



Resilient cities

Preparing urban communities for the future with connected thinking



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

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

Urbanization 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 labor-intensive agriculture, leading to more people migrating from rural to urban areas in search of a job and new life.

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

The impact of storms, floods, and heat waves 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, geopolitical, and other hazards. With the capacity to absorb different kinds of stresses, they can evolve and become even stronger.

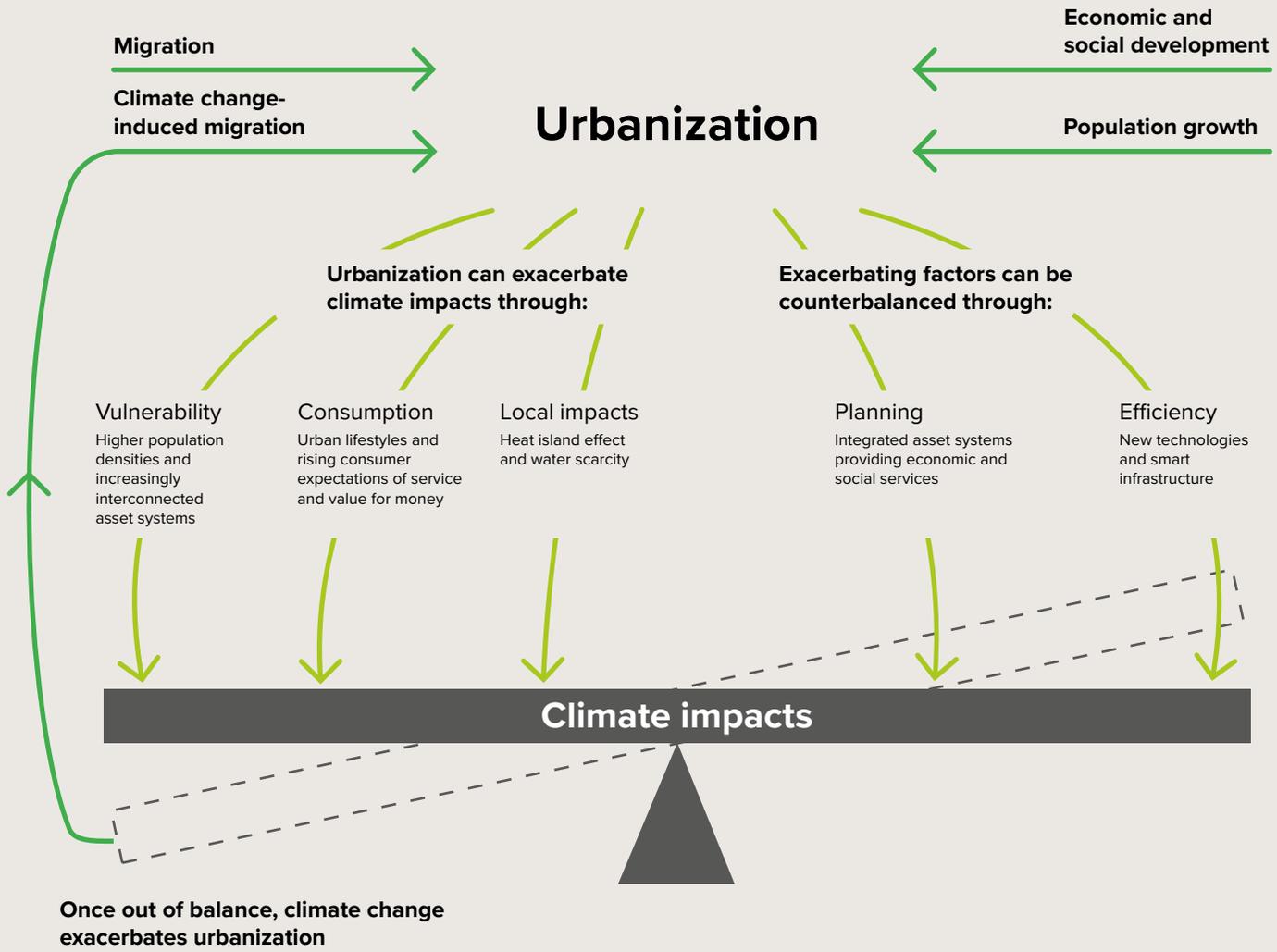
In short, a resilient city is a better, safer place to live, do business, invest, and build for the future.

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.

Urban resilience: the key to keeping climate change in check



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Evaluate the risks and explore the solutions

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 minimize disruption to business and essential services.

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 \$200 billion 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 minimize 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 that 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 building new relationships. 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.

Holding back the sea

Opportunity

In October 2012, a storm surge from Hurricane Sandy cut through the narrow section of the Barnegat Peninsula where the Borough of Mantoloking is located. All of the Borough's 521 homes were damaged by the storm, and scores of them were destroyed.

Solution

Mott MacDonald was retained to provide design, financing, and construction observation for a sea wall to be built from steel sheet pilings along two miles of oceanfront of Mantoloking and one and one half miles in neighboring Brick Township. At 3.5 miles long, the sea wall is the largest and longest coastal resilience sheeting project ever constructed in New Jersey.

Project

Mantoloking sea wall

Location

Mantoloking, NJ, USA

Client

New Jersey Department of Environmental Protection

Expertise

Design, financing, construction observation



Left: At 3.5 miles long, the Mantoloking sea wall is the largest and longest coastal resilience sheeting project ever constructed in New Jersey.



