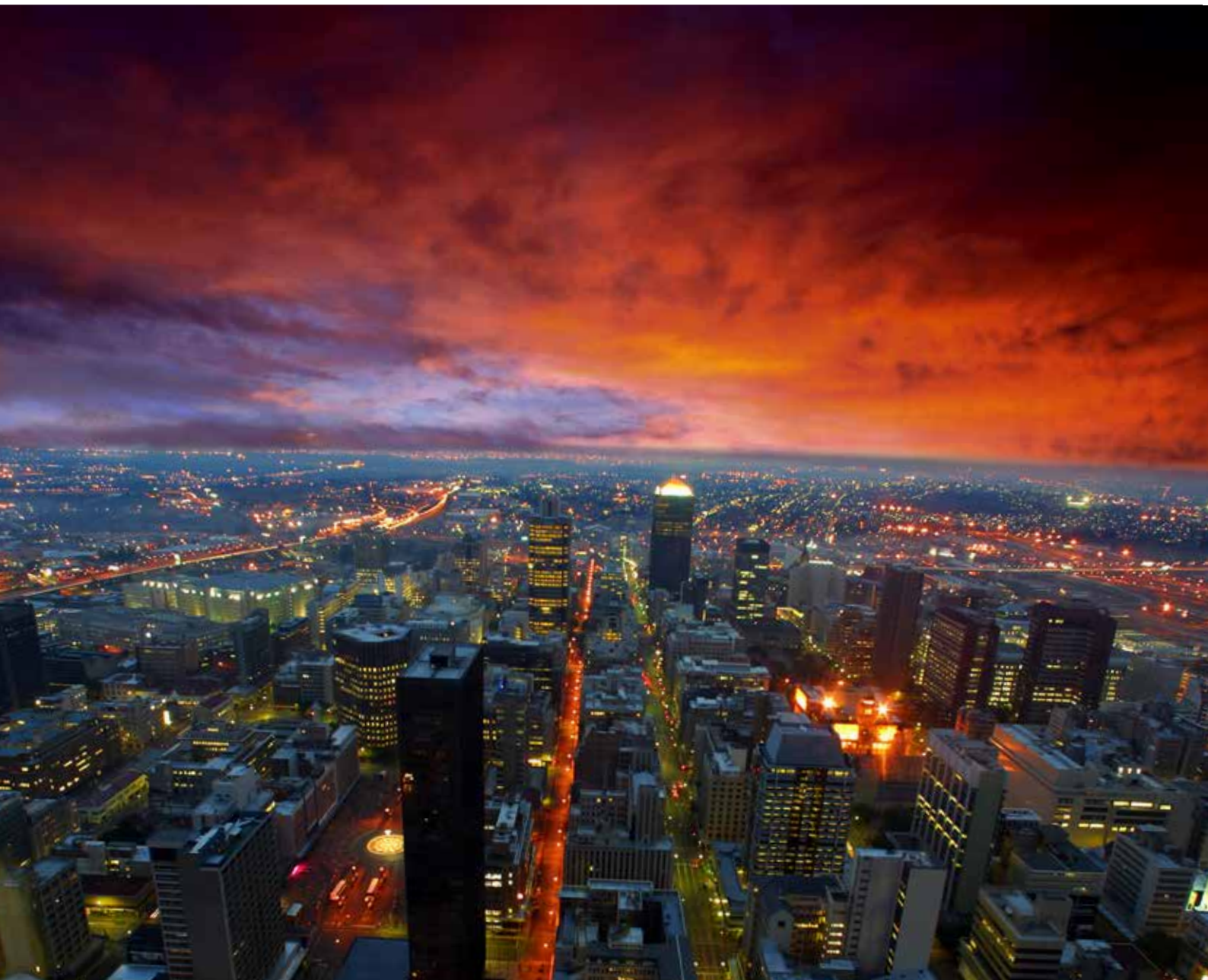


# BECOMING CLIMATE RESILIENT

AN EXECUTIVE BUSINESS CASE FOR CLIMATE RESILIENCE



# resilience

Resilience is the ability of human settlements and organizations to withstand, recover quickly from and continue to prosper in the context of increasing impacts of natural and man-made hazards or disasters.

Driven by the urgent need for new tools and strategies to protect human, economic and natural assets, AECOM is working with multiple programs and private and public clients to better understand the risks a changing climate presents, and determine how to use our skills and strengths to prepare and take critically-important actions.

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*The information in this guide is intended for informational purposes and in some instances, was drawn from publically available data. The Self-Assessment Tool is also intended for informational purposes and should not be relied upon to determine compliance, risk management, climate change readiness or as the means for other business assessments.*

# FOREWORD

**Margareta Wahlström**  
Special Representative UN Secretary General  
for Disaster Risk Reduction

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Disaster risk has no borders. Indirect losses from extreme weather events can cripple national economies, kill small businesses, shut down factories and take away jobs. At UNISDR, we frequently hear of real-life case studies that perfectly illustrate the scale and spread of impacts on business from natural hazards.

The private sector needs to start protecting itself. Governments can't do it alone.

We are starting to see businesses all over the world taking these issues seriously and forging partnerships to manage risk rather than the fallout from natural hazards.

We believe this is important because the business community can be more agile than governments. It can move quickly to assess risk, promote systems and technology, and set standards for resilience. It is also well positioned to advocate for resilience thinking because of its direct relationships with customers, suppliers and everyone in between.

This guide aims to communicate to decision makers why action to address the risks from climate change can make good business sense, and provides guidance on embedding climate risk assessment and evaluation of resilience options into business planning and operations.

AECOM is supporting a number of UNISDR activities. They are co-creators, with IBM, of our Disaster Resilience Scorecard for Cities and are an active member of our Private Sector Advisory Group.

This guidance, targeted specifically at the private sector, is another example of AECOM's leadership in climate risk and resilience.

**Dr. Peter Williams**  
Dr. Peter Williams  
Chief Technology Officer, Big Green Innovations,  
IBM

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IBM recently partnered with AECOM as part of a UNISDR private sector initiative to develop a resilience scorecard for cities. This work — and the dialogue it has created — has served as a useful reminder of the critical role the private sector will need to play in supporting governments to increase resilience to disasters and extreme weather events.

It is clear that collaboration across all sectors will be essential to protect cities, businesses and populations from the impacts of climate change. But this collaboration is far more likely once all stakeholders have a robust understanding of their own risk profile.

An improved understanding of your own business risks and opportunities will help in directing resources and prioritizing collaborations, advocacy and direct investment in a way which leads to better outcomes for your business, your customers and the communities in where you operate.

I support this AECOM initiative and hope that it can provide another trigger point for private sector action to address disaster resilience. And of course, as part of a forward thinking business, I hope that IBM can be a part of any future collaborations and solutions.



01

INTRODUCTION

The climate conditions of a location, region or country have always impacted the productivity and profitability of businesses operating in that area. Weather — and particularly extreme events — impacts infrastructure, agriculture and food production, supply chains, health and economic opportunities, and much more. Recent extreme weather events such as hurricanes in the United States, floods and storms in Europe, typhoons in Asia, droughts in Africa, and bushfires in Australia have served to remind us of this important link and have, in many cases, highlighted shortcomings in preparedness and disaster response.

