

Resilient cities

Future assured urban communities
through connected thinking



A resilient city is a better place to live, do business and invest in for the future

More than half of the world's population now live in cities and urbanisation is advancing rapidly. The population of Amman, for example, doubled in the last 20 years of the last millennium and has since already doubled again.

Urbanisation is being driven by population growth and the search for economic and social opportunity.

It is also a response to the changing climate, one of the impacts of which is a decline in the viability or desirability of labour-intensive agriculture, leading to more people migrating from rural to urban areas in search of a job and new life.

Ironically, urbanisation and urban lifestyles can exacerbate climate change, while in some cases people can be more vulnerable to extreme weather events in densely populated urban centres.

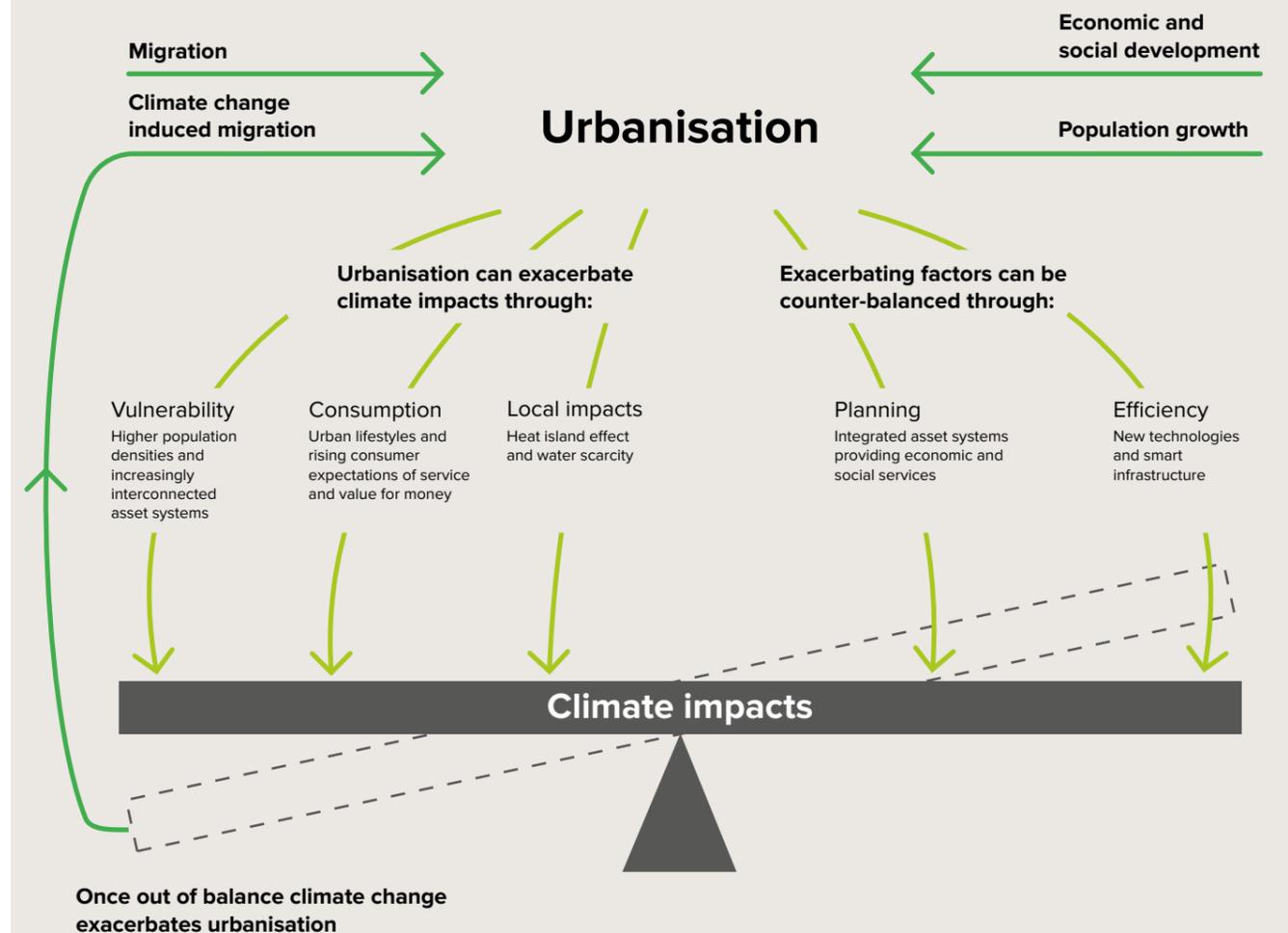
The consequences of storms, floods, heatwaves and other impacts can be devastating: accelerated degradation and destruction of buildings and infrastructure, failure of water, sanitation, energy, transport and communication services, and, not least, loss of lives and livelihoods.

