, accounting for 40% of urban population growth.<sup>3</sup>

# ageing society



The global population is ageing, due to both an increase in life expectancy and a decrease in total fertility rates. The number of people aged 65 and older is projected to triple from 531M in 2010 to 1.5bn by 2050.<sup>4</sup> Cities will need to adapt to and prepare for the needs of a larger cohort of older people. While urban areas offer advantages to older residents such as access to services, cities can also create feelings of insecurity and social isolation.

# mobile working

Employee expectations, device innovation and faster connectivity are converging to transform the way we do business. Employees increasingly want to choose the type of device and operating system they use, as well as where and how they work. In the US it is estimated that 63M workers — or 43% of the workforce — will undertake some kind of work from home by 2016.<sup>5</sup>

# household patterns

The global trend towards smaller and less conventional household units is continuing to gather pace. This is due to a combination of factors including lower marriage and fertility rates, ageing populations, rapid urbanisation and rising wealth in emerging markets. There are 1.9bn households globally, with single-person households making up 15% of these.<sup>6</sup>

# inequality



Global inequality is rising. The world's 85 wealthiest people now control as much wealth as the poorest half of the global population (3.5bn people). Economic inequality can exacerbate social problems, as the wealthy have better access to healthcare, education and positions of power.<sup>7</sup> By 2016, it is estimated that the world's richest 1% will own more than the other 99% of people combined.<sup>8</sup>

# employment

## APPLICATION FOR EMPLOYMENT

### PERSONAL INFORMATION

Name:

Last

First

Middle

Address:

Street

(Apt)

State

Zip

Alternate Address:

Street

DATE OF APPLICATION: \_\_\_\_\_

Globally, employment is not expanding fast enough to keep up with a growing labour force. If current trends continue, global unemployment is set to increase to more than 215M jobseekers by 2018 (up from 202M in 2013). Young people are most affected by this trend, with a global youth unemployment rate of 13.1%, which is almost three times as high as the adult unemployment rate.<sup>9</sup>

# community cohesion



As cities face increasing infrastructure and service demands as well as threats from climate change, community-led solutions are becoming more common to build self-reliance and resilience in order to prepare for, respond to, and recover from crises. As the greatest burden of increasing shocks often falls on poor and vulnerable citizens,<sup>10</sup> this approach helps in improving community cohesion through generating a sense of belonging.

# informal settlements

Due to rapid urbanisation and the lack of affordable housing, informal settlements continue to grow. The number of slum dwellers is now estimated to be 863M worldwide. In sub-Saharan Africa, 62% of the urban population lives in slums.<sup>11</sup> Poor hygiene conditions in slums often propagate illness and disease, which leads to further economic hardship.

# public health



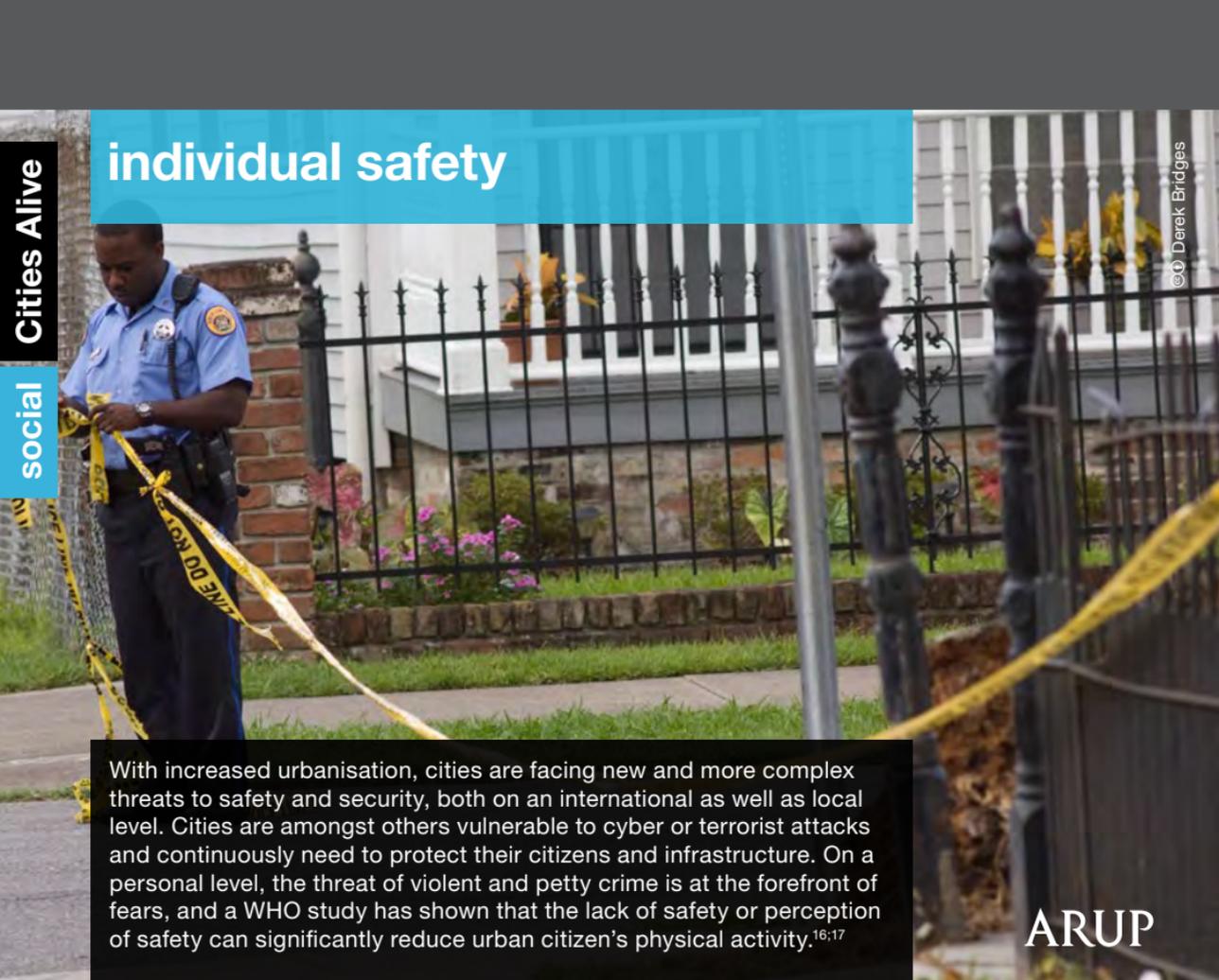
According to the World Health Organization, 38M people die from noncommunicable diseases each year<sup>12</sup> and about 3 in 10 global deaths can be attributed to cardiovascular diseases. A healthy diet, physical activity and tobacco avoidance could prevent at least 80% of cardiovascular disease-related premature deaths. Obesity is also a pressing issue, and about 10% of the world's adult population suffers from diabetes.<sup>13</sup>

# education



Education is a powerful tool to reduce poverty and inequality, but global educational standards and school attendance rates vary widely. In 2012, around 58M children of primary school age were out of school, which is 9% of the global population in this age group. The average urban out-of-school rate was found to be half that of rural areas (16 vs 8%). In sub-Saharan Africa, over a third of children who start school in 2012 will leave before the last grade of primary education.<sup>14,15</sup>

# individual safety



With increased urbanisation, cities are facing new and more complex threats to safety and security, both on an international as well as local level. Cities are amongst others vulnerable to cyber or terrorist attacks and continuously need to protect their citizens and infrastructure. On a personal level, the threat of violent and petty crime is at the forefront of fears, and a WHO study has shown that the lack of safety or perception of safety can significantly reduce urban citizen's physical activity.<sup>16,17</sup>

# tourism



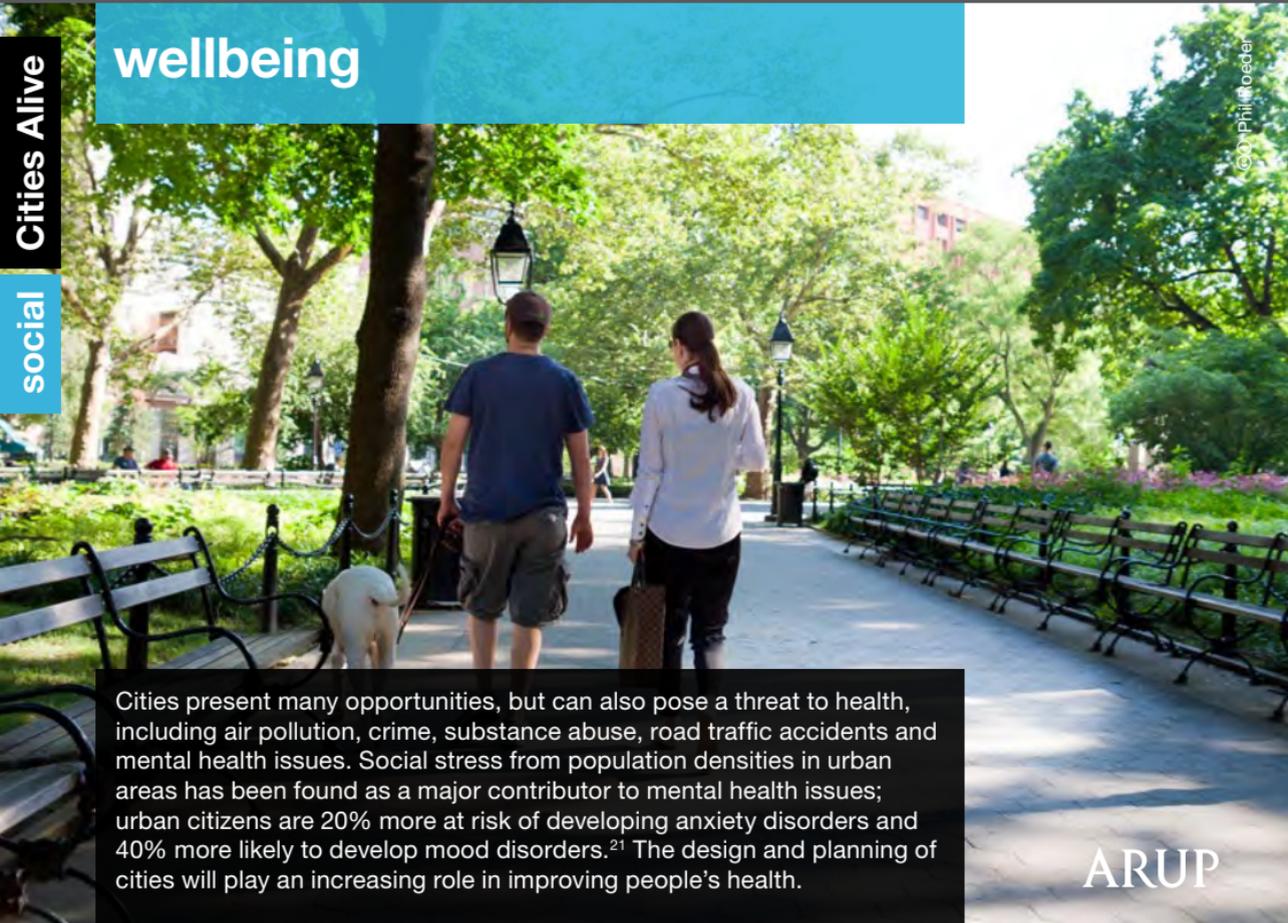
Urban tourism has experienced significant growth and diversification, with new destinations emerging. The number of international tourist arrivals worldwide is expected to increase by 43M every year, reaching a total of 1.8bn arrivals by 2030.<sup>18</sup> Tourism can contribute to urban wellbeing, economic growth and citizens' quality of life,<sup>19</sup> but can also place a burden on already strained city infrastructure and services.

# global middle class



The global middle class is growing rapidly, which will have important implications for how people choose to travel, work, live, consume, and spend their leisure time. Emerging economies are predicted to contribute the most to this trend, especially Asia, and by 2030, nearly two thirds of the global population — 5bn people — could be classified as middle class,<sup>20</sup> which will drive consumer expectations and consumption patterns.