In the past, when businesses have needed to make important decisions relating to business planning, new investments and diversification, design of new assets and insurance they have relied on historical weather data. This is no longer adequate; the rules are changing.

The observed change in climatic conditions over the past 30 years is clear on every continent. All the key indicators of climate change, including sea-level rise, temperature and drought days, are expanding outside the normal ranges of frequency, intensity and location. Increasingly businesses will need to start making decisions based on predictions of new climate norms.

Understanding the direct and indirect impacts of climate change for your industry and business can help with effective planning and preparation. Once you have a robust understanding of your business risk profile, you are better positioned to direct resources and investment, and will have a clearer understanding of which collaborations are important and what advocacy actions you should support.

WHAT'S IN THE REPORT

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AECOM CLIMATE ADAPTATION PRACTICE

AECOM is a global multidisciplinary company bringing together strategy, design, environment, sustainability, engineering, consultancy (energy, water, buildings and transport), and construction and project management. Our mission is to positively impact lives, transform communities and make the world a better place.

AECOM is currently working across a number of major programs to help implement and facilitate ideas and tools to better understand the risk that disasters pose. We are using our skills and strengths to help clients cope, recover and even prosper, under changing climate conditions. We have completed more than 200 adaptation and resilience projects at local, regional, state, national and international scales, looking at climate hazards, risk, vulnerability and resilience.

We developed the UNISDR Disaster Resilience Scorecard with IBM to support the U.N.'s implementation of the International Strategy for Disaster Reduction, in a move to alter disaster response to disaster reduction. AECOM and IBM received the prestigious 2015 ND-GAIN prize (Notre Dame Global Adaptation Index) for developing the UN Disaster Resilience Scorecard. We are also delivering RISE, founded by the UNISDR and PwC, which aims to make all investments risk- sensitive and contributes to building the resilience of local communities and the global economy. Additionally, AECOM is delivering climate adaptation and resilience projects for private and public clients across the Americas, Asia-Pacific, Europe, Middle East and Africa, and have supported numerous businesses in the energy, water, resources (mining and agriculture) and property sectors to respond to climate risks.

## PURPOSE

This brief guide targets business executives, and makes the case for considering the potential risks from climate change and integrating climate resilience into existing business frameworks and processes now. It links to a second document that provides a step-by-step guide and tools to assess climate risk, develop solutions and support decision-making for implementation. Climate resilient businesses know when and how to respond to a changing climate, and have established strategies and investments to protect people, profit, assets and supply chains.

There are a number of similar frameworks developed by governments, multi-lateral organizations and Non Government Organizations, but very few of these focus on the private sector. The private sector in the context of this guide refers to private business and excludes individuals or households.

## CASE STUDY INFORMATION

The intention of this guide is to raise awareness of the potential impacts from climate change for businesses and direct readers to a second document which outlines an approach to managing these risks. While we cite multiple case studies in this document, AECOM has not had direct involvement in all of them, and we have cited publically-available information for some of them. AECOM accepts no responsibility for the accuracy of information contained in the case studies. However, some of the businesses profiled are clients of AECOM and some of the case studies reference projects that AECOM has been involved with.

## AUTHORS/ACKNOWLEDGEMENTS

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Michael has over 20 years of experience in managing sustainability and climate change outcomes for government, business and urban development. Michael has led over 200 climate change impact, risk assessment, adaptation and resilience projects relating to cities, municipalities and critical infrastructure.

### ***Ben Smith, Director of Sustainable Development for Design, Planning and Economics, AECOM***

Based in London and covering Europe, Middle East, Africa and India region. Ben works with planning and design teams to affect policy and implement strategies to help communities mitigate and adapt to climate change.

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## BUSINESS DRIVERS



**1**  
Productivity,  
Business Continuity  
and Prosperity



**2**  
Divestment  
and Investment



**3**  
Insurance



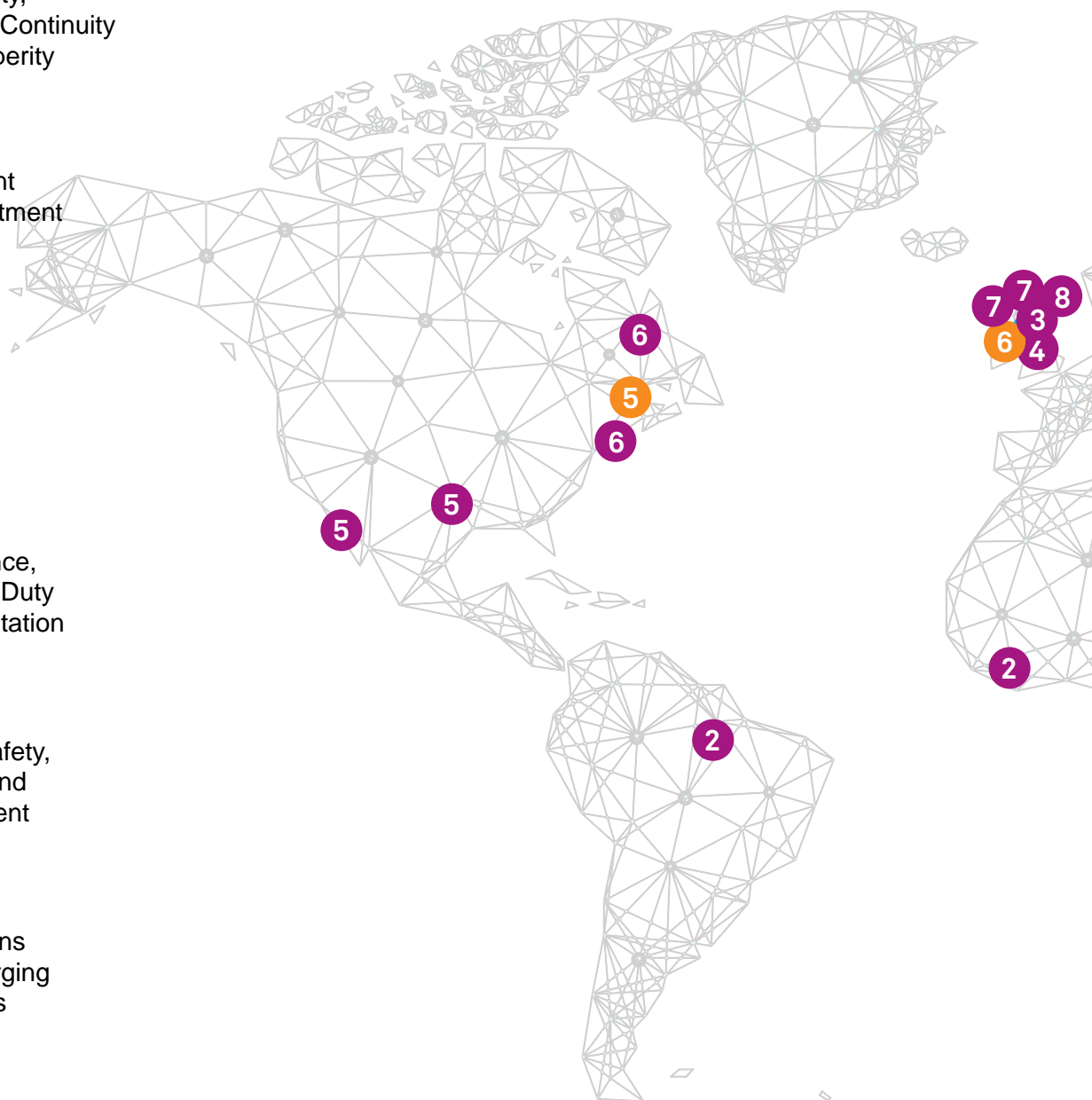
**4**  
Governance,  
Fiduciary Duty  
and Reputation