It is therefore essential for cities to invest in their resilience, focusing efforts and resources on raising levels of preparedness.

Resilient cities will not only be better able to withstand the increasing severity of climate shocks, but also non-climate risks, such as seismic, geo-political and other hazards. With the capacity to absorb different kinds of stresses, they can evolve and become even stronger.

In short, a resilient city is a better, safer place to live, do business, invest in and build for the future.

Urban resilience: the key to keeping climate change in check



How we can help your city

In this brochure you'll find insight and analysis into urban resilience across the four key phases of research, planning, delivery and operation, plus case studies.

In each section, we also list the relevant services and expertise we can provide to help you protect your city and citizens against all forms of shocks and stresses.

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Evaluate the risks and explore the solutions

The increasing severity of climate change

Social and economic infrastructure is experiencing unprecedented stresses from population growth, constrained public finances and rising consumer expectations for better service.

Climate change is a dominant pressure as many urban assets are vulnerable in some way to weather-related hazards. Losses attributed to climate and weather events are estimated to have quadrupled in 30 years. The effects of climate change already cause up to US\$200bn in global annual economic losses.

Residential, commercial and public buildings are often poorly adapted to cope with existing climatic conditions, with current building codes and standards not designed to take into account anticipated changes in climate impacts. The steady pace of climate change, more rapid than in the past, is rendering current approaches to risk management both insufficient and inappropriate.

The importance of research

The immediate task facing cities is to understand how climate challenges will change, and determine what investments are required to maintain levels of safety and minimise disruption to business and essential services. Cities need to pinpoint vulnerabilities and risks, assess how those risks may change and consider stakeholder expectations of what a resilient city should look like.

It is vital to identify interdependencies which can result in cascade failures (failures that trigger other failures within an interconnected system), and protect against them where it is cost-effective to do so. Maintaining business and service continuity will require new relationships to be built. Identifying solutions to increase resilience will involve collaborative decisions, and inevitable compromise, with a range of stakeholders.

Both climate change projections and vulnerability and risk assessments should inform investment decisions. The next steps are to identify commercially viable technologies and international best practices to upgrade and futureproof infrastructure and buildings, and assess the scope for financing these solutions.

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Finding viable ways of making buildings more resilient

We were appointed by the European Bank for Reconstruction and Development to carry out a regional study of the climate resilience and resource efficiency of buildings in Egypt, Jordan, Morocco, Tunisia and Turkey. Residential, commercial and public buildings in these highly urbanised countries account for significant levels of energy and water use and are directly affected by climate change. They are often poorly adapted

to cope with existing climatic conditions and current building codes and standards do not take into account anticipated increases in heat and water stress. Our study identified commercially viable climate-resilient technologies and practices, assessed the market potential for financing them and composed policy roadmaps to promote take-up.

Project

National/regional climate resilience assessment

Location

Turkey and Southern and Eastern Mediterranean

Client

European Bank for Reconstruction and Development

Expertise

Climate resilience and resource efficiency in buildings

How we can help your city

- Climate risk interpretation
- Growth and development forecasting
- Locating service and asset system interdependencies and vulnerabilities
- Problem identification and prioritisation
- Systemic solutions testing
- Policy planning and implementation



Plan ahead and reap the dividend

Our interlinked world

Service providers and asset systems are increasingly interconnected and interdependent. Rapid urban development has resulted in vast and complicated supply chains stretching around the world. Disruption in one sector can have diverse, far-reaching consequences as the failure cascades through others.