Right: In October 2015, the sea wall protected Mantoloking and Brick from heavy surf. According to Mantoloking police chief Stacy Ferris, "The wall did exactly what it was designed to do. Without that wall, we would have had breaches the length of the town."

Outcome

Bob Martin, Commissioner of the New Jersey Department of Environmental Protection, said, "This project will help protect a segment of coastline that was breached during Superstorm Sandy, especially offering protection to Route 35 and residents and businesses that were battered by Sandy. Coupled with the forthcoming coastal protection project by US Army Corps of Engineers, this particularly vulnerable section of the Jersey Shore will be more resilient for future severe weather events."

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 most at risk from such failures. More frequent, intense, and enduring extreme weather events, such as flooding and heat waves, will increase the risk and the level of failure.

Take practical action

1. 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. Identify these interconnections, and if they cannot be eliminated, develop a management plan or build a redundancy plan 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 the effects of poorly planned infrastructure that could exacerbate climate change, or could increase one risk while mitigating another.
5. Translate climate scenarios and risk assessments into practical, meaningful action plans.
6. Remember that implementing these plans can be costly, especially when they involve aging 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 minimize 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 defenses 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



The Red Hook Integrated Flood Protection System will help protect this vital neighborhood from extreme weather events.

Improving coastal defenses in the wake of a hurricane

Opportunity

The waterfront neighborhood of Red Hook in Brooklyn, founded in the 1600s, was once the busiest freight port in the world. Surrounded by water on three sides, Red Hook was devastated by flooding from Hurricane Sandy in 2012. Many residents and businesses were left without basic services for weeks, prompting efforts to protect the neighborhood from extreme weather events.

Solution

The Red Hook Integrated Flood Protection System is a federally funded coastal protection initiative aimed at reducing flood risk in the neighborhood due to coastal storms and sea level rise.

As part of the first phase of the project, Mott MacDonald is conducting a comprehensive feasibility study of the different options available to strengthen the resilience of Red Hook to severe coastal flood events. Our engineering team is also supporting outreach efforts to ensure the study is completed on schedule.

Outcome

With the help of community involvement, the flood protection program will help protect a neighborhood that remains a working port and a base for glassblowers, metalworkers, furniture makers, and producers of chocolate, wine, and spirits.

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. It is estimated that this will be in the order of \$1 trillion 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. They 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 to initiate projects that respond to increasingly severe climate impacts. This requires greater cooperation 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, maximizing benefits for customers and end users, and optimizing 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 (e.g., seismic)
- Change management
- Development program management and optimization
- Financial planning
- Stakeholder engagement

A smarter way to manage flood risks



Opportunity

Founded in 1857 near the confluence of the Klang and Gombak Rivers, the city of Kuala Lumpur has grown rapidly. The result has been increased runoff from paved surfaces, the canalization of the two rivers, and more frequent and severe flooding in the city.

Solution

Flood relief tunnels were proposed as a solution to flooding, but the innovative dual-purpose stormwater management and road tunnel (SMART) meets an additional need. The first tunnel of its kind in the world, it doubles as a highway route.

Outcome

The 7-mile (11.5-kilometer) tunnel diverts floodwaters away from the rivers that run through the city center. Its central section doubles as a two-deck highway to relieve traffic congestion at the main southern gateway into the city center.

During 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 modeling, can provide new insights into the condition of urban infrastructure. They will help identify weaknesses in the asset base and operations, 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. Modeling tools and system-wide vulnerability assessments can help target investment where it will make the biggest difference, weighing probability with consequences to help prevent failures and their potential 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 nonclimate 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 key 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 centers, allowing quicker and better decision making. Smart infrastructure systems alert managers to any anomalies in performance, and trigger automated responses to predefined incident scenarios. They will aid asset recovery after a natural or man-made disaster by pinpointing faults and prioritizing actions, saving valuable time, money, and resources.

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Project

Bioengineered oyster reef demonstration

Location

St. Bernard Parish, LA

Client

Louisiana Coastal Protection and Restoration Authority

Expertise

Coastal engineering analysis, design, construction oversight

Growing an oyster reef to protect a city

Opportunity

Constructed in 1965, the Mississippi River–Gulf Outlet Channel provided a shorter route for ships traveling from the Gulf of Mexico to the inner harbor of New Orleans.

Blamed for allowing the storm surge from Hurricane Katrina to reach the city more easily in 2005, the channel was closed to shipping in 2009. Over time, erosion caused the channel to widen, and saltwater intrusion affected the Biloxi Marsh, a network of coastal wetlands that shelters wildlife and helps protect New Orleans.

Solution

Mott MacDonald provided engineering services for a project to create a “living shoreline” along a coastal area that retreating at an average of 15 feet per year. We compiled historical data, modeled coastal processes, and analyzed nine alternative concepts. Completed in 2016, an artificial oyster reef now stretches along more than three miles of the coast.

Outcome

The living shoreline provides self-sustaining protection to the shoreline, reducing erosion and moderating the impact of waves and storm surges. It also stimulates the growth of oysters and increases biodiversity in the area.

Oyster reefs filter and improve the quality of seawater, provide nursery habitat for fish and shellfish, provide food for predatory fish such as flounder, drum, and speckled trout, and mitigate nutrient loading, eutrophication, and hypoxia.

Opening opportunities with connected thinking.

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