**5**  
Health, safety,  
security and  
environment



**6**  
Regulations  
and Emerging  
Standards



# CLIMATE RESILIENT BUSINESS

CASE STUDIES

## PROJECTS

1. Fortescue Metals
2. Asset Owners Disclosure Project
3. Munich Climate Insurance Initiative
4. SM Supermalls
5. World Trade Center Campus
6. Building Research Establishment

## SECTORS

1  
Manufacturers



2  
Agriculture  
and Mining



3  
Resource  
Development  
(Mining, Oil and Gas)



4  
Retailers and  
Distributors



5  
Transportation



6  
Utilities –  
Energy



7  
Property



8  
Utilities –  
Water



1 2  
Global

## SECTORS

1. Toyota  
Global Manufacturer
2. BASF  
Nestle
3. Rio Tinto
4. Carrefour Group
5. Port of Long Beach  
Brisbane Airport  
Port of Houston Authority
6. New York City Command Center  
Toronto Hydro
7. York Water  
Thames Water
8. LendLease



03

## WHY ACT – BUSINESS DRIVERS

Businesses make changes and take actions for a range of reasons, often depending on factors such as costs, returns on investment, type of sector, the size of the business, and the availability of knowledge and information. Businesses taking action on climate change and resilience issues will likely cite different or often multiple drivers. However, inaction is no longer a viable option for the private or the public sector. A list of common drivers is outlined in this section together with case studies on how this driver has led to action for a business or sector group.



### Business Driver: Productivity, Business Continuity and Prosperity

Extreme weather events can have direct and indirect impacts on a business. They can lead to downtime, loss of production, jobs and reduced profits.

Businesses should understand the climate vulnerabilities of their assets, operations and services, and should be able to translate

these in to potential costs. They should have controls, procedures and strategies in place to respond to extreme climatic events.

In addition, businesses should be aware of assets, supply chains, services and market conditions that sit outside of their control but which could be impacted by

climate change (i.e., external failures). They should address these potential failures through policy, advocacy and procurement practices.

### CASE STUDY

#### Fortescue Metals

##### CONTEXT

Fortescue is an iron ore producer that operates in the Pilbara region of Western Australia. The company has experienced rapid growth, and intends to expand its ore processing facilities and other supporting infrastructure, including roads, rail and port facilities, work camps and containment dams. The Pilbara climate experiences extreme heat and storms. Projected changes in climate over the lifetime of the infrastructure were considered to inform capital investment and asset planning.

##### RELEVANT CLIMATE VARIABLES

Sea-level rise, increased cyclone intensity and frequency, storm surge, increased rainfall intensity, frequency and temperature rise.

##### RISKS

Health, safety and environmental risks (e.g., heat fatigue/illness, and employee health and safety). Transportation risks (e.g., roads and rail damage reducing or eliminating access to sites for people, goods and products; flight disruptions. Productions risks (e.g., interruptions to water supply, overheating of equipment, increases in repairs).

##### INCREASED RESILIENCE

The company updated its Standard Engineering Specification for Drainage and Flood Protection to ensure potential climate changes are factored into design considerations for new infrastructure. This will lead to less future downtime related to extreme weather events, and will in turn increase productivity and profit. [Source: Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education, 2013.<sup>1</sup>





# “THE ANNUAL COST OF DISASTERS WORLDWIDE HAS REACHED US \$250 TO \$300 BILLION.”

*U.N. Global Assessment Report on Disaster Risk Reduction, 2015*



## Business Driver: Divestment and Investment

Divestment, the opposite of investment, occurs when financial support is removed or scaled back from a company in order to promote certain behaviors or policies or to reduce real or perceived investment risks.

Understanding which assets and infrastructure can withstand or adapt to climate impacts and which factors

should be considered when acquiring new assets is important for business.

Buildings, facilities and infrastructure typically have a medium-term establishment timeframe and long-term investment return horizon. Considering and managing climate impacts from the outset can minimize disruption, and provide medium-to long-term

benefits for investors. Similar issues can arise with products and services in sectors such as food production and tourism.

Evaluation of climate resilience is being used by investors to inform property, resource and infrastructure asset investment and divestment decisions.

## CASE STUDY

### The Asset Owners Disclosure Project

#### CONTEXT

The Asset Owners Disclosure Project (AODP) is an independent, global, not-for-profit organization whose objective is to protect members' retirement savings from risks posed by climate change. A key element of the initiative is the publication of an annual survey and assessment of the world's 1,000 largest asset owners related to management of climate change risks and opportunities.

#### RELEVANT CLIMATE VARIABLES

All

#### RISKS

The AODP for risk management covers how asset owners manage climate change-related risks at the portfolio level and how they drive fund managers to manage climate risk at the fund and company levels. Asset owners need to assess long-term risks, and take an evidence-based view of potential and likely future carbon regulation and physical

impacts and factor these into investment decisions. The scheme recognizes that a robust risk management approach is imperative to manage the long-term risks associated with climate change. Regulation and, in some instances, physical impacts will affect a significant portion of these high-carbon, long-term assets, and this therefore poses a huge risk to asset owners whose investment portfolios have exposure to them.

#### INCREASED RESILIENCE

Increased awareness of an individual's ability to influence how their pension and superannuation funds are managed could give rise to significant divestment and re-investment over the next few years. Schemes such as AODP support this awareness-raising and could lead to businesses further considering what they can do to increase asset resilience in the face of climate change threats.<sup>2</sup>



### Business Driver: Insurance

Insurance continues to play a significant role in loss recovery and risk transfer — increasingly in relation to climate change.

Insurers are increasingly basing risk assessments on future climate projections in

addition to using Standard historical risk profiles.

Available insurance coverage is altering, based on the changed risk profile that climate models indicate.

Insurers are generally private corporations with a duty to shareholders to generate profits and as such, are adding increased change scrutiny to the mix in their decision-making.

### CASE STUDY

#### Munich Climate Insurance Initiative (MCII)

##### CONTEXT

Insurance companies recognize the impacts that a changing climate could have on their industry and the significant role insurance can play in promoting adaptation to a wide range of stakeholders. Many of the world's leading insurers and reinsurance companies are members of global insurance climate change initiatives like MCII.

MCII offer two insurance products to support developing countries in adapting to climate change. The first is to protect the livelihoods of those on low incomes (livelihood protection policy), and the second to protect loan portfolios exposed to weather risks (loan portfolio cover). These products were first made available to communities in the Caribbean Islands due to their risk of hurricanes, tropical storms, flooding and drought.