In urban spaces, water, sanitation, energy, transport and communications are vulnerable and most at risk from such failures. More frequent, intense and enduring extreme weather events, such as flooding and heatwaves, will increase the risk and the level of failure.

Take practical action

1. Owners and operators must look beyond individual assets to understand the extent and complexity of the dependency chains, assessing their vulnerability to climate change and other kinds of shocks and stresses.
2. These interconnections should be identified and, if they cannot be eliminated, a management plan developed or a redundancy plan built into the system to limit the extent of cascade failure.
3. Integrate climate resilience planning with long-term strategic infrastructure and investment plans to protect against acute events that are already occurring, and prepare for the added impact of chronic events in the future.
4. Avoid poorly planned infrastructure that could exacerbate climate change or that in mitigating one risk becomes more vulnerable to another.
5. Climate scenarios and risk assessments need to be translated into practical, meaningful action plans.
6. Implementing these plans can be costly, especially when they involve ageing and densely situated assets, but the cost of not having adequate resilience measures in place is far greater.

The resilience dividend

There is a clear business case for investment in climate resilience as the asset base continues to grow and as climate impacts increase in severity and frequency. Resilient cities minimise losses and reduce the future liability risks of assets. There is a dividend in terms of direct and indirect financial returns from investing in resilience, whether that is through improved flood defences or better emergency planning.

A city that survives shocks and achieves continuity of, or quickly restores, essential services will be more competitive than rival cities. It will attract greater investment because it will demonstrate that it has the strength and systems to withstand climate change and other hazards.

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Project

Red Hook Integrated Flood Protection System

Location

Brooklyn, New York, USA

Client

New York City Economic Development Corporation

Expertise

Civil, structural and geotechnical engineering, land and site planning



Improving coastal defences in the wake of a hurricane

In 2012 Hurricane Sandy caused unprecedented flooding in Red Hook, Brooklyn, leaving many residents and businesses without basic services for weeks. The Red Hook Integrated Flood Protection System is a federally funded coastal protection initiative aimed at reducing flood risk in the neighbourhood due to coastal storms and sea level rise. The first phase of

the project is a comprehensive feasibility study of the different options available to strengthen the resiliency of Red Hook to withstand severe coastal flood events. The success of the scheme relies heavily on community involvement and our engineering team is also supporting outreach efforts to ensure the study is completed on schedule.

How we can help your city

- Risk and opportunity evaluation
- Intervention development and project preparation
- Spatial planning and land use management and solution appraisal
- System resilience vulnerability assessment
- Investment and capital expenditure planning

A holistic approach will deliver maximum benefits

Unlocking investment

The cost of climate events is rising exponentially and it is estimated that this will be in the order of US\$1trn per annum within two to three decades unless there is a major and concerted increase in resilience spending. Asset owners and operators, service providers and communities can't afford not to invest in improving resilience and require solutions that are cost-effective and sustainable.

There is an urgent need to address the shortfalls in resilience funding that occur locally to globally, and initiate projects that respond to increasingly severe climate impacts. This requires greater co-operation across the public and private sectors to develop innovative financial mechanisms to unlock the investment needed.

Fostering culture change

Resilience also involves fostering culture change and raising awareness of the risks. Relationships have to be built: different stakeholders have different priorities, which necessitates more connected thinking and collaboration. It is no longer sufficient to look at assets in isolation and it is essential to take a holistic approach to asset design and funding.

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Design and delivery

Resilience should be incorporated into all aspects of urban planning, urban development, urban operation, and urban life. Cities need innovative, affordable ways to design new infrastructure or upgrade existing assets to withstand social, economic or climatic shocks.

Cities seeking to develop urban spaces with embedded resilience will require holistic solutions, encompassing a range of specialist fields. Planning, advisory, technical and management activities must encompass the social and institutional dimensions of development.

Working closely with stakeholders will help with identifying and managing risks, developing solutions, reassuring investors and mitigating long-term risks. Only by engaging all stakeholders in dialogue right through project development will buy-in and support be secured, maximising benefits for customers and end users, and optimising the legacy value of projects.