# wellbeing



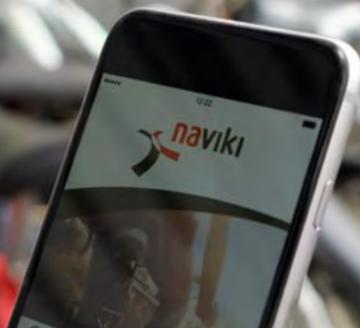
Cities present many opportunities, but can also pose a threat to health, including air pollution, crime, substance abuse, road traffic accidents and mental health issues. Social stress from population densities in urban areas has been found as a major contributor to mental health issues; urban citizens are 20% more at risk of developing anxiety disorders and 40% more likely to develop mood disorders.<sup>21</sup> The design and planning of cities will play an increasing role in improving people's health.

# sustainable behaviours



Environmental factors play an increasing role in both consumer and business product and service purchase decisions, as awareness of environmental impacts and regulations around labelling and transparency increase. A survey across 60 countries found that 55% of online consumers consider a company's environmental and social commitment when deciding where to shop, and will accept higher prices for sustainable products.<sup>22</sup>

# digital lifestyles

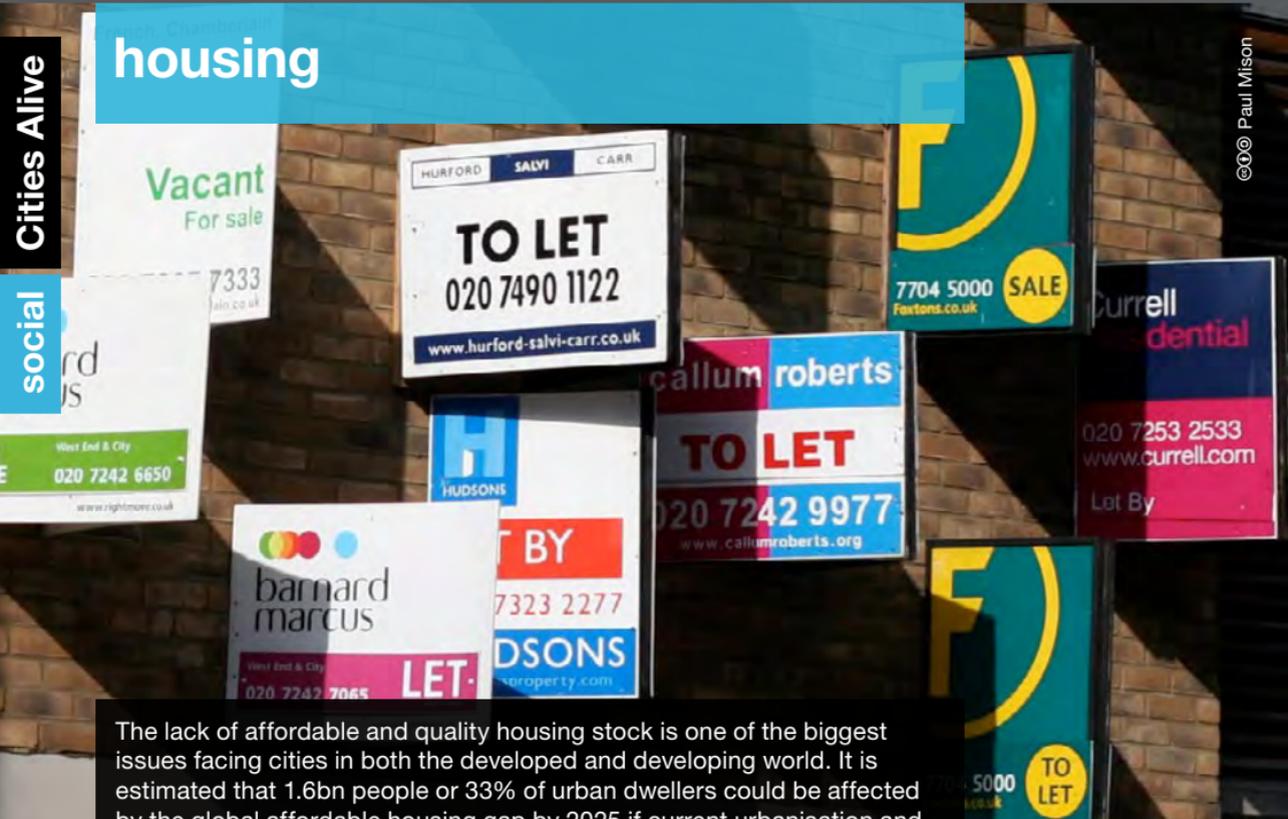


Mobile devices are increasingly at the center of our digital lifestyles. These devices are becoming the 'remote controls' of our lives, acting as hubs for sensor-based health monitoring products and fitness apps. The number of smartphone users worldwide will exceed 2bn by 2016 (over a quarter of the global population).<sup>23</sup> Smartphones have the potential to transform city life, easing service and administration accessibility but increasing demand for ICT infrastructure.

# housing

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social



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The lack of affordable and quality housing stock is one of the biggest issues facing cities in both the developed and developing world. It is estimated that 1.6bn people or 33% of urban dwellers could be affected by the global affordable housing gap by 2025 if current urbanisation and income trends continue.<sup>24</sup> Burgeoning informal settlements in developing cities also highlight the extent of this global issue.

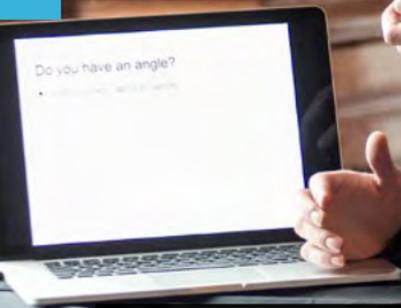
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# infectious diseases



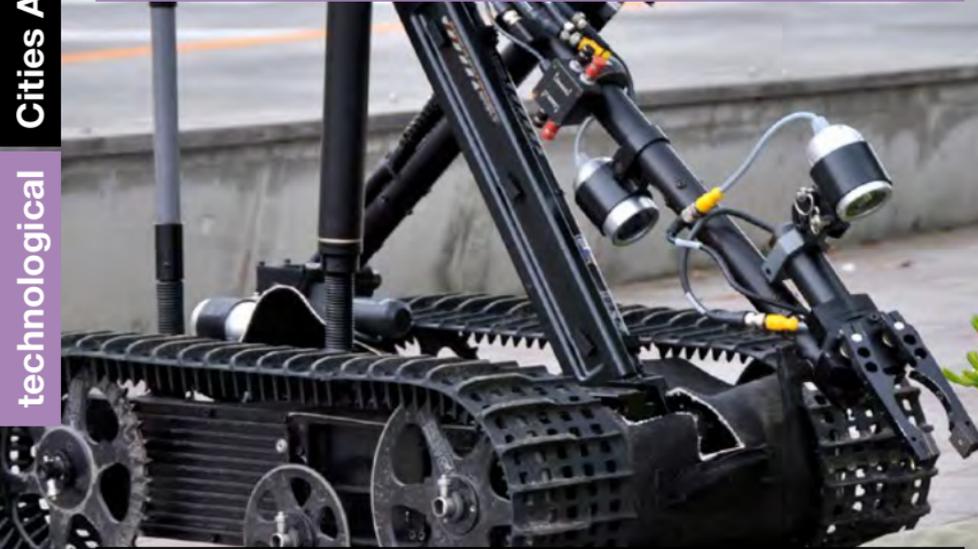
Rapid, unplanned urbanisation and unprecedented population growth, led to a growing number of urban areas that suffer from overcrowding and lack adequate sanitation, waste and water management, and which have become potential breeding grounds for communicable diseases. Global migration, transport and logistic patterns, especially growth in air travel, aid in the dispersion of diseases across the globe.<sup>25</sup> London, for example, has seen a considerable rise in tuberculosis rates in recent years.<sup>26</sup>

# entrepreneurship



Cities provide a fertile ground for entrepreneurship due to the proximity of business opportunities and creative people. They also provide a concentration of consumers for entrepreneurs to test their ideas. According to the Brookings Institution, the 100 largest cities account for 78% of patents issued, 81% of research and development jobs and 94% of all venture capital investments.<sup>27</sup>

# automation



Robotics and automation will play an increasing role in the delivery of city services. Applications include cleaning, security and infrastructure maintenance. Greater automation may also lead to substantial job losses as buildings and processes become more automated. A wider deployment of automated systems in cities could also lead to a significant increase in the 24h availability of products and services, while decreasing the need for 'physical' workers and increasing the need for digital surveillance.<sup>28</sup>

# internet of things

The rise of the Internet of Things — the connection of a huge range of devices, sensors, and machines to the Internet — will enable city infrastructure to be designed and operated in a more integrated way. Currently, 99% of physical objects that may one day be part of this network are still unconnected. It is estimated that by 2020, 200bn objects will be part of the IoT (26 smart objects for every person on earth).<sup>29</sup>



# sensors and data

Sensors smaller than a grain of sand can be sprayed to measure chemicals or injected to diagnose problems in the human body. At the other end of the scale, large systems of sensors in cities collect huge amounts of data in real-time to help manage complex systems.<sup>30</sup> It is expected that global data will grow from 5 zettabytes (one zettabyte is a billion terabytes) in 2014 to 40 zettabytes in 2020.<sup>31</sup>

# smart infrastructure

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technological

Smart infrastructure uses information captured from sensors to monitor, analyse and communicate details about its condition. Generated data enables proactive management of infrastructure assets. The Cambridge Centre for Smart Infrastructure and Construction develops smart monitoring sensors permanently integrated in infrastructure assets.<sup>32</sup> Smart energy grids can adapt to supply and demand changes to maximise efficiency. Their global market is expected to reach US\$400bn by 2020.<sup>33</sup>

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# intelligent transport systems



Intelligent Transport Systems (ITS) enable a smarter, more integrated system for moving passengers and freight. They allow transportation modes to communicate with each other and with the environment, paving the way for truly integrated and inter-modal transport solutions that maximise efficiency. For example, ITS could help reduce the congestion which cost the London economy around £5.4bn in 2013.<sup>34</sup>

# technology leapfrogging



The rapid adoption of the mobile phone in developing markets, which allowed them to skip fixed-line infrastructure, is the classic example of a leapfrog technology. It is estimated that mobile penetration in Africa has reached 80%.<sup>35</sup> There is an opportunity for cities in these markets to do something similar with smart cities technology, by adopting advanced technologies and lessons from more mature cities.

# energy efficiency

As urban centers are home to the majority of the world's population, improving the energy efficiency of cities could result in substantial energy savings, as well as economic and environmental benefits. Currently, buildings use about 40% of the world's energy, with residential and commercial buildings using 60% of the world's electricity.<sup>36</sup> Making buildings more energy efficient could result in substantial long-term benefits.

# system integration

future cities

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Traditionally, city systems, from energy to transport to waste disposal, have operated independently of each other. Smart systems could enable the integration of these infrastructures to share data and resources, save energy and serve more people.<sup>37</sup> In London, for example, there are plans to pump excess heat from the Underground's Northern Line to heat over 500 homes.