##### RELEVANT CLIMATE VARIABLES

All

##### RISKS

Loss and damage from extreme weather events affecting assets and income.

##### INCREASED RESILIENCE

Following a storm in December 2013, policy holders in St. Lucia received their first insurance payout. Offering targeted insurance coverage like MCII at a regional level and for low-income groups allows vulnerable communities to gain protection from weather risks and foster continued economic growth.<sup>3</sup>





### Business Driver: Governance, Fiduciary Duty and Reputation

From a fiduciary responsibility perspective, it is important to have a plan to reduce the likelihood of risks occurring, limit the consequence of the impacts, and identify which risks need to be communicated to third parties (e.g. investors and shareholders).

Climate change can also expose companies to reputational risks where they have failed to disclose critical information on their risk profiles, or if impacts on their business result in secondary impacts on the environment or community where they operate.

## CASE STUDY

### SM Supermalls

#### CONTEXT

SM Supermalls (owned by SM Prime Holdings, Inc.) is a chain of shopping malls in the Philippines and China. In 2008, the SM City Marikina mall in the Philippines was built on a 6-hectare property within the Marikina River Watershed, a high-risk flood zone. Knowing the flooding risk of the site, SM Supermalls considered longer term flood cycles of 100 years in designing the mall. As a result, the mall was built 90 meters further from the Marikina River on concrete stilts to reduce the risk of damage to the property and ensure the safety of mall goers during historical flood events.

#### RELEVANT CLIMATE VARIABLES

Extreme rainfall, storms, typhoons and flooding.

#### RISKS

Property loss and damage from flooding; access restrictions; utility service disruptions.

#### INCREASED RESILIENCE

SM Prime now has a reputation of incorporating innovative technologies for mall design in disaster-prone areas. By disclosing flood risks to tenants, SM was able to work with the tenants to develop continuity plans to ensure business and communities can recover rapidly from natural disasters.

During the extreme floods in 2009 caused by Typhoon Ketsana (Ondoy), the tenants in the mall continued to operate safely and serve the needs of the 1,400 stranded people seeking shelter until floods subsided. This early investment in resilience meant that SM averted the loss of almost P1 billion from business sales alone, already returning more than what had been invested for forward thinking, and superior engineering and architecture.<sup>4</sup>



**Business Driver:**  
Health, Safety,  
Security and  
Environment

Extreme temperatures, including heat waves, storms, floods, forest fires and other climate events increase the risk of injury and death.

The risk is often more significant to industries that are not usually exposed to these risks. For example,

work practices regulations in most countries usually contain a maximum (or minimum) temperature threshold. If this temperature is exceeded, work must cease for health and safety reasons. Such risks and the potential for lost work time change as the climate changes.

In addition, expansion of the climate change geographical distribution zones to higher altitudes and latitudes of vector-borne diseases, including malaria and dengue fever, will be a significant issue in some countries; a clear case for a “new” rush for a region or area.

**CASE STUDY**

World Trade  
Center Campus

After 9/11, the Port Authority of New York and New Jersey had an immense challenge in redeveloping the World Trade Center (WTC) site as an American landmark that could be accessible by the public, yet incorporate numerous features to enhance public safety and security. In addition to serving as construction manager for several of the

WTC towers, AECOM has been involved in many of the Port Authority's reconstruction projects, including development of the overall campus plan, design of the World Trade Center transportation hub, the vehicular security center, and tour bus parking facility, as well as streetscape design and planning, and infrastructure design.<sup>5</sup>

Creating a  
more secure  
World Trade  
Center







### Business Driver: Regulations and Emerging Standards

In some jurisdictions, regulations and standards are emerging to encourage the consistent consideration of changing climate conditions into the development of major infrastructure, cities and coastal urban areas.

Maritime standards are already well-developed and incorporate sea-level

rise and changes in wave climate. Wider engineering codes and guidance are still in development.

Climate change risk and adaptation is already part of regulatory processes such as Environmental Impact Assessment in Australia, Canada and the Netherlands.

Voluntary standards such as BREEAM, LEED, Green Star and the Infrastructure Sustainability rating tool already incorporate credits specifically addressing climate risk and resilience for new building and infrastructure projects.

## CASE STUDY

### Building Research Establishment (BRE, UK) — BREEAM New Construction

#### CONTEXT

BREEAM is one of the world's foremost environmental assessment methodologies and rating systems for buildings. It sets the standard for best practice in sustainable building design, construction and operation, and has become one of the most comprehensive and widely recognized measures of a building's environmental performance. It encourages designers, clients and others to think about designing buildings with low environmental impacts.

A BREEAM assessment uses recognized measures of performance set against established benchmarks, to evaluate a building's specification, design, construction and use. The measures used represent a broad range of categories and criteria from energy to ecology. The 2014 update of BREEAM includes, for the first time, a credit to address climate resilience in a holistic sense.

#### RELEVANT CLIMATE VARIABLES

Buildings can be exposed to many climate hazards including flooding, extreme temperatures and wind.

#### RISKS

Loss of services, overheating, freezing scenarios, high energy use and utility costs.

#### INCREASED RESILIENCE

Environmental assessment standards such as BREEAM support increased resilience in the buildings sector. A number of BREEAM credits within the 'New Construction 2014' scheme contain assessment criteria which aim to support resilience to impacts of extreme weather events arising from climate change. There is also a specific credit, Waste 05, which focuses on climate adaptation. The credit focus addresses structural and fabric resilience not covered in other areas of the assessment, although an exemplary credit is awarded where other issues relating to adaptation to climate change are covered holistically.



### Business Driver: Resilience to short- and long-term shocks and stresses

With 50 percent of the world's population already living in cities and substantial urban population growth projected over the coming decades, there is a pressing need for new tools and approaches that enable local administrations and citizens, and businesses as well, to better protect the human, economic and natural assets of our towns and cities.

Resilience refers to the ability of human settlements to withstand, recover quickly and continue growing in the context of the increasing impacts of hazards. These hazards include natural and man-made shocks and stresses; natural acute shocks that are short term, including tsunami, earthquakes and cyclones; and man-made chronic stresses that are longer term, ranging from youth unemployment to sea-level rise.

The ability to plan for hazards allows us to transform the way we view and cope with adversities. We need clearer guidance to help develop strategies to deal with hazards across sectors and tools to assess their progress. We require progressive solutions that enable us to be more prepared in the face of disaster.

AECOM is currently working across a number of programs to help implement and facilitate ideas and tools to better understand the risk that disasters pose so we can utilize our skills and strengths to cope, recover and prosper.

#### **UNISDR and the Disaster Resilience Scorecard**

The U.N. Office for Disaster Risk Reduction was created with a purpose to implement the International Strategy for Disaster Reduction, a move to alter disaster response to disaster reduction.

As part of the Making Cities Resilient campaign, the UNISDR has launched the City Disaster Resilience scorecard, a collaborative effort between AECOM and IBM to measure a cities' resilience to disasters. The Scorecard is based on the UNISDR's list of top 10 priorities for building urban resilience to disasters, including reviewing policy and planning, engineering, informational, organizational, financial, social and environmental aspects of disaster resilience.