How we can help your city

- Conceptual, feasibility and detailed design of integrated solutions
- Climate change risk assessment and cost-benefit analysis
- Climate science and analysis
- Vulnerability identification, risk assessments and cost-benefit analysis for other forms of shock (eg seismic)
- Change management
- Development programme management and optimisation
- Financial planning
- Stakeholder engagement

A smarter way to manage flood risks

Kuala Lumpur's dual-purpose stormwater management and road tunnel (SMART) is an inventive solution to the Malaysian capital's long-term traffic and stormwater management problems and was the first tunnel of its kind in the world. The 11.5km tunnel diverts floodwaters away from the confluence of the two major rivers running through the city centre while its central 3km section doubles up as a two-deck motorway

to relieve traffic congestion at the main southern gateway into the city centre. In extreme floods the road decks are shut to traffic, increasing the tunnel's stormwater storage and conveyance capacity. SMART, which has received international acclaim for its innovation and ingenious design – including the UN-Habitat Scroll of Honour Award – has saved central Kuala Lumpur from serious flooding and disruption on several occasions.

Project

SMART

Location

Kuala Lumpur, Malaysia

Client

MMC Engineering Group-Gamuda JV

Expertise

Feasibility, detailed design, engineering support, construction supervision, specialist tunnel and hydraulic design services



Manage your assets better to achieve full resilience

Maintaining urban infrastructure

Across the world there is increasing expectation that utilities and services should not fail. If they do, they must fail safely and recover quickly. At the same time, economic reality demands that their operation and maintenance must deliver value for money – albeit on an increasingly wide scale.

Asset management techniques, in particular asset information modelling, can provide new insights into the condition of urban infrastructure. They will help identify weaknesses in the asset base and operations, and quantify risks, to establish a clear priority list of assets that are critical to safety and operational continuity, and inform strategic thinking.

A key challenge facing cities will always be to maintain the safe, efficient operation of infrastructure, both old and new, despite severe financial constraints. Modelling tools and system-wide vulnerability assessments can assist in the targeting of investment where it will make the biggest difference, weighing probability with consequences, to help prevent failures and their potential knock-on impacts, extending the working life of assets by making them more resilient.

Improved recoverability

Even if extreme events can be predicted, they cannot be prevented. It is not possible to eliminate all risk but cities can attain virtually full resilience. This is achieved when a city has not only identified climate and non-climate risks and protected itself against them, but has also developed the capability to survive shocks and recover swiftly.

This comes from building awareness, increasing capacity, strengthening institutions, and adopting processes and mechanisms that enable utilities and essential services to be quickly restored after failure. By applying resilience planning principles to the development of effective contingency and emergency plans, a city will be better prepared for severe climate and other shock events. If and when a shock occurs, recovery will be less disruptive and less costly.

Building smart cities

Smart infrastructure, the result of enhancing physical infrastructure with digital technology, is one of the keys to urban resilience. It will assist owners and operators of assets in their efforts to expand capacity and improve service reliability.

Sensors installed at critical points of asset systems and networks feed back real-time information to control centres, allowing quicker and better decision making. Smart infrastructure systems alert managers to any anomalies in performance, and trigger automated responses to pre-defined incident scenarios. They will aid asset recovery after a natural or man-made disaster by pinpointing faults and prioritising actions, saving valuable time, money and resources.

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Merlin: a wizard way of contingency planning

Our latest smart infrastructure solution contributed to the success of the Glasgow 2014 Commonwealth Games. Our tactical and strategic command tool Merlin, which allows decision makers to easily share critical real-time information through a secure web-based platform, supported transport co-ordination and communications, helping to ensure that the travelling public in Glasgow kept moving smoothly during the event. Merlin enables decisions to be made and outcomes disseminated more quickly and effectively, which strengthens intra- and inter-organisational collaboration and aids incident management and contingency planning, improving the resilience of cities to cope with situations at times of crisis.

Project

Glasgow 2014 Commonwealth Games

Location

Glasgow, Scotland, UK

Client

Glasgow City Council

Expertise

Digital technology to support tactical and strategic command, smart city solutions, contingency planning

How we can help your city

- Disaster management
- Contingency planning
- Asset resilience
- Institutional strengthening
- Capacity building
- Smart infrastructure solutions

Opening opportunities with connected thinking.

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