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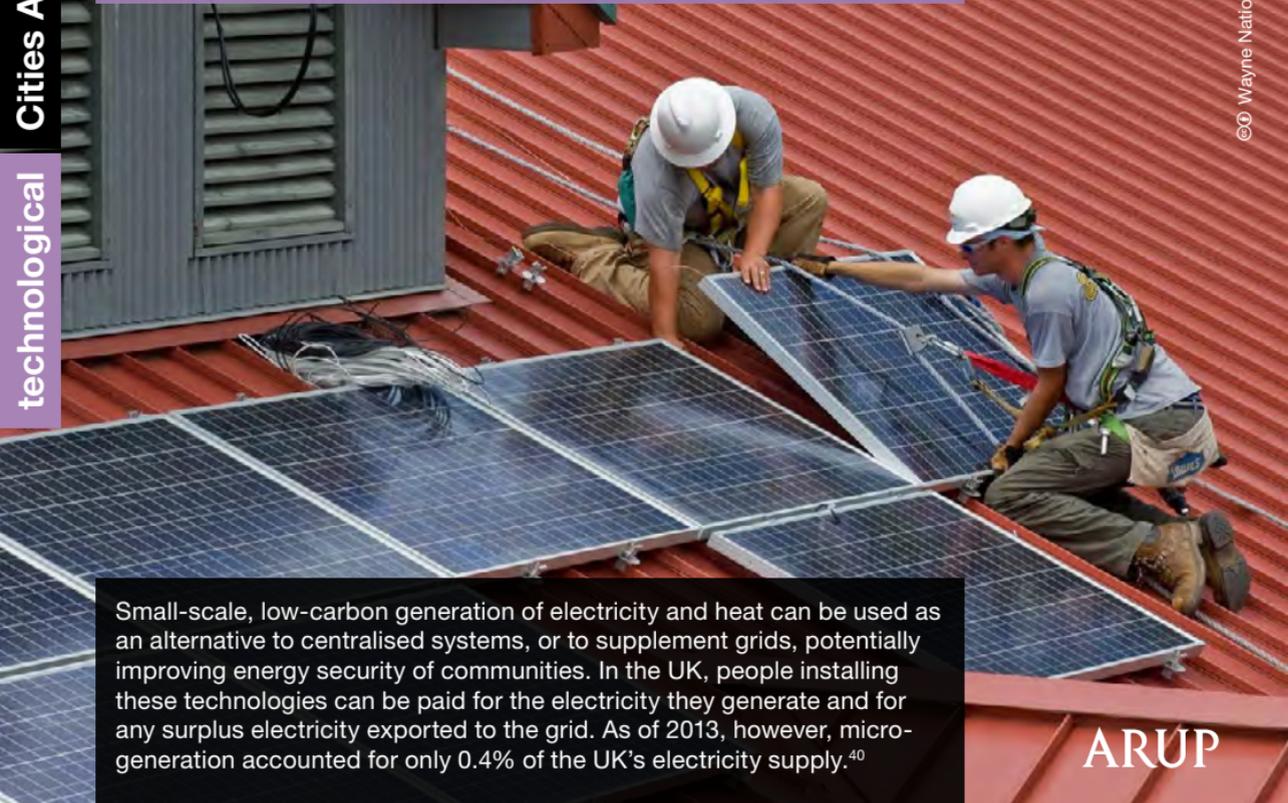
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# autonomous vehicles



As the majority of car accidents are due to human error, autonomous vehicles will have significant implications for safety and efficiency. It is estimated that with 50% autonomous cars on US roads, 9,600 lives could be saved and crashes reduced by 1.88M annually.<sup>38</sup> Driverless cars can also safely travel closer together, increasing peak capacity of existing infrastructure. Ultimately, road infrastructure demand could be decreased as one autonomous vehicle could potentially replace 10 private vehicles.<sup>39</sup>

# micro-generation



Small-scale, low-carbon generation of electricity and heat can be used as an alternative to centralised systems, or to supplement grids, potentially improving energy security of communities. In the UK, people installing these technologies can be paid for the electricity they generate and for any surplus electricity exported to the grid. As of 2013, however, micro-generation accounted for only 0.4% of the UK's electricity supply.<sup>40</sup>

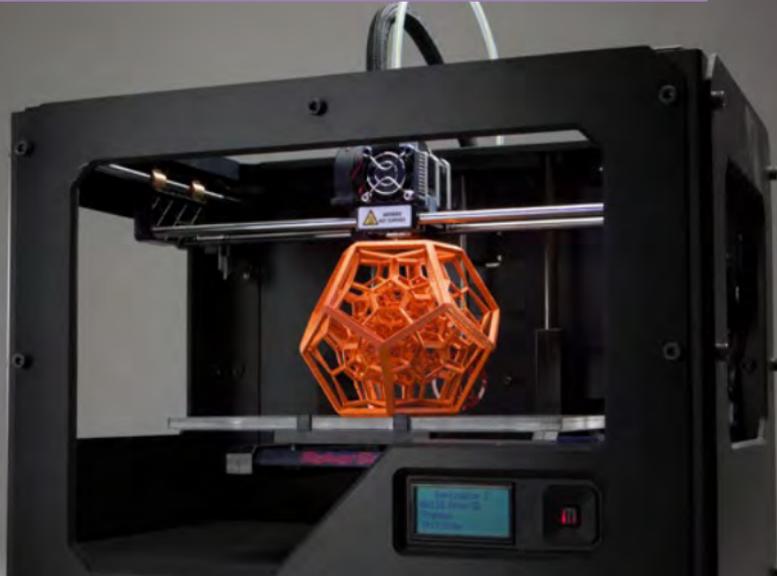
# e-mobility

E-mobility refers to vehicles running on electricity for their primary energy. The need to reduce carbon emissions and increase energy security has resulted in significant advances in e-mobility technology, including a range of new hybrid and fully electric vehicles, and improved battery storage. It is estimated that worldwide sales of light duty electric vehicles will increase from 2.7M in 2014 to 6.4M in 2023.<sup>41</sup>

# data connectivity

The growth of cloud computing and the Internet of Things is enabling us to access our data from almost anywhere, resulting in an explosion of data connectivity. It is estimated that global data centre IP traffic will nearly triple over the next 5 years. Overall, data centre IP traffic will increase at a compound annual growth rate of 23% from 2013 to 2018.<sup>42</sup>

# additive manufacturing



3D printing, or additive manufacturing, is being hailed as a breakthrough development which could lead to a new industrial revolution. This technology could reduce waste and transportation, as well as change the location of manufacturing (allowing more manufacturing to happen locally in cities, for example). It is estimated that the global additive manufacturing market could reach £5.5bn by 2023.<sup>43</sup>

# artificial intelligence



Some experts predict that AI will transform the internet, the global economy, and civilisation itself. Cloud computing and big data is opening up AI to exponential development, and it is thought that by 2030 computers could be capable of human-level intelligence.<sup>44</sup> Urban AI applications can potentially improve city processes and decisionmaking. World-renowned physicist Dr. Stephen Hawking believes that while primitive forms of AI could be very useful, advanced AI could “spell the end of the human race.”

# quantified self



The 'quantified self' movement is made possible through the rise of wearable devices measuring every detail of our daily lives, from sleep quality to step counts. By 2018, the wearable device market is expected to be worth US\$12.6bn.<sup>45</sup> In New York, Hudson Yards, the first fully 'quantified community' is being developed. Evaluation of daily data generated by 65,000 people will be used to understand city processes and potentially improve the management of future cities.<sup>46</sup>

# intelligent buildings

Intelligent buildings are part of an increasingly integrated and smart built environment. Through a combination of new technologies and interconnected systems, buildings can become more energy and resource efficient, more secure, and more pleasant to work in. In the US, commercial businesses spend around US\$100bn on energy annually, but greater use of intelligent building technology could reduce this cost by about US\$25bn a year.<sup>47</sup>

# cyber security



As cities begin to rely more and more on smart technologies and connected systems, cyber security becomes critical to safety, privacy and wellbeing. It is estimated that 22% of targeted cyber-attacks are aimed at governments and energy or utilities companies. Cyber-attacks have significant financial consequences as well, costing businesses as much as £270bn a year globally.<sup>48</sup>

# small-scale solutions



Small-scale technology solutions can be beneficial in both developing and developed contexts, improving urban communities' resilience to external stresses and strengthening community cohesion. In cities of the developing world, context-appropriate technologies — small scale, energy efficient, environmentally sustainable — including the provision of water, energy and sanitation systems, promote economic and social development and bring necessary services to the urban poor.<sup>49</sup>

# remote services



The rise of mobile devices, cloud computing and other advances in technology are enabling remote services to be more widely deployed. Applications include remote healthcare and monitoring, off-site technical support, and access to work and education platforms from almost anywhere. The global remote patient monitoring market, for example, is expected to grow by 15% annually until 2018,<sup>50</sup> while saving the global economy \$36bn in the same time.<sup>51</sup>

# digital modelling

Advances in 3d modelling will enable the use of digital models to assist urban planning and design processes. Digital models of planned buildings and infrastructure, incorporating time-based simulations (of population growth or weather events, for example), will allow decisionmakers to better understand the impact of projects and improve a city's environmental and social performance. It allows scenario testing, and can improve public participation processes by clarifying the presentation of complex ideas.<sup>52:53</sup>

# regional connectivity



Improving city-region connectivity can lead to economic benefits as greater linkages in regulation, infrastructure and people can boost productivity. Infrastructure is vital for regional connectivity as the connectivity of people, places and resources creates the networks needed to support economic and social productivity.<sup>54</sup>

# ageing infrastructure



The need to invest more into inadequate and ageing infrastructure comes at a time when many governments are highly indebted and face competing demands for scarce resources. For many cities, this will mean an increased focus on boosting the capacity and lifetime of existing infrastructure. In the US, for example, US\$3.6tr is needed by 2020 for repair and upgrade of existing infrastructure, resulting in a big financing gap, as investments in the same timeframe are projected at US\$2tr.<sup>55</sup>

# finance

Infrastructure investment is critical to the future success of cities. McKinsey estimates that around US\$57 trillion would be needed worldwide in the period to 2030 to satisfy the global demand for infrastructure.<sup>56</sup> In developing countries alone, the infrastructure deficit is estimated at US\$1-1.5 trillion per year.<sup>57</sup> Much of this infrastructure will be needed in cities, requiring new financing mechanisms that take the burden from city authorities and increasingly include private sector investments.



# circular economy

In a circular economy, products and resources are reused to extract their maximum value rather than entering the waste stream. Resource scarcity and tighter environmental standards will propel this trend forwards, as will new technologies and new patterns of consumer behaviour. US-based company Recology, for example, has reduced San Francisco's landfill disposal by 78% through "source reduction, reuse, and recycling and composting programs".<sup>58</sup>

# skills shortages

Cities will continue to compete with each other to attract capital and skilled workers. Globally, skills shortages are most apparent in jobs requiring knowledge of the STEM subjects (science, technology, engineering and maths). In the US, 75% of the fastest growing occupations require significant maths or science knowledge, and by 2018 there could be 2.4M unfilled STEM jobs.<sup>59</sup>

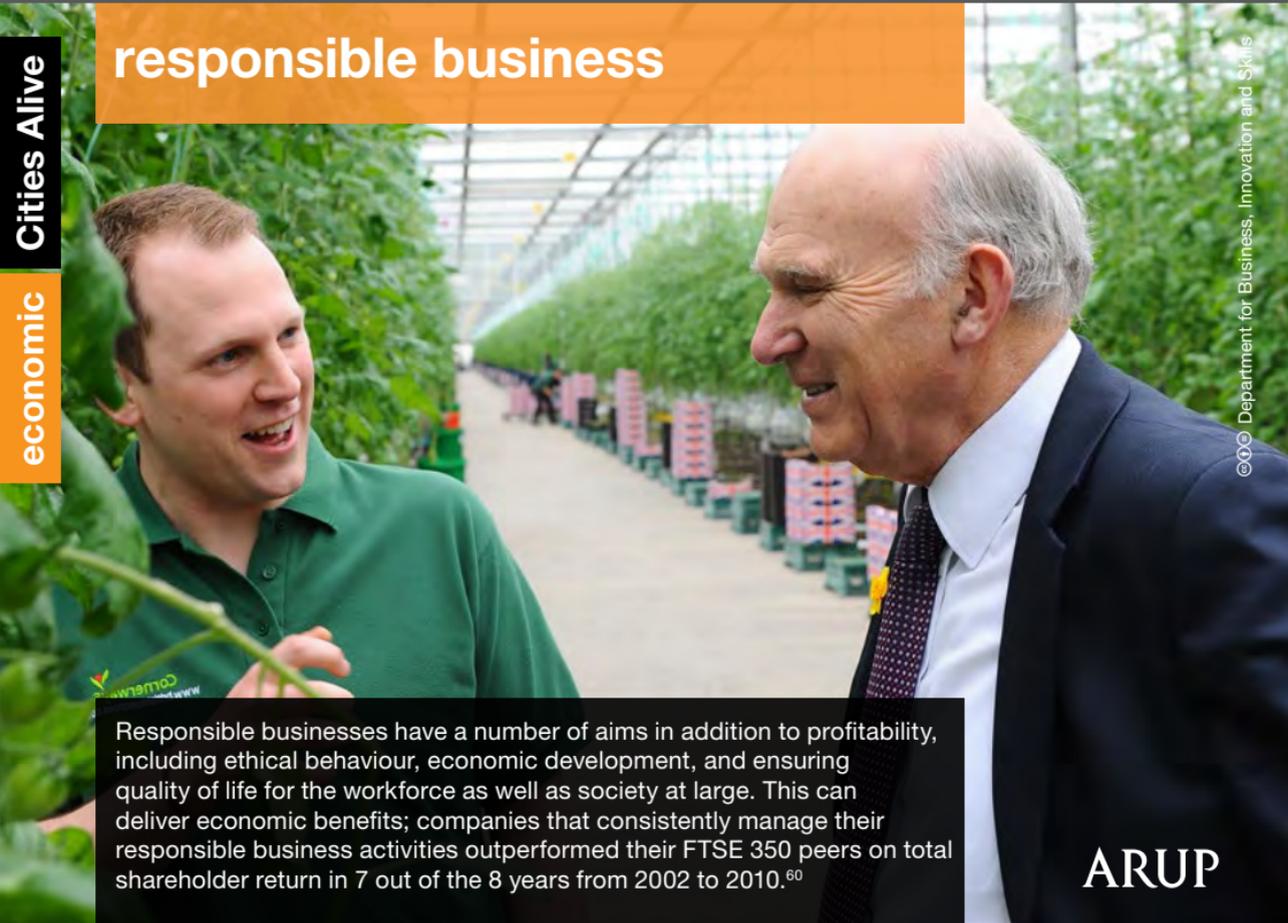
# user centricity

B44 Avenue U 2  
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As businesses strive to differentiate themselves and customer expectations increase, the need to innovate around the consumer experience is becoming a critical factor for good design, including in the design of the built environment. As cities strive to become more liveable and direct increasing attention to citizens as their main stakeholders, user centricity considerations (designing systems that are responsive to citizens' needs and desires) will become fundamental.