As a co-creator of the scorecard, and member of UNISDR's Private Sector Advisory Group and the Making Cities Resilient Steering Committee, AECOM is working with a number of the 2,400 cities that have signed up to the campaign to implement the scorecard. AECOM and IBM received the prestigious 2015 ND-GAIN prize (Notre Dame Global Adaptation Index).

#### **R!SE**

Founded by the UNISDR and PwC, the R!SE program aims to make all investments risk-sensitive and contribute to building the resilience of local communities and the global economy as a whole. R!SE promotes collaboration between the public and private sector to take leadership on disaster risk reduction. AECOM, Economist Intelligence Unit, Willis Insurance and Principles for Responsible Investment, amongst others, have joined the UNISDR and PwC to build a broad alliance in support of the program.

The private  
sector is  
not immune  
to climate  
change risk  
and impacts



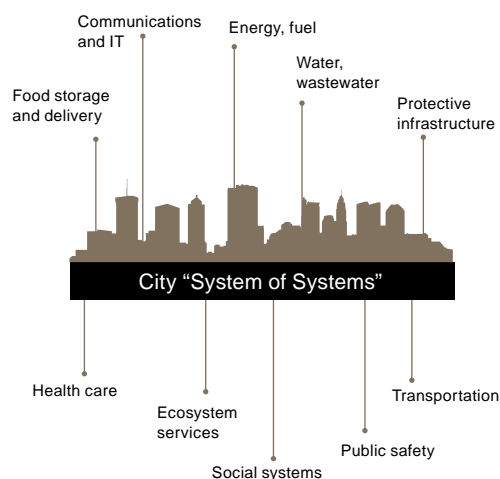
The roadmap for the RISE initiative has been set by evidence and recommendations in the 2013 Global Assessment Report on Disaster Risk Reduction (GAR13). Eight activity streams, relevant to both the private and public sectors, outline the value proposition for investing in prevention. AECOM is responsible for leading the Resilient Cities activity stream. This stream is where the Disaster Resilience Scorecard will be implemented in 50 cities to measure city-level preparedness. It will also provide a toolkit to facilitate public and private sector engagement on disaster risk reduction, response planning and recovery.

100 Resilient Cities program pioneered by the Rockefeller Foundation

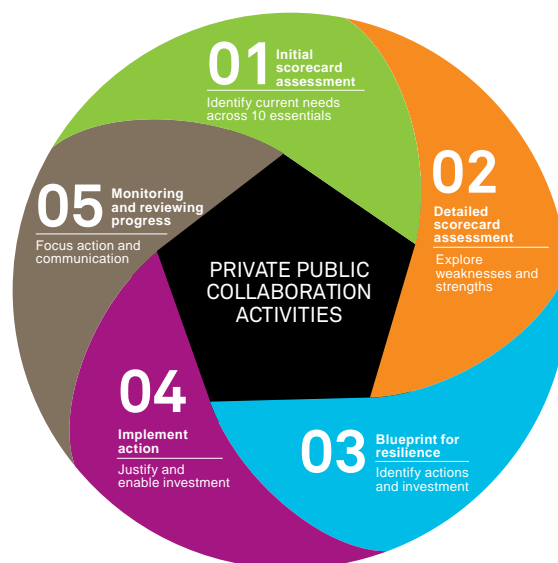
The Rockefeller Foundation's mission is to promote the well-being of humanity throughout the world. The foundation works to address the underlying causes of emerging challenges and create systemic change.

In 2013, The Rockefeller Foundation launched the 100 Resilient Cities Centennial Challenge, a program that engages 100 cities to better address the increased shocks and stresses of the 21st century. Nearly 400 cities across six continents applied. The first 32 were selected, and are receiving support to create and implement a resilience plan and hire a Chief Resilience Officer (CRO) to oversee the strategy. AECOM has already worked with a number of cities across the globe to support delivery of resilience strategies through design and facilitation of workshops, and to implement strategy tools to kick-off and apply city resilience plans.

#### City Level Resilience has to address the “System of Systems”



#### RISE Private Public Collaboration Activities



05

## SECTOR RISKS



## Manufacturing

**DIRECT IMPACTS**

- Physical impacts from damage to facilities, buildings, equipment and products
- Financial impact from asset damage and degradation
- Reduced productivity
- Increased safety risk management and supply chain interruptions

**INDIRECT IMPACTS**

- Loss of raw materials, components, electricity, gas and water
- Impacts to services such as hazardous waste collection, freight and logistics

**CLIMATE HAZARDS AND IMPACTS:**

- Manufacturing sites are often in expensive low-lying areas and prone to flooding
- Increased frequency of extreme high (or low) temperature scenarios or storm events could impact operations/functions of buildings and facilities
- Extreme high or low temperatures reduce productivity and staff safety
- Electronic equipment is more likely to fail leaving businesses without monitoring controls, air conditioning and refrigeration
- Increases in wildfire frequency and intensity could increase rates of damage to buildings, structures and property
- Changes in water availability can affect day-to-day operation and long-term stability

## CASE STUDIES

## Toyota

**Climate Resilience Supply Chain.** The 2011 flooding in Thailand demonstrate the shocks and flow-on effects extreme weather can have on local industries and the global economy through supply chains. Carmaker Toyota was one of the many manufacturing companies forced to halt production when its auto parts facilities were inundated and damaged from extreme rainfall. Toyota lost production of 260,000 vehicles (3.4 percent decrease) from this weather event. Production shutdown at three plants in Thailand led to an annual earnings loss of US\$1.55 billion and a 56 percent decrease in net revenue (US\$2.3 billion).

To build their resilience, manufacturing companies in Thailand have started redesigning their supply chain networks. Toyota is moving production to different regions and changing their globally centralized production system to regionally independent production. Toyota requested suppliers disclose details of their supply chains to understand their risks. This review found 300 production sites could be vulnerable to extreme weather events. Toyota has requested implementing mitigation measures aimed at diversifying procurement, securing alternate facilities and increasing inventories.<sup>6</sup>

## Global Consumer Electronics Manufacturer

**Supply Chain Sustainability Program and Water Reduction/Reliability Plan.** Not only must a company's operating facilities be resilient to climate change disruptions, supply chains should be as well. AECOM worked with a major global manufacturer to minimize risks and other interruptions posed by climate change, and institute a global supply chain sustainability program. This program evaluated environmental, health and safety practices at hundreds of industrial facilities. A principal component of the program included a plan to reduce and reuse water throughout the supply chain, reducing potential impacts and enabling better resiliency to water shortages.





## Agriculture and Mining Forestry and Fisheries

### DIRECT IMPACTS

- Damage to crops, trees, livestock, and fish nurseries from temperature stresses, extreme events, increases in pests and spread of disease. Temporary reduction in agricultural product yields.
- Damage to facilities, buildings, equipment and products.
- Negative impact on global food markets and local livelihoods.
- Financial impact from asset damage and degradation due to during high intensity weather events

### INDIRECT IMPACTS

- Loss of water and power for production
- Health issues

### CLIMATE HAZARDS AND IMPACTS

- Changes in rainfall and temperature patterns (land and ocean) are significant because of the sensitivity of flora and fauna to the timing and range of climatic conditions in a region.
- Variations in minimum and maximum temperatures are affecting, for example, the quality and quantity of grape or other fruit production in some regions due to heat stress and increased growth of fungal and pest species, while other wine or fruit growing regions are becoming more viable for popular varieties as the climate warms.
- The increased frequency of high temperature days, as well as the timing of heat wave events in growing and harvesting seasons, will increase the heat stress experienced by crops and livestock.
- Increases in wildfire frequency and intensity also have the potential to change availability of forestry products.

## CASE STUDIES

### Nestle

**Climate Adaptation.** Nestle opened a food products research and development center in Abidjan, Ivory Coast with a focus on agriculture, raw materials and traditional African ingredients. The research is helping to improve cocoa production in extreme weather conditions by providing farmers with 1 million high-potential cocoa trees each year.<sup>7</sup>

### BASF

**Climate Adaptation.** BASF has developed products that are helping coastal settlements protect local dikes by absorbing the force of breaking waves and slowing down water masses. BASF researchers are also developing stress-tolerant plants that are more resistant to extreme weather conditions such as drought, and new superabsorbers are being trialed for a reforestation project in Brazil to increase water storage capacity.<sup>8</sup>





## Resource Development (Mining, Oil and Gas)

### DIRECT IMPACTS

- Physical damage to assets (e.g., platforms, mines, tailings dams, water and power supply, rail, roads, ports, airports, mining, and storage facilities and accommodations)
- Financial impact from asset damage/accelerated degradation and/or failure during larger intensity weather events

### INDIRECT IMPACTS

- The impacts to the natural environment from tailings dam failure, oil spills and pollution emissions can have long-term reputational and financial implications
- Climate change will impact marine and terrestrial ecosystems which may change the required approaches for asset closure and rehabilitation efforts in some coastal areas. Mine rehabilitation and re-vegetation may require a broader range of species due to changes in rainfall, temperature and the increased likelihood of bushfire events

### CLIMATE HAZARDS AND IMPACTS

- Storm events causing accelerated degradation of materials and reduced structural integrity of physical built assets
- Rising temperatures can potentially increase corrosion rates
- The increased frequency and severity of drought, as well as changes to ground water will also generate increased ground movement, subsidence and changes to hydrology and soil chemistry, also impacting foundations and structures
- In the longer term, sea-level rise, coastal inundation and increased salt water intrusion inland will impact facilities and sites

## CASE STUDY

### Rio Tinto

**Climate Risk Planning.** Rio Tinto is a leading global mining and metals company which focuses on finding, mining and processing the earth's mineral resources to maximize value for shareholders. They employ 66,000 people in 40 countries across six continents, including in some of the most difficult terrains and climates. Rio Tinto recognizes that risk is an integral and unavoidable component of their business, and is characterized by both threat and opportunity. They have published a climate change position statement which states that: 'Further climate change is now inevitable, requiring adaptation to its effects ... we will take action to address climate change, consistent with Rio Tinto's objective of creating long-term shareholder value'.

AECOM produced a guidance document for Rio Tinto focused on embedding climate risk and resilience planning into project delivery in 2012. This process identified that climate risks and impacts for Rio Tinto are quite different depending on the location and type of facility. Rio Tinto commissioned the Hadley Centre in the U.K. to synthesize climate projections (temperature, precipitation, flood and drought, sea-level change, wind) for each of the key geographies they operate in, and now has a draft framework for considering these impacts in alignment with their standardized project delivery framework.

Adopting this robust and structured approach offers a number of benefits, including opportunity to capture low cost/no cost options to improve climate resilience and reduce costly downtime, future retrofits and rebuilds, improved financial returns, ability to meet internal and external reporting requirements in a streamlined manner. It also provides improved alignment with environmental regulatory approval processes, and the ability to proactively respond to increasing scrutiny by external stakeholders including government, communities and financial institutions to demonstrate effective response to climate risk.<sup>9</sup>





## Retail and Distribution

### DIRECT IMPACTS

- Damage to facilities, buildings, data centers and stored products
- Financial impacts due to asset damage and degradation
- Operational impacts include temporary business closure due to repair, losses to information systems, refrigeration, safety and access. For example, a heat waves impact perishable food goods in distribution warehouses and can be further exacerbated by electricity supply failure and loss of refrigeration when power networks are stressed due to peak summer demands

### INDIRECT IMPACTS

- Indirect impacts include temporary declines in food production
- Disruptions in supply chains can also greatly reduce productivity and profitability of retailers and distributors
- Health impacts

### CLIMATE HAZARDS AND IMPACTS

- Increased frequency and intensity of storms and floods are likely impacts to productivity, distribution, as well as health and safety of staff and customers
- Sea-level rise and storm surge will be a risk for distributors located close to the coast and tidal waterways

## CASE STUDY

### The Carrefour Group

**Climate Risk Management.** The Carrefour Group is the leading retailer in Europe and the second- largest retailer in the world, employing nearly 365,000 people. As a multi-local, multi-format and multi-channel retailer with 10,100 stores in 34 countries, the group generated revenues of over US\$100.2 billion in 2013. Carrefour takes climate risk very seriously and has integrated climate change and natural disasters into their risk assessment framework. In most countries where it operates, it is exposed to natural disasters, with direct or indirect impacts on its activities, its assets and employees, and consequences for its reputation and financial position.

Since 2008, Carrefour has worked to improve the management of natural risks in its operations, develop knowledge, improve assessment, adapt preventive measures and adjust insurance coverage in all the countries where it operates. They use forward-looking exercises related to climate change, specifically through a mapping of natural risks, assessments by risk and country to identify “sensitive” sites, and develop prevention fact sheets. To manage difficult situations that may significantly impact its activities or its image, it has also developed a comprehensive crisis management system. Carrefour believes that a proactive approach to risk management is an essential part of sustainable development for their business.<sup>10</sup>





## Transportation

### DIRECT IMPACTS

- Physical impacts to all forms of transportation infrastructure
- Financial impacts to asset damage and degradation
- Increased accidents, injuries and fatalities
- Repair and maintenance costs
- Loss of communication
- Closures of roads, bridges, tunnels, etc.

### INDIRECT IMPACTS

- Business disruption
- Community, infrastructure, traffic disruptions

### CLIMATE HAZARDS AND IMPACTS

- Increase in extreme rainfall, variations in wet and dry spells: More frequent landslides, impacts on soil foundations, subsidence, e.g., infrastructure, bridges
- Higher flood levels: tunnel closures, road and rail blocked access, and increased maintenance and recovery costs, and airport runway inundation
- Extreme high (or low) temperatures: deterioration of road pavements and buckling of railways
- Increase wind strength: damage/closure of bridges, windblown debris, transport route hazards, runway closure
- Sea-level rise, and increases in height and intensity of storm surges: Where heights of wharfs, jetties, sea wall protection and storm water outfall pipes are inadequate, this can lead to unplanned salt water exposure to port infrastructure, increased corrosion, erosion and asset damage

## CASE STUDIES

### Port of Houston Authority

**Climate Change Adaptation.** The port contracted AECOM to define the potential impacts of climate change that posed business and operational risks to its Bayport Terminal facilities through 2050. AECOM developed an inventory of at-risk facilities and operations; identified climate change threats; and prioritized high risk and high consequence facilities and operations. A vulnerability and risk assessment of high priority facilities using our Adapting to Climate Change Application (ACCA) performed a high-level analysis of the potential impacts of future climate change and extreme weather events on the port's assets and operations.