# responsible business



Responsible businesses have a number of aims in addition to profitability, including ethical behaviour, economic development, and ensuring quality of life for the workforce as well as society at large. This can deliver economic benefits; companies that consistently manage their responsible business activities outperformed their FTSE 350 peers on total shareholder return in 7 out of the 8 years from 2002 to 2010.<sup>60</sup>

# city resilience



In October 2013, Cyclone Phalin hit the Indian State of Odisha, which includes a number of major cities. The storm affected more than 13M people, damaged 420,000 houses, and is estimated to have cost US\$700M.<sup>61</sup> By evaluating their exposure to certain risks, cities can develop a comprehensive and proactive plan to mitigate the effects of shocks and stresses. City resilience should not only focus on improved infrastructure, but also on aspects of cultural and institutional resilience.

# digital economy

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economic



Digital technology generates new market opportunities and has a large economic impact across a range of sectors. The emergence of wireless networks, sensors, mobile devices and satellite navigation is further embedding technology into our daily lives, changing the way we do business. It is estimated that digitisation boosted the world economy by US\$193bn and created 6M jobs in 2011.<sup>62</sup>

# urban logistics



Increasing urbanisation, denser city centres and congestion, as well as paradigm shifts in manufacturing and retail will change the urban logistics landscape.<sup>63</sup> Consolidation centres can increase efficiency and reduce city-centre traffic. London's Regent Street centre consolidates deliveries from all suppliers to one point outside the city centre, and has reduced deliveries to participating retailers by 80%.<sup>64</sup> DHL is trialling unmanned aerial vehicles (UAV) to tackle the urban first and last mile logistics.<sup>65</sup>

# urban manufacturing

Manufacturing is returning to the city, as factories become cleaner, greener, and quieter and no longer demand large-scale rectilinear spaces. Instead, many are able to occupy vertical spaces enabling more central urban factory locations. As they are closely located, these urban factories can also share resources and supply chains. New York City is home to almost 7,000 small manufacturers employing 65,000 people.<sup>66</sup>

# womenomics



Womenomics describes the shift in economic financial power from men to women. In the UK, it is predicted that women's pay will overtake men's by 2020, and that women will own 60% of Britain's wealth by 2025.<sup>67</sup> In Japan, increasing the number of women in the workforce has become a policy objective, as employing more women is expected to boost Japan's growth rate.

# urban regeneration

Urban regeneration can revitalise derelict urban areas and spark positive economic, social, and environmental impacts. Regeneration prevents urban decline and includes the revitalisation of brownfield sites and restoration of urban physical fabric, as well as efforts to rebuild a city's economic base.<sup>68</sup> The Guggenheim Museum in Bilbao revitalised Bilbao's economy; the museum receives 1M visitors annually and in it's first three years US\$110M in tax money was raised through visitors to the city.<sup>69</sup>

# SME's

While small and medium-sized enterprises (SMEs) generate less revenue than larger corporations, they are often the building block of local economies. Smaller enterprises can often adapt faster to changing climates and keep innovation and growth in communities.<sup>70</sup> SMEs are considered highly vital for urban centres; since 2005, urban SMEs have grown by 37% compared to 17% growth rate of large scale businesses and almost 50% of private sector jobs available in cities are SME based.<sup>71</sup>

# sharing economy

Traditional models of ownership are changing, and platform based, peer-to-peer services are disrupting traditional service industries in cities around the world. The trend towards a shared economy of service provision rather than product ownership means that private individuals, for example, can purchase goods and services directly from each other via the internet. The consumer peer-to-peer rental market is worth US\$26bn,<sup>72</sup> and around 1.8M people worldwide participate in carsharing schemes.<sup>73</sup>

# supply chain vulnerability



© Tech. Sgt. Jeremy Call

As cities have moved away from relying on their rural surroundings for resource needs, including energy, food and water, a global network of long-distance, interconnected supply chains has emerged, with distant disruptions (deliberate or casual) able to negatively impact dependent urban areas. In 2012, a drought period in central parts of the US decreased the Mississippi's water levels, which interrupted cargo transport and ultimately led to nationwide delays in commodity flows to cities.<sup>74</sup>

# informal economy



The informal economy has been found to be a vital factor in urban development; it constitutes a large share of employment in many developing countries, and can act as an activator for urban transformation, especially as cities are faced by a large amount of rural migrants.<sup>75</sup> In Asia, the informal economy has a 40-60% share of urban employment (61% in Africa). In Tanzania, for example, the informal economy employs 55% of urban households versus 34% in rural areas.<sup>76</sup>

# self-sufficiency

Cities are reliant on vast quantities of imported food, water and other resources. In order to become sustainable, self-sufficiency is increasingly becoming an aim for cities and their inhabitants. Singapore, for example, aims to be self-sufficient in fresh water supplies by 2061, when its agreement to draw water from Malaysia ends. The shift will be achieved through greater water recycling and desalination.<sup>77</sup>

# identity



A city's identity is more than a result of the planning and design of physical spaces. It includes how cultural and social interactions define a place. The aim is to create public spaces that improve liveability, as well as people's health, happiness, and wellbeing. More and more cities turn to branding and marketing to ensure their competitiveness in a global arena. Amsterdam's "I Amsterdam" city branding, for example, led to increased tourism, a solidified economy and strengthened position as a top European city.<sup>78</sup>

# economic growth

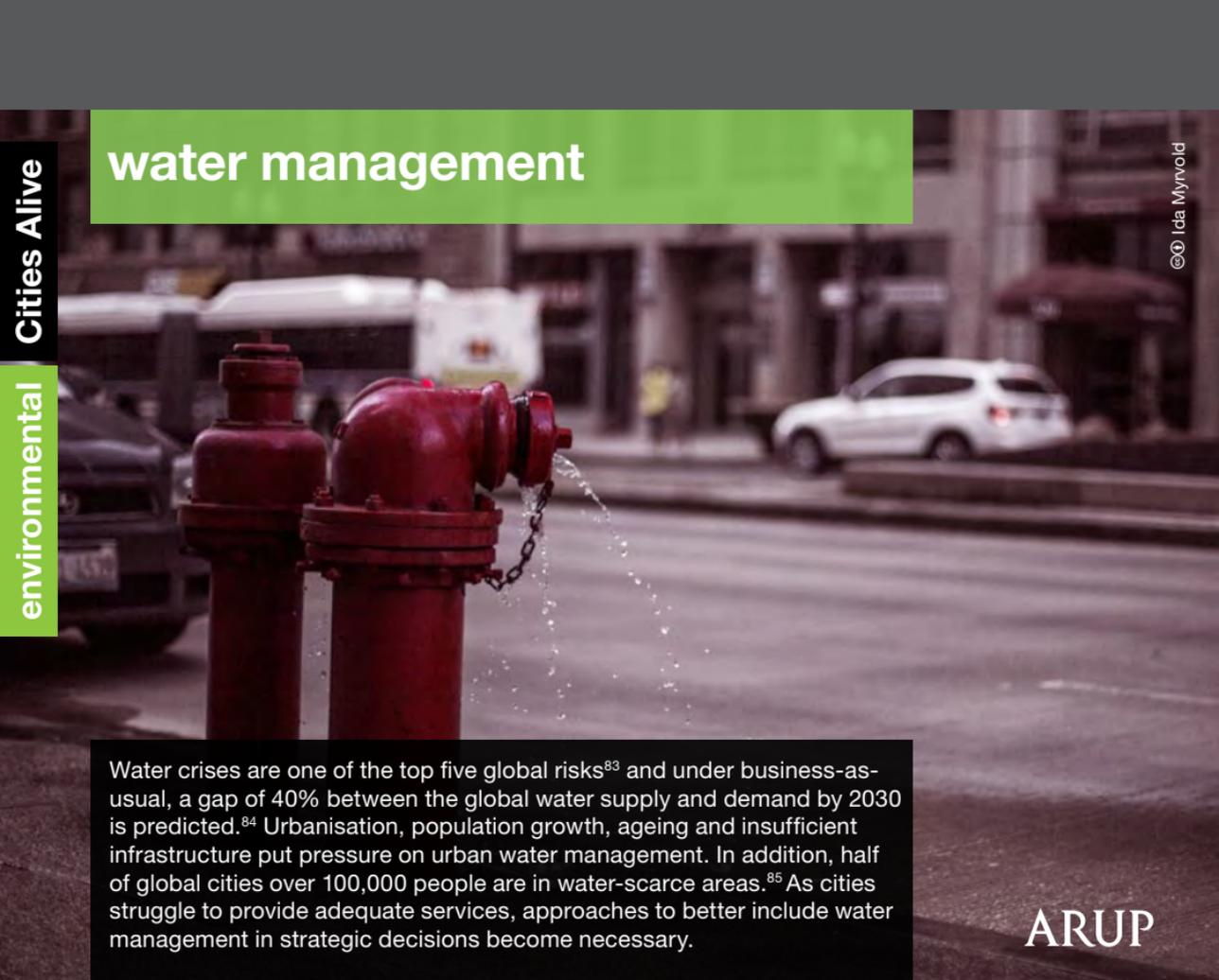


Cities, especially those located in developing markets, are driving economic growth. The world's top 600 cities (in terms of GDP) are expected to drive nearly two-thirds of global economic growth by 2025.<sup>79</sup> By that time, the world's 60 megacities will contribute just over 10% of global growth, with the 'middleweight' cities (cities with populations between 150,000 and 10M) having the greatest impact — accounting for 40% of global growth.<sup>80</sup>

# decarbonisation

Decarbonisation is the process of decoupling energy supply and economic growth from greenhouse gas emissions. To limit global warming to 2°C and minimise the risk of further climate change requires a carbon emissions reduction target of 80% of 1990 levels.<sup>81</sup> As cities contribute around 70% of global emissions,<sup>82</sup> many mitigation measures will need to be focused on urban areas, in particular urban electricity supply and transport.

# water management

A photograph of a red fire hydrant on a city street. Water is spraying from the side of the hydrant. In the background, there is a white van, a white car, and a person in a yellow vest. The scene is slightly blurred, focusing on the hydrant.

Water crises are one of the top five global risks<sup>83</sup> and under business-as-usual, a gap of 40% between the global water supply and demand by 2030 is predicted.<sup>84</sup> Urbanisation, population growth, ageing and insufficient infrastructure put pressure on urban water management. In addition, half of global cities over 100,000 people are in water-scarce areas.<sup>85</sup> As cities struggle to provide adequate services, approaches to better include water management in strategic decisions become necessary.