### Brisbane Airport New Parallel Runway

**Climate Risk Planning and Engineering.** The Brisbane Airport project proposed a new runway and infrastructure, on a low-lying coastal area, parallel to the main runway. The proposed runway site is subject to flood events and at risk to climate change impacts such as storm surge and sea level rise. The airport board recognized early on that climate change impacts needed to be assessed and factored into infrastructure design, including climate-specific planning, and scientific and engineering advice for the new runway. The project determined runway height specifications and other measures far exceeding minimum requirements to mitigate future climate impacts. This advice, alongside operational and compatibility requirements with existing infrastructure, should ensure the new runway remains operational even in the worst case climate change scenarios.<sup>11</sup>

### Port of Long Beach

**Climate Adaptation and Coastal Resiliency Planning.** The POLB in California is part of the biggest port complex in the U.S. AECOM worked with the port on climate change vulnerability assessment for its assets and operations. Inundation maps were developed to show inundation less than 16 feet, 36 feet, and 55 feet of static sea-level rise, as well as with a 100-year storm surge. The detailed maps created vulnerability profiles for piers, transportation access, critical facilities and utilities. The assessment also considered the effect of extreme heat. The assessment of breakwater performance allowed the port to understand current and future needs for maintaining resilience and prosperity.





## Utilities – Energy

### DIRECT IMPACTS

- Physical damage to transmission and distribution assets (towers, poles, wires and substations), and to power generation assets (hydro, coal, gas, oil, wind, solar and marine)
- Financial impacts due to asset damage

### INDIRECT IMPACTS

- Loss of electricity service. Brown outs and extended outages can have catastrophic consequences that cascade throughout a region, supply chain and market
- Where utility assets are the originators of significant cascading consequences, the financial liabilities can be substantial
- Health impacts

### CLIMATE HAZARDS AND IMPACTS

- Extreme high temperature and wind events. For example, electrical faults can lead to wild fires and injury or death
- Sea-level rise and flooding. Involve potential issues for substations and gas infrastructure. Generally gas infrastructure is considered more resilient due to very high safety and maintenance controls, and because assets are often buried and less exposed to climatic conditions
- Security and availability of fresh or seawater for cooling is at risk under increased temperatures

## CASE STUDIES

### Consolidated Edison

**Regulatory requirement for resilience implementation.** Consolidated Edison illustrates a case of how stakeholder interest and pressure contributed to a regulatory requirement for considering climate risks and investment in resilience projects, and support by the regulatory authority with US\$1billion approved to support implementation. The New York State Public Service Commission approved an order requiring Con Edison to implement state-of-the-art measures to plan for and protect its electric, gas and steam systems from the effects of climate change. Over the next four years, Con Edison will focus on redesigning underground networks, flood-proofing vulnerable facilities, investing in smart-grid technologies, upgrading overhead systems, burying select overhead lines, protecting gas systems from flooding and reinforcing critical tunnels.<sup>12</sup>

### Toronto Hydro Climate

**Climate change vulnerability assessment.** Toronto Hydro is the largest municipal electric distribution utility in Canada. It pioneered the application of the Engineers Canada Public Infrastructure Engineering Vulnerability Committee Risk Assessment Protocol to better understand the resilience of its assets to weather hazards. AECOM assisted with conducting a complete system-wide assessment of overhead and underground assets based on current and future climate projections, using the results to support city wide asset planning and maintenance.





## Utilities — Water

### DIRECT IMPACTS

- The inability of water systems to cope with extreme or multiple extreme high or low temperature weather events in a season can lead to substantial damages/costs, environmental spills, even potential fatalities. Older developed areas such as inner cities and developments on floodplains are at greater risk. Loss of electricity to major trunk sewer and potable water pumping stations during a flood is a significant threat

### INDIRECT IMPACTS

- Increased risk of water pollution from extreme rainfall can affect quality of water sources
- Impacts to runoff and recharge patterns of ground and surface water can affect aquatic ecosystems
- Health impacts

### CLIMATE HAZARDS AND IMPACTS

- Extreme rainfall and flooding events: Impact the capacity and maintenance of stormwater, drainage and sewer infrastructure, particularly in coastal areas where sea-level rise reduces drainage capacity to bays and oceans
- Sewage: Treatment plants tend to be located at low elevations to maximize efficiency.
- Fire: Bushfires in catchments of dams and reservoirs impact water quality and availability. Costly short-term water quality solutions might be needed for fires in major catchments.
- Water scarcity: Areas dependent on snowfall for water will likely be impacted by changes in timing supply as precipitation falls as rain rather than snow, delivering a large water supply in a shorter timeframe. Glacial feed water supply is likely impacted in the short term by increased water supply

as glaciers melt, and in the longer term with decreased water stored as ice. As glaciers recede, river flows will decrease. Water shortages may also occur due to greater demand for water associated with increased temperatures and population. Forecasted decreases in annual rainfall in catchments would also affect water supply. Resultant water shortages in regions and cities would be costly to public and private sectors and could lead to health and economic impacts. Adaptive responses include construction of infrastructure to capture and reuse stormwater, or costly, large-scale and infrastructure developments such as desalination plants or dams

- Construction and materials for water supply, sewer and stormwater pipelines may experience accelerated depreciation due to ground movement or changes in groundwater during extreme stormwater events, thus affecting the chemical and physical make-up of foundations and structures. Accelerated degradation could reduce life expectancy of infrastructure, increase maintenance costs and lead to structural failures
- Coastal zone wastewater systems may be impacted by sea-level rise, causing salt water intrusion into treatment ponds, sewer pipes and pumping stations. Salt water destroys biological treatment processes. Relocating treatment plants for coastal cities is very difficult due to locations in low-lying areas surrounded by urban development. Functional loss of wastewater treatment plants for major cities would be very expensive, and could lead to environmental and health impacts. With coastal zone development, new water and sewer infrastructure could become a liability for authorities who may struggle to maintain services when impacted by sea-level rise during an asset's lifetime of 40-60 years.

## CASE STUDIES

### Yorkshire Water Utility

**Climate Resilience.** Yorkshire Water asked AECOM to develop a strategic climate change risk assessment (CCRA) to enhance resilience of its assets and ensure high levels of service in a changing climate. The CCRA focused on business operation risks and was designed to inform board-level decisions on future direction, business continuity, and strategic investment and inform this Yorkshire Water asset-level investment risk assessment process. We used our ACCA tool to develop the CCRA and identify, prioritize and quantify vulnerabilities to climate change and extreme weather events. The risks and adaptation recommendations identified through the CCRA will maximize levels of strategic and operational resilience. Yorkshire Water is one of the government-regulated, private-sector water companies responsible for water capture, supply purification and wastewater treatment.