# food security



Cities are reliant on imported food to feed their growing populations, and food insecurity and under-nutrition are increasingly urban issues. In many cities, the urban poor spend up to 90% of their household income on food. In addition, a growing global middle class will demand more food, especially meat, dairy products and processed foods. To meet global demand, food production will need to at least double by 2050.<sup>86</sup>

# green infrastructure

Green infrastructure is the network of green and blue spaces — such as parks, agriculture, woods, rivers and ponds — in and around cities. Appropriately planned, designed and managed, green infrastructure has the potential to deliver a range of benefits including water management and flood mitigation. It can improve environmental conditions, air quality and reduce urban temperatures locally by 0.5 to 5°C.<sup>87</sup> Urban farming can form a part of green infrastructures, while improving urban food security.

# ecosystem services

Ecosystem services are natural services such as water purification, groundwater recharge, biodiversity preservation, pollination and waste decomposition. While they are seemingly free, the annual estimated economic value is around US\$33 trillion.<sup>88</sup> According to the Millennium Ecosystem Assessment, 60% of evaluated ecosystems experience degradation or non-sustainable use.<sup>89</sup> In addition to urban ecosystems, cities rely on external services from areas 500-1000 times a city's size.<sup>90</sup>

# waste minimisation

Waste minimisation strategies are increasingly important in cities, as per capita municipal solid waste (MSW) creation is expected to grow faster than urbanisation.<sup>91</sup> MSW is projected to increase by 70% until 2025, from 1.3 to 2.2bn tonnes per year with annual costs rising from US\$205-375bn. In low-income countries MSW management constitutes the largest urban budget item.<sup>92</sup>

# extreme weather

Climate change is seen as a catalyst for extreme heatwaves, earthquakes, flooding and other natural disasters. As 60% of urban dwellers already live in areas at high risk for natural hazards,<sup>93</sup> it is vital that governments consider how to improve the resilience of cities, infrastructure and public policies. Copenhagen's heavy flooding in 2011, for example, cost the city around £870M.<sup>94</sup> Low-tech solutions to locally absorb rainwater would be a similar investment, as well as a longer term strategy.<sup>95</sup>

# air quality



More than 1bn people are subjected to urban air pollution every year, which is estimated to cost about 2% of GDP in developed countries and about 5% of GDP in developing countries. Over 90% of air pollution in cities of developing countries is caused by vehicle emissions.<sup>96</sup> Additionally, about 50% of the global urban population experiences air pollution 2.5 times higher than WHO recommendations.<sup>97</sup>

## environmental pollution



Environmental pollution entails five main different types of pollution: air, water, soil, noise and light pollution. WHO estimates suggest that environmental factors cause around 25% of death and disease globally, rising to 35% in regions such as sub-Saharan Africa.<sup>98</sup> In China, only around 50% of urban water meets quality standard.<sup>99</sup> Urban noise pollution not only affects quality of life but can potentially become a long-term health issue, which has led many cities to implement noise limitation laws.<sup>100</sup>

# urban sprawl

The majority of the world's rapid population growth — which will see about 1M new people on earth each week until 2050 — will occur in cities. The resulting urban sprawl could cause a host of environmental problems including loss of wildlife habitat, deteriorating air and water quality, and increased potential for flooding as a result of impervious surfaces. In the US, urban sprawl is claiming over 2M acres of undeveloped land a year.<sup>101</sup>

# recycling

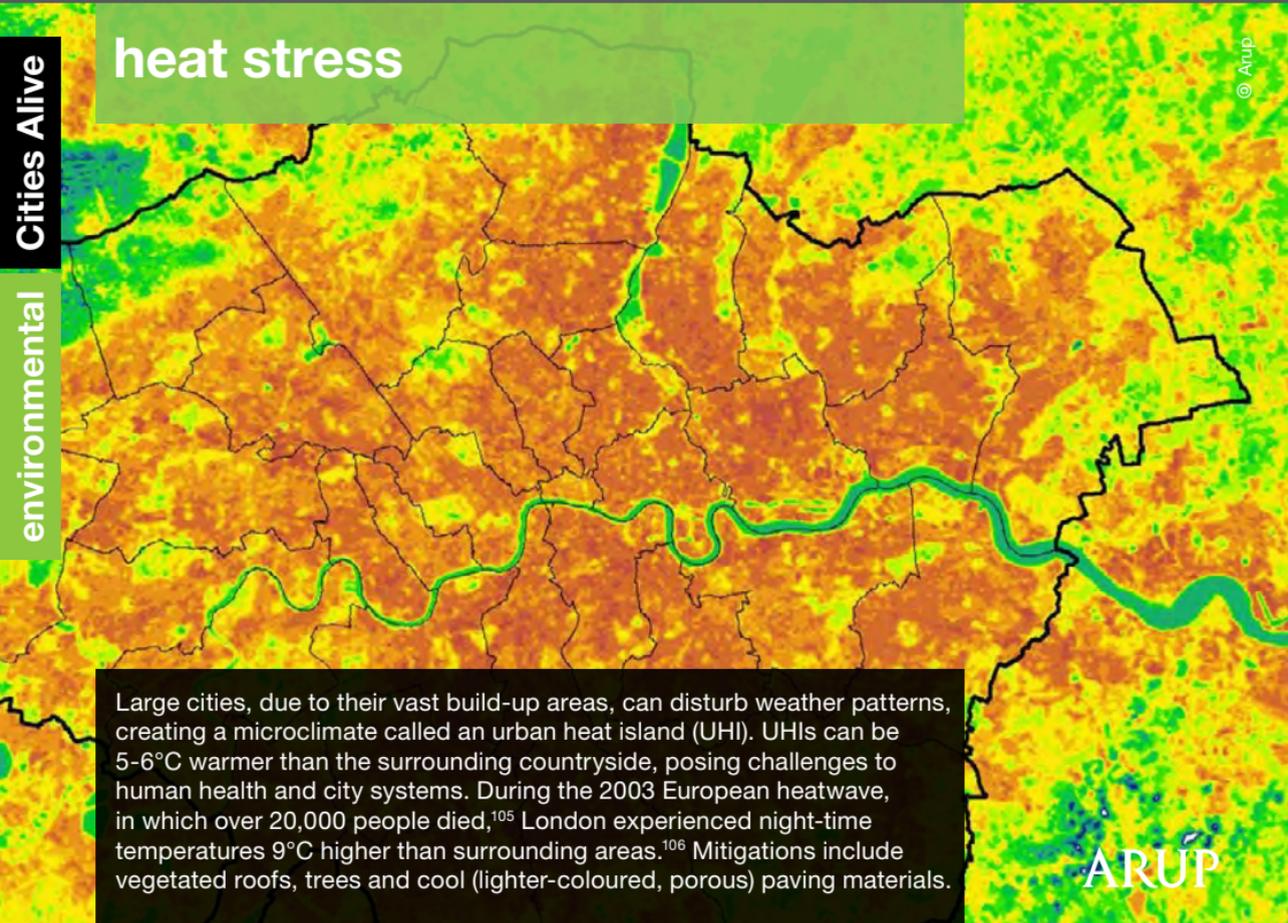


Recycling costs are often picked up by municipal governments, whose funding for services is already stretched, and who tend to lose money on recycling programs. One solution is to shift to a model of “extended producer responsibility” (EPR) which transfers the costs of recycling from city governments to producers. In Belgium, where the overall packaging recycling rate is 78%, around 5,900 companies are part of a producer responsibility organisation.<sup>102</sup>

# biodiversity loss

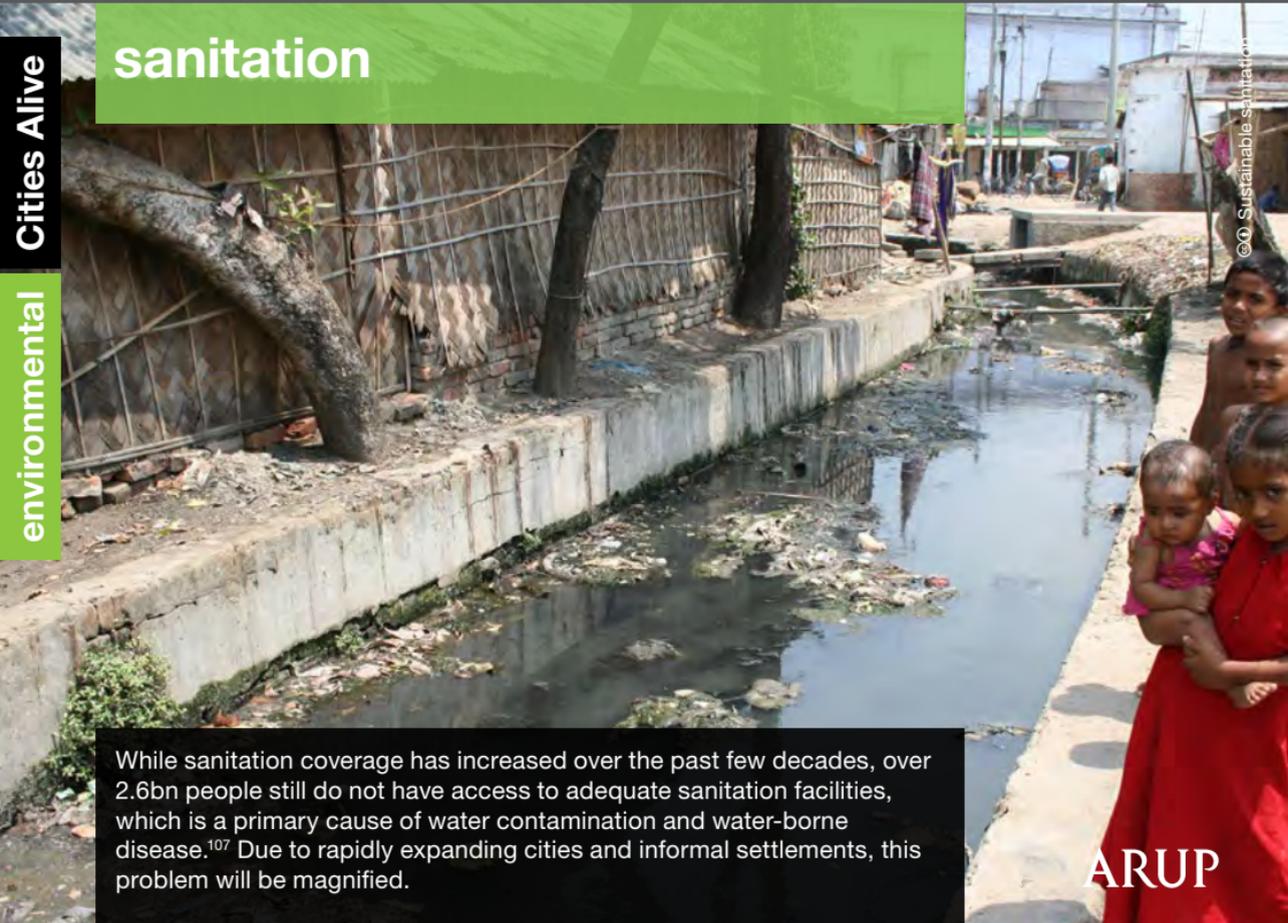
Projections under a range of global warming scenarios indicate a loss of 18-35% of species under 2050 climatic conditions, mainly due to land-use and management changes.<sup>103</sup> In general, undeveloped land areas support a far larger number of species than urban areas, which are only inhabited by 8% of bird and 25% of plant species. Cities also retain geographically distinct biodiversities, which offers a promising starting point for the implementation of biodiversity protection measures.<sup>104</sup>

# heat stress



Large cities, due to their vast build-up areas, can disturb weather patterns, creating a microclimate called an urban heat island (UHI). UHIs can be 5-6°C warmer than the surrounding countryside, posing challenges to human health and city systems. During the 2003 European heatwave, in which over 20,000 people died,<sup>105</sup> London experienced night-time temperatures 9°C higher than surrounding areas.<sup>106</sup> Mitigations include vegetated roofs, trees and cool (lighter-coloured, porous) paving materials.

# sanitation



While sanitation coverage has increased over the past few decades, over 2.6bn people still do not have access to adequate sanitation facilities, which is a primary cause of water contamination and water-borne disease.<sup>107</sup> Due to rapidly expanding cities and informal settlements, this problem will be magnified.

# non-motorised transport



Walking and cycling are great equalisers, reducing the cost of transport and increasing access to jobs and amenities. Shifting to non-motorised transport decreases urban pressure on public transport systems and reduces citizen's reliance on cars, while offering immediate environmental and health benefits.<sup>108</sup> While some cities in the developed world are moving towards becoming car-free (in Copenhagen, half of the city's population cycles to work), motorisation in the developing world is increasing.

# land use patterns

As cities increase in density, they transform natural areas such as farmlands, wetlands and forests into built-up human settlements with significant consequences for climate change, as well as for the impacts of natural hazards. Good urban planning can mitigate these impacts. For example, Curitiba in Brazil has turned areas vulnerable to flooding into parks with trees, and has created artificial lakes to hold floodwaters to avert a potentially costly flooding problem.<sup>109</sup>

# sea-level rise



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From 1901 to 2010, mean sea levels rose by 0.19m, due to a thermal expansion of the warmer oceans and melting land ice. It is estimated that there will be a further increase of 0.75-1.60m until 2100 (compared to 1990 levels). Around 60% of metropolitan areas with populations over 5M are located within 100km of the coast. High densities of people are also found in delta regions, which are particularly vulnerable to flooding.<sup>110</sup>

# retrofitting



If cities are to achieve carbon emissions reduction targets, it is not enough to build new energy-efficient buildings; old buildings will need to be retrofitted as well, as most of current building stock, especially in developed cities, will still be around in 2050. This could ultimately result in cost savings. It is estimated that cutting the CO<sub>2</sub> emissions from UK commercial buildings by 35% could save £4.5bn a year by 2020.<sup>111</sup>

# infrastructure usage

Reusing existing and unused infrastructure is seen as highly beneficial for urban areas, both economically and socially. Existing transport and underground infrastructure are prime examples for adaptive reuse, where cities create valuable public space without compromising further land areas. New York's Highline project, for example, has successfully transformed a piece of the city's unused infrastructure into a public park, creating vital green space for its citizens.<sup>112</sup>

# motorisation

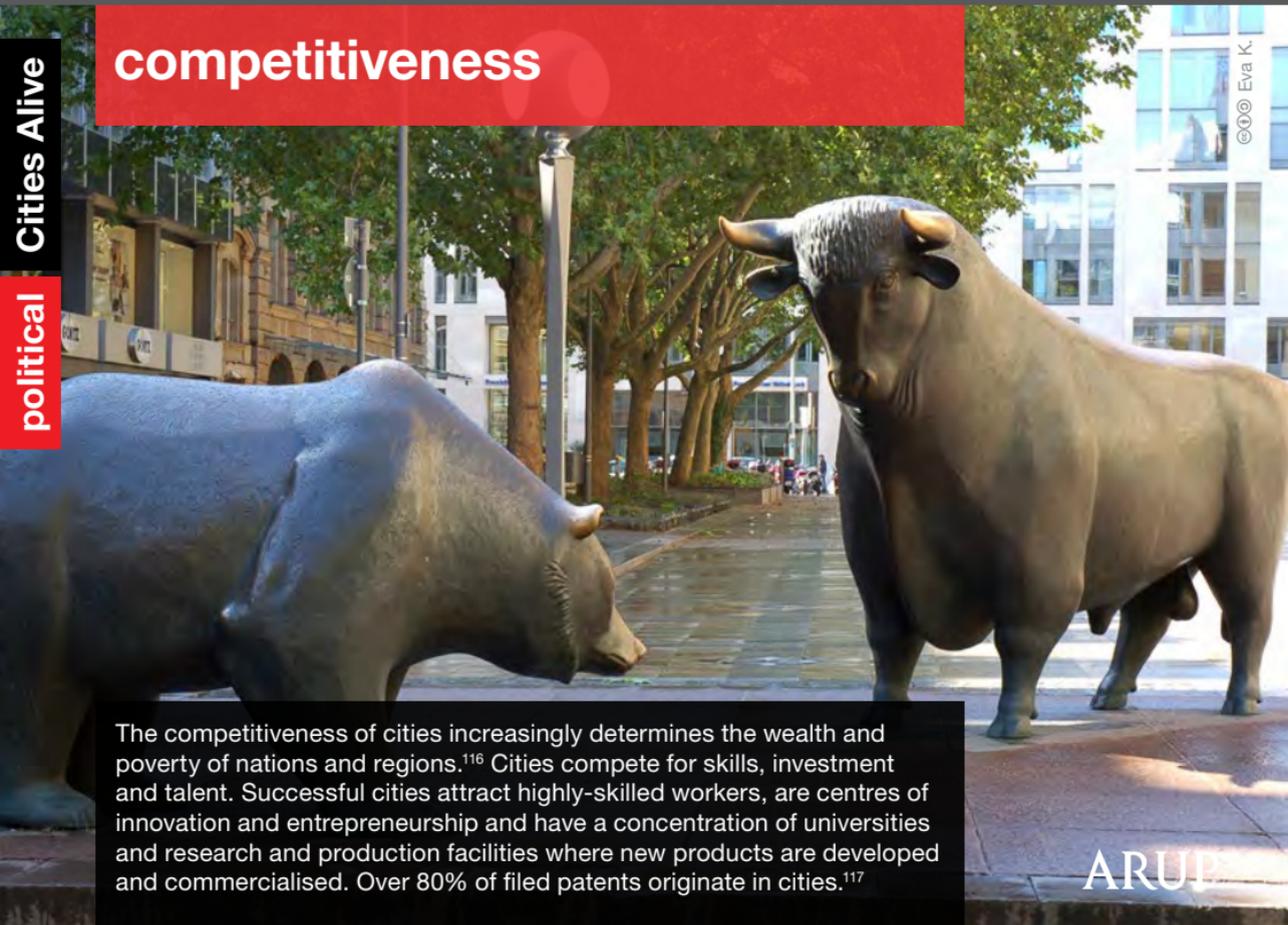
Urban capacity for motorised transport is reaching its limit, while the number of motorised vehicles worldwide is expected to increase 3% annually until 2030. Rates of growth in Europe and the US are likely to be slow (1% and 2% respectively), but in India growth rates could be as high as 7 or 8%.<sup>113</sup> In the UK, traffic congestion costs the economy £4.3bn a year,<sup>114</sup> while in the US the congestion cost is estimated at US\$121bn.<sup>115</sup>

# global politics



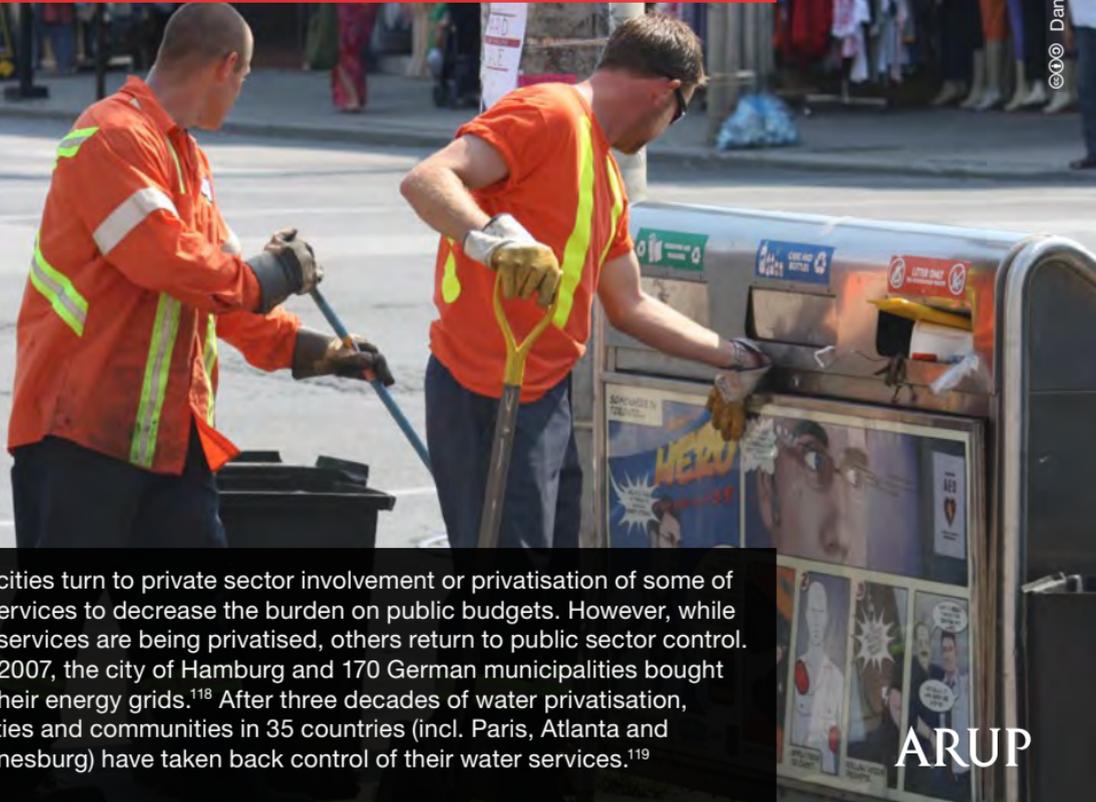
As key centres of political and financial power, cities are playing an increasingly important role in international politics, cooperating with each other on matters including climate change and security. While international relations has traditionally involved a range of actors including states, cities are increasingly representing themselves and their interests at an international level.

# competitiveness



The competitiveness of cities increasingly determines the wealth and poverty of nations and regions.<sup>116</sup> Cities compete for skills, investment and talent. Successful cities attract highly-skilled workers, are centres of innovation and entrepreneurship and have a concentration of universities and research and production facilities where new products are developed and commercialised. Over 80% of filed patents originate in cities.<sup>117</sup>

# privatisation



Many cities turn to private sector involvement or privatisation of some of their services to decrease the burden on public budgets. However, while some services are being privatised, others return to public sector control. Since 2007, the city of Hamburg and 170 German municipalities bought back their energy grids.<sup>118</sup> After three decades of water privatisation, 180 cities and communities in 35 countries (incl. Paris, Atlanta and Johannesburg) have taken back control of their water services.<sup>119</sup>

# public-private partnerships



Public-private partnerships (PPPs) are a mechanism for cities to fund infrastructure and government services such as transport, health and education, enabling urban areas to undertake improvements without raising taxes. While there are downsides to PPPs, including their short-term nature, global PPP volume reached US\$97bn in 2013 (twice the 2009 level), most of which went to infrastructure finance.<sup>120</sup>

# collective consciousness



Social media and crowdsourcing are opening up new possibilities for public engagement and participation, changing how cities undertake projects, collect data and gauge public opinion. Social media opens up the planning process to a larger, more representative audience, while crowdsourcing can be used to leverage intellectual capacity and local knowledge to help solve city problems.

# stakeholder engagement



Stakeholder engagement, including the involvement of local communities, private companies and NGO's, can be a powerful tool for cities to find solutions to complex issues. Giving stakeholders a say in decision-making, rather than simply informing them, gives the process more legitimacy and can lead to better solutions. Community involvement in urban planning processes helps tailor developments to the needs of communities, increases commitment and provides valuable location-specific insights.<sup>121</sup>

# public opinion



Climate change, energy shocks, economic crises and political upheavals will continue to foster public dissent and political activism. For example, The Campaign Against Climate Change organises a yearly Global Day of Action to coincide with the UN Climate Talks. In 2014, over 600,000 people took part in the protest.<sup>122</sup> As governments fear political instability, public protest can be the tipping point that forces change.

# institutional capacity

New forms of institutions and leadership (such as community based organisations for water management) are needed to manage the complex, interdependent social, economic and environmental issues facing cities. Fast-growing developing cities in particular could benefit from establishing systems that involve a variety of urban actors and a strong community basis, as these cities often lack the appropriate institutional capacity to respond to growing demands for urban services and infrastructure.

# transparency



Citizens are demanding greater accountability and transparency from their governments to fight corruption and improve services. Slovakia, for example, has an initiative that evaluates the 100 largest cities in the country across 111 indicators of transparency. This has led to cities releasing more and higher quality information.<sup>123</sup> The UK government has been ranked as the most transparent in the world, followed by the US and Sweden.<sup>124</sup>

# leadership



Strong city leadership, such as mayors, provide visibility, legitimacy and decision-making power to city governance. More financial powers and autonomy are important for urban areas to achieve economic growth and social and environmental improvements.<sup>125</sup> Many countries already have elected city mayors. Germany, for example, has thousands of towns and cities which all have directly elected mayors.<sup>126</sup>

## environmental policy



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Cities are a key contributor to climate change, responsible for 75% of global CO<sub>2</sub> emissions.<sup>127</sup> Cities, therefore, need to be an integral part of fighting climate change, through environmentally sensitive practices and policies. Some cities have ambitious targets for reducing greenhouse gas emissions, water use and waste generation. Melbourne, Australia, for example, has set a municipal target of zero net emissions by 2020.<sup>128</sup>

# system interdependence

In order to improve resilience and efficiency, city authorities increasingly need to consider the interdependence of urban systems. This includes the effects of global issues, such as climate change and food prices, on interdependent urban systems, including water, energy and waste, as well as on social infrastructure. Significant natural events, like Hurricane Sandy in New York in 2012, highlight the interdependencies of city systems and the cascading negative effects environmental hazards can cause.

# terrorism



Global terrorism constitutes a fundamental threat to cities' security. A terrorist attack could have devastating effects on a city's citizens and economy, with critical infrastructure particularly vulnerable. There were nearly 10,000 terrorist attacks in 2013, a 44% increase from 2012. The individual's risk, however, is still 64 times higher for homicide.<sup>129</sup> Cyberterrorism could also become an increasing threat; in 2013, the energy industry accounted for 56% of all hacker attacks in the US.<sup>130</sup>

# subsidies



One of the most common forms of subsidy by urban authorities is the provision of public transport systems. In developed countries, these subsidies are often sizeable – in the 20 largest cities in the US, they make up around 70% of the operational cost of public transport. In the developing world, however, subsidies are usually non-existent or very small.<sup>131</sup> Subsidies are often a matter of debate as to who benefits most and whether they reduce economic efficiency.

# urban governance



Urban governance refers to the process through which democratically elected local governments and a range of urban stakeholders make decisions about how to plan, finance and manage the urban realm. There are an almost endless variety of governance institutions and models, but in many countries a challenge is that increasing city responsibilities, including in the regional context, have not been matched by an increase in fiscal autonomy.<sup>132</sup>

# policing



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Declining public budgets and growing populations are placing strain on urban police forces. In India, the government has allocated US\$72M from 2013 to 2017 under the Mega City Policing (Safe City) Project, which aims to strengthen the police system by using the latest technologies to combat a number of threats, including terrorist attacks.<sup>133</sup> Six of India's largest cities have adopted aerial surveillance measures to support city policing.<sup>134</sup>

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Many cities, particularly those in centralised states like the UK, are calling for greater financial freedom to enable local politicians to maximise growth potential. Cities thus empowered can be more competitive and can be incentivised to grow faster. In London, for example, only 7% of tax paid by London residents and businesses is redistributed directly by locally elected bodies.<sup>135</sup>

# building standards

An aerial, isometric view of a modern urban development. The buildings feature extensive green roofs, some with courtyards and walkways. The architecture is a mix of glass-fronted structures and more solid, multi-story buildings. A prominent feature is a large, oval-shaped courtyard or plaza area with a reddish-brown border. The surrounding area includes streets with trees and other buildings in the background.

New standards set benchmarks and requirements for the performance and design of urban systems and structures, and are increasingly asked for by the public and private sector. This includes enabling better integration between different urban systems, such as transport, energy and waste. The same applies to the components of buildings. Launched in 2014, the WELL Building Standard is the world's first building standard to focus on enhancing people's health and wellbeing through the built environment.

# electoral cycle

A group of women wearing black hijabs are gathered at a political rally. They are holding a large banner that features a portrait of a woman and Arabic text. One woman in the foreground is pointing upwards with her right hand. The background shows other people and more banners, suggesting a public demonstration or campaign event.

The power of mayors in cities is increasingly recognised, and many cities and planning decisions become dependent on the electoral cycle. Decisions over city systems, infrastructure assets and buildings often depend on the direction of city governments. A study by Arup and C40 showed that the length of electoral cycles highly influences actions taken in cities: "Actions per city may decrease with increasing term length, but the proportion of transformative actions broadly increases."<sup>136</sup>

# public space

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political

Many cities realise the importance of public spaces for the wellbeing of citizens, as spaces for interaction or quiet, rest or play. Well-designed public spaces also improve a city's liveability, have a positive impact on its economy, and provide city residents with chances to encounter nature and wildlife. In many cities, however, space is becoming increasingly owned and controlled by private entities, undermining the democratic nature of public space and potentially resulting in declining public realm vitality.<sup>137</sup>

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## references

### social

1. United Nations, Department of Economic and Social Affairs, Population Division (2015). *World Population Prospects: The 2015 Revision, Key Findings and Advance Tables. Working Paper No. ESA/P/WP.242*. <http://bit.ly/1Munrdx>
2. United Nations, Department of Economic and Social Affairs, Population Division (2014). *World Urbanization Prospects: The 2014 Revision, Highlights*. <http://bit.ly/1tslPlu>
3. World Bank (2013). *Global Monitoring Report 2013: Rural-Urban Dynamics and the Millennium Development Goals*. <http://bit.ly/1Bpb3Dn>
4. Pew Research Center (2014). *10 projections for the global population in 2050*. <http://pewrsr.ch/1kMmvBV>
5. Wired (2013). *The new Workplace Reality: Out of the Office*. <http://wrd.cm/1Q5Y15l>
6. Euromonitor (2013). *Downsizing Globally: The Impact of Changing Household Structure on Global Consumer Markets*. <http://bit.ly/1uQ7kit>
7. Oxfam (2014). *Working for the few: Political capture and economic inequality. Oxfam Briefing Paper - Summary*. <http://bit.ly/1JX9AIS>
8. Oxfam International (2015). *Richest 1% will own more than all the rest by 2016*. <http://bit.ly/1BBc62l>
9. International Labour Organization (2014). *Global Employment Trends 2014: Risk of a jobless recovery?* <http://bit.ly/19lvyCD>
10. Briar Lloyd (2014). *Building Resilience: An Opportunity to Create Shared Value*. Shared Value Initiative. <http://bit.ly/1UL1Kqk>
11. United Nations Human Settlements Programme (2014). *Background Paper. World Habitat Day: Voices from Slums*. <http://bit.ly/1Q60HOD>
12. World Health Organization (2015). *Noncommunicable diseases*. <http://bit.ly/18Fz04M>
13. World Health Organization (2014). *10 facts on the state of global health*. <http://bit.ly/1gekQaK>
14. UNESCO Institute for Statistics (2014). *Out-of-School Children*. <http://bit.ly/1LNAF7L>
15. United Nations (2015). *The Millennium Development Goals Report 2015*. <http://bit.ly/1gxl0O3>
16. The Economist Intelligence Unit (2015). *The Safe Cities Index 2015: Assessing urban security in the digital age*. <http://bit.ly/1vreDIN>
17. World Health Organization: Centre for Health Development (N/A). *The effect of urban crime and perceived safety on urban levels of physical activity: a review*. <http://bit.ly/1KluG32>
18. World Tourism Organization (2012). *Global Report on City Tourism*. <http://bit.ly/1h1g5fx>
19. Fariborz Aref (2011). *The Effects of Tourism on Quality of Life: A Case Study of Shiraz, Iran*. Life Science Journal, Volume 8, Issue 2, 2011. <http://bit.ly/1OFY5bK>
20. Homi Kharas and Geoffrey Gertz (2010). *The New Global Middle Class: A Cross-Over from West to East*. Wolfensohn Center for Development at Brookings. <http://brook.gs/1VRnR0K>
21. Mazda Adli (2011). *Urban Stress and Mental Health*. LSE Cities. <http://bit.ly/1UL519l>
22. The Nielsen Company (2014). *Global consumers are willing to put their money where their heart is when it comes to goods and services from companies committed to social responsibility*. <http://bit.ly/1GyCmb>
23. eMarketer (2014). *2 Billion Consumers Worldwide to Get Smart(phones) by 2016*. <http://bit.ly/1vWbVJR>
24. McKinsey Global Institute (2014). *Tackling the world's affordable housing challenge*. <http://bit.ly/1tjiv6Y>
25. World Health Organization (N/A). *WHO Report on Global Surveillance of Epidemic-prone Infectious Diseases - Introduction*. <http://bit.ly/1loAqeH>
26. Joe Watts (2015). *'Dickensian levels' of tuberculosis in Newham are higher than in Tajikistan*. Evening Standard. <http://bit.ly/19ngcni>
27. City Observatory (N/A). *Introduction to Innovation & Entrepreneurship*. <http://bit.ly/1XSGJym>

## references

### technological

28. Thomas Frey (2013). *Introducing the Fully-Automated 24-Hour City*.  
<http://bit.ly/1F19cfn>
29. Intel (N/A). *A Guide to the Internet of Things: How Billions of Online Objects are making the Web wiser*.  
<http://intel.ly/1DHjDAz>
30. Intel (N/A). *A Guide to the Internet of Things: How Billions of Online Objects are making the Web wiser*.  
<http://intel.ly/1DHjDAz>
31. Steven Kostyshen (2015). *The Bridge To Big Data - Nice Work If You Can Get It!* K2View.  
<http://bit.ly/1QsLsk>
32. University of Cambridge (2015). *Cambridge Centre for Smart Infrastructure and Construction*.  
<http://bit.ly/1Q6IZgN>
33. David Groarke, Zach Pollock and Ben Kellison (2013). *Global Smart Grid Technologies and Growth Markets 2013-2020*. GTM Research.  
<http://bit.ly/1xiSSH>
34. INRIX (2014). *Traffic Congestion to Cost the UK Economy More Than £300 Billion Over the Next 16 Years*.  
<http://bit.ly/1F1pAwc>
35. Michael H. (2013). *Mobile penetration in Africa is now at 80% and growing fast*. phonearena.com.  
<http://bit.ly/1K0ruda>
36. New Start Magazine (2014). *How cities are financing their own energy efficiency*.  
<http://bit.ly/1J2zIA1>
37. Peter Madden (2014). *Using integrated infrastructure systems to make cities more efficient*. PlacemakingResource.  
<http://bit.ly/1J2A21y>
38. Robert E. Calem (2014). *Driverless Cars on the Rise*.  
<http://bit.ly/1iR05e>
39. Yonah Freemark (2015). *Will autonomous cars change the role and value of public transportation?* The Transport Politic.  
<http://bit.ly/1K0sVsd>
40. Matthew Hancock (2014). *Microgeneration: Written question - 217160 (Answer)*. Parliament UK.  
<http://bit.ly/1Q6rBHS>
41. Electrical Cars Report (2015). *Sales of Light Duty Electric Vehicles to Reach 6.4 Million Annually by 2023*.  
<http://bit.ly/1iCdoC>
42. Cisco (2014). *Cisco Global Cloud Index: Forecast and Methodology, 2013-2018*.  
<http://bit.ly/1BNhCTZ>
43. Statista (2015). *Projected global additive manufacturing market size from 2008 to 2023 (in billion euros)*.  
<http://bit.ly/1J2GICo>
44. Natalie Wolchover (2012). *What Is the Future of Computers?* LiveScience.  
<http://bit.ly/1XT6LBB>
45. Statista (2015). *Wearable device market value from 2010 to 2018 (in million U.S. dollars)*.  
<http://bit.ly/1nNWRvk>
46. Jessica Leber (2014). *Beyond The Quantified Self: The World's Largest Quantified Community*. Fast Company.  
<http://bit.ly/1rjYvaA>
47. Rita Tatum (2013). *Potential Energy Savings Drive Interest in Intelligent Buildings*. facilitiesnet.  
<http://bit.ly/1GiPqF>
48. Stephen Gandel (2015). *Lloyd's CEO: Cyber attacks cost companies \$400 billion every year*. Fortune.  
<http://for.tn/1uXYb9F>
49. National Academy of Sciences (2006). *Engineering for the Developing World*.  
<http://bit.ly/1LnMyKV>
50. PRNewswire (2015). *Remote Patient Monitoring Market to Grow at 15% CAGR to 2018*.  
<http://prn.to/1ESgstS>
51. Greg Slabodkin (2013). *Remote patient monitoring to save \$36B globally by 2018*. FierceMobileHealthcare.  
<http://bit.ly/1XT9ATI>
52. Streetline (2013). *5 Urban Technology Trends Impacting City Planning*.  
<http://bit.ly/1ge29r9>
53. Ruchika Goel (2015). *3D model-based design can help make future cities more livable, sustainable, and economically vital: Sunil MK, Autodesk*. Dataquest India.  
<http://bit.ly/1F1Bx4W>

### economic

54. RSA (2014). *Connected Cities - The Link to Growth*.  
<http://bit.ly/1NtAX5>
55. Arcadis (2014). *Second Global Infrastructure Investment Index 2014: Competing for private finance*.  
<http://bit.ly/1rjqnzU>
56. McKinsey Global Institute (2013). *Infrastructure productivity: How to save \$1 trillion a year*.  
<http://bit.ly/1i8MtCa>

## references

57. The World Bank (N/A). *Global Infrastructure Facility*. <http://bit.ly/1ij5yTW>
58. American Recycler (2012). *San Francisco celebrates composting achievements*. Recology. <http://bit.ly/1KcYPRx>
59. Adecco (N/A). *STEM skills drive innovation*. <http://bit.ly/1Nm7iqV>
60. Business in the Community (2010). *The Value of Responsible Business: June 2010*. <http://bit.ly/1J2RmDF>
61. ClimateWise (N/A). *Building Resilient Cities*. <http://bit.ly/1ULBM64>
62. PwC strategy& (2013). *Digitization for economic growth and job creation: Regional and industry perspectives*. <http://pwc.to/1iCsnC3>
63. Frost & Sullivan (2013). *Delivering to Future Cities - Mega Trends Driving Urban Logistics*. <http://bit.ly/1LnQMcc>
64. Arup (N/A). *Regent Street delivery and servicing reduction scheme*. <http://bit.ly/1F1laV1>
65. DHL Trend Research (2014). *Unmanned Aerial Vehicles in Logistics: A DHL perspective on implications and use cases for the logistics industry*. <http://bit.ly/1ij8r7j>
66. Pratt Center for Community Development (N/A). *Made in NYC*. <http://bit.ly/1J2TriM>
67. Julia Llewellyn Smith (2014). *Womenomics: why women are the future of our economy*. <http://bit.ly/1kkrfPx>
68. UCL (N/A). *MSc/Dip Urban Regeneration: Overview, The Bartlett School of Planning*. <http://bit.ly/1KIQFqk>
69. The Economist (2013). *The Bilbao effect: If you build it, will they come?* <http://econ.st/1h1oYtb>
70. J. Mariah Brown (N/A). *How Important Are Small Businesses to Local Economies?* Demand Media, Small Business. <http://bit.ly/VYwwBa>
71. XLN Telecom (N/A). *New Report Highlights the Importance of SMEs to UK Cities*. <http://bit.ly/1M1PbEV>
72. The Economist (2013). *The rise of the sharing economy: On the internet, everything is for hire*. <http://econ.st/1ehOMOL>
73. PwC (N/A). *Have your say: the sharing economy debate*. <http://pwc.to/1Av2RQR>
74. Alan Bjerga (2012). *Drought-Parched Mississippi River Is Halting Barges*. Bloomberg. <http://bloom.bg/1K26ncl>
75. Deden Rukmana (2007). *Urban Planning and the Informal Sector in Developing Countries*. Planetizen. <http://bit.ly/1Kd3PWf>
76. Kristina Flodman Becker (2004). *The Informal Economy*. Sida. <http://bit.ly/1O5HdOr>
77. ABC Carbon (N/A). *A Sustainable Future with Water Self-Sufficiency is Singapore's Aim*. <http://bit.ly/1L6xmWR>
78. Jimmy Stamp (2012). *Rebranding Amsterdam and What It Means to Rebrand a City*. Smithsonian. <http://bit.ly/1XTq4Z>
79. Aimee Kim, Nathalie Remy, Jennifer Schmidt and Benjamin Durand-Servoingt (2014). *The glittering power of cities for luxury growth*. McKinsey&Company. <http://bit.ly/1gfc1qk>
80. Aimee Kim, Nathalie Remy, Jennifer Schmidt and Benjamin Durand-Servoingt (2014). *The glittering power of cities for luxury growth*. McKinsey&Company. <http://bit.ly/1gfc1qk>
81. WWF (2012). *Living Planet Report 2012: Biodiversity, biocapacity and better choices*. <http://bit.ly/1nRSqm4>
82. The New Climate Economy (2014). *Better Growth, Better Climate: The New Climate Economy Report. Chapter 2*. <http://bit.ly/1Kd50Vy>
83. World Economic Forum (2014). *Global Risks 2014, Ninth Edition*. <http://bit.ly/1d164y3>
84. 2030 Water Resources Group (2013). *Managing Water Use in Scarce Environments: A Catalogue of Case Studies*. <http://bit.ly/1KIMyQd>
85. Brian D. Richter, David Abell, Emily Bacha, Kate Brauman, Stavros Calos, Alex Cohn, Carlos Disla, Sarah Friedlander O'Brien, David Hodges, Scott Kaiser, Maria Loughran, Christina Mestre, Melissa Reardon, Emma Siegfried. *Tapped out: how can cities secure their water future?* Water Policy, 2013;(15):335-63. <http://bit.ly/1F1T798>
86. William J. Garvelink, Kristin Wedding (2013). *Nutrition and Food Security in the City*. Center for Strategic & International Studies. <http://bit.ly/1gfhQen>

## environmental

## references

87. Arup (2014). *Cities Alive: Rethinking green infrastructure*. <http://bit.ly/1ooEhtS>
88. United Nations Environment Programme (2009). *Water Security and Ecosystem Services: The Critical Connection*. <http://bit.ly/1gfsk6>
89. Millennium Ecosystem Assessment (2005). *Overview of the Millennium Ecosystem Assessment*. <http://bit.ly/1J34wRa>
90. Per Bolund, Sven Hunhammar (1999). *Ecosystem services in urban areas*. Ecological Economics 29 (1999) 293-301. <http://bit.ly/1gfi0q5>
91. Daniel Hoornweg, Perinaz Bhada-Tata (2012). *What a Waste: A Global Review of Solid Waste Management*. World Bank. <http://bit.ly/1Kd8444>
92. World Bank (2012). *'What a Waste' Report Shows Alarming Rise in Amount, Costs of Garbage*. <http://bit.ly/1NmnAQI>
93. United Nations (2012). *World Urbanization Prospects: The 2011 Revision*. <http://bit.ly/1EXxFlP>
94. International Federation for Housing and Planning (N/A). *Making Cities Climate Resilient*. <http://bit.ly/1F91vUe>
95. Justin Gerdes (2012). *What Copenhagen Can Teach Cities About Adapting To Climate Change*. Forbes. <http://onforb.es/1J7gRDN>
96. United Nations Environment Programme (N/A). *Urban Air Pollution*. <http://bit.ly/1QcGQz3>
97. World Health Organization (2014). *Air quality deteriorating in many of the world's cities*. <http://bit.ly/1nnM5Pb>
98. World Health Organization (N/A). *The Health and Environment Linkages Initiative: Environment and health in developing countries*. <http://bit.ly/1OqcFpK>
99. Jonathan Kaiman (2014). *China says more than half of its groundwater is polluted*. <http://bit.ly/1Pt3VDX>
100. Rajiv Bhatia (2014). *Noise Pollution: Managing the Challenge of Urban Sounds*. Earth Journalism Network. <http://bit.ly/1iJq9B0>
101. John G. Mitchell (N/A). *Urban Sprawl*. National Geographic. <http://on.natgeo.com/1gmljrw>
102. Sarah Laskow (2015). *Who Will Pay America's \$1.5 Billion Recycling Bill?* Next City. <http://bit.ly/1LwEZIs>
103. OECD (2012). *OECD Environmental Outlook to 2050*. <http://bit.ly/1LcBwFf>
104. Mark Kinver (2014). *Study shows urbanisation's impact on biodiversity*. BBC. <http://bbc.in/1ACW4J>
105. Met Office (2015). *The heatwave of 2003*. <http://bit.ly/1NznXca>
106. Arup (2014). *Reducing urban heat risk: A study on urban heat risk mapping and visualisation*. <http://bit.ly/1iJsuVH>
107. UN Habitat (2012). *Water & Sanitation*. <http://bit.ly/1Knt6U7>
108. Centre for Livable Cities and Urban Land Institute (2014). *Creating Healthy Places through Active Mobility*. <http://bit.ly/1zjkaJl>
109. United Nations Environment Programme (N/A). *Success Stories: Sustainable urban planning in Brazil*. <http://bit.ly/1M6SPgQ>
110. Greenpeace International (2012). *Sea level rise*. <http://bit.ly/1Jc3BQ3>
111. Nic Fleming (2014). *Retrofitting older buildings: innovations and necessity*. The Guardian. <http://bit.ly/1LsbzYs>
112. Friends of the Highline (N/A). *The Highline*. <http://bit.ly/OIPtq6>
113. Daniel Sperling and Deborah Gordon (2010). *Two Billion Cars: Driving Toward Sustainability*. Oxford University Press.
114. roadtraffic-technology (2012). *Traffic congestion on roads costs UK economy £4.3bn a year*. <http://bit.ly/1KIZTGY>
115. ITS International (2013). *Assessing driver behaviour in work zones*. <http://bit.ly/1M6VNBT>

## political

116. World Economic Forum (2014). *The Competitiveness of Cities*. <http://bit.ly/1nS7fSY>
117. OECD (2006). *OECD Territorial Reviews: Competitive Cities in the Global Economy*. <http://bit.ly/17T5aFl>
118. Claire Provost and Matt Kennard (2014). *Hamburg at forefront of global drive to reverse privatisation of city services*. <http://bit.ly/1u1Clhh>

## references

119. University of Greenwich (2014). *Report identifies global trend to reverse the privatisation of water*.  
<http://bit.ly/1VXRaFo>
120. The City UK (2014). *Infrastructure 2014*.  
<http://bit.ly/1q4vG6m>
121. Guneet Kaur (2007). *Participatory Approach / Community Involvement in Planning, 43rd ISOCARP Congress 2007*.  
<http://bit.ly/1Oqr4IZ>
122. BBC (2014). *Climate change summit: Global rallies demand action*.  
<http://bbc.in/1v6aL1K>
123. Transparency International (2012). *Slovakia: Cities ranked on their transparency*.  
<http://bit.ly/1LcH4Xw>
124. Mark Easton (2015). *UK government 'most transparent' in the world*. BBC.  
<http://bbc.in/1yDjNGp>
125. Zach Wilcox (2014). *The leadership deficit: why mayors are a necessary investment in our cities*. Centre for Cities.  
<http://bit.ly/1NrRdjh>
126. Jonas Schorr (2015). *German Mayors*. City Mayors.  
<http://bit.ly/1UStZn0>
127. United Nations Environment Programme (N/A). *Cities and Climate Change*.  
<http://bit.ly/1URJ2mg>
128. City of Melbourne (2014). *Zero Net Emissions by 2020: Update 2014*.  
<http://bit.ly/1idxd8f>
129. Vision of Humanity (2014). *Global Terrorism Index*.  
<http://bit.ly/14DPHs0>
130. Nicole Perloth (2015). *Smart City Technology May Be Vulnerable to Hackers*. The New York Times, Bits Blog.  
<http://nyti.ms/1yRBbL4>
131. Leonardo Basso and Hugo Silva (N/A). *Cities that subsidise transit will get the best value for money in the absence of congestion pricing and bus lanes*.  
<http://bit.ly/1QtZzq3>
132. Enid Slack and André Côté (2014). *Comparative urban governance, Future of Cities: working paper*. Foresight, Government Office for Science.  
<http://bit.ly/1Qt3mav>
133. Ankush Kumar (2015). *Megacity Policing Project to Boost Development of Safe Cities Across India*. IFSEC Global.  
<http://ubm.io/1LeyTdk>
134. The Economic Times (2014). *Six mega cities under aerial surveillance to aid policing: Home Minister Rajnath Singh*.  
<http://bit.ly/1OcpHsb>
135. Core Cities (N/A). *New campaign calling for decentralised fiscal reform launched by Core Cities group, London Councils and Mayor of London*.  
<http://bit.ly/1sZKpRp>
136. C40 Cities (2015). *New Research from C40 and Arup Shows How City Governments are Changing the World*.  
<http://bit.ly/1JEQQ21>
137. Jacek Tittenbrun (2013). *The privatisation of public space*. The Conversation.  
<http://bit.ly/1KkrSCO>

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