### Thames Water

**Climate Change Adaptation.** Thames Water is the U.K.'s largest water and wastewater company, supplying 2.6 giga-liters of drinking water and treating 4.4 giga-liters of wastewater per day for 15 million customers (27 percent of the population). Thames Water relies on the natural environment and any impacts of climate change will be felt throughout its business. To protect public water supplies, climate change adaptation has become part of its business strategy and risk management. Through asset and employee capacity building and public consultation, Thames Water outlined its response to climate change, leakage and improving water efficiency through 2035 in a Strategic Direction Statement. The document focused on water resources, improving sewerage/sewer flooding via uplifting standards for new assets to a 1-in-30-year level of flood protection, and incorporating resilience into asset management. Thames Water realized that proactively addressing climate change and making appropriate investments is more cost effective than responding after impacts have occurred.<sup>13</sup>



## Property

### DIRECT IMPACTS

- Physical damage to buildings. The climatic impacts to real estate, financial, information and other service businesses are generally associated with damage to the character and function of buildings and property
- Health impacts to staff and clients resulting from physical damage are a major consideration

### INDIRECT IMPACTS

- Loss of income during repair and replacement due to temporary business closure, loss of information systems, safety and access. For example, data centers that manage financial information may be impacted by increased frequency and intensity of extreme storm events including flooding.
- Decreasing or increasing property values due to direct climatic impacts depending on a property's location. For example, the value of coastal property on elevated and stable land is likely to increase compared to property that is low-lying and/or situated where there would be a threat of inland migration of the coastline from sea-level rise
- Impacts on utility services due to extreme events or temperatures

### CLIMATE HAZARDS AND IMPACTS

- Increased frequency of extreme high or low temperature scenarios will have the largest impact on operations and functions of buildings in the services sector. Heat waves or extreme cold spells can reduce productivity and health of staff. Electronic equipment is also more likely to fail, leaving businesses without monitoring controls, air conditioning and refrigeration for extended periods of time.
- Increases in wildfire frequency and intensity have the potential to increase rates of fire damage to buildings, structures and properties, also posing a greater risk for tourism, recreation and accommodation properties situated in wildfire prone areas.

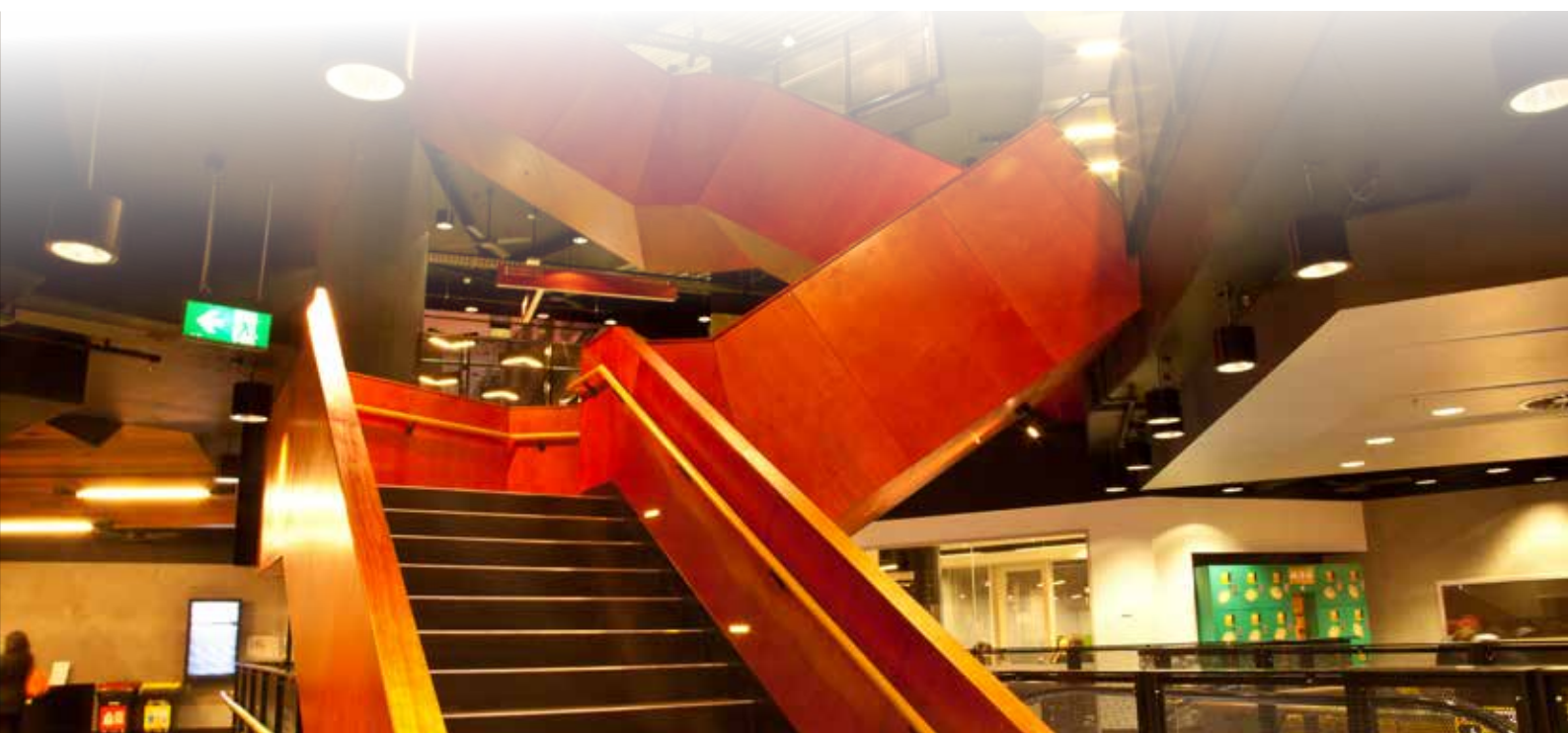
- Buildings and properties close to the coast and tidal waterways are potentially at risk when storm surges are combined with sea-level rise.
- Multiple extreme weather events also present a significant risk to service businesses. Typically buildings are designed to cope with extreme rainfall and hail storm events but not with the combined impact of both. An extreme hail event (hail stones greater than 2 inches) which blocks drainage at roof and ground level and is followed by extreme rainfall will have a greater chance to enter buildings and equipment. These combined events are very rare but in some locations are increasing in frequency and magnitude. For example, multiple businesses in Melbourne were impacted by this combination of extreme hail and rainfall in 2010 and 2011.

### CASE STUDY

#### Lend Lease

U.K. company Lend Lease has adopted a forward-thinking and innovative approach to minimizing the risks of climate change in its portfolio. In 2009 Lend Lease developed a Climate Change Adaptation Framework which it has used to develop a rigorous Climate Change Adaptation Strategy for each of its development projects. Lend Lease integrated climate change risk consideration into all relevant decision- points in their development process: from property value chain to investment management and development, and from construction to asset and property management.

The framework addresses risks such as flooding, heat stress, biodiversity, subsidence or unstable land, water stress weathering, infrastructure and insurance. By integrating climate risk management into their end-to-end business process, Lend Lease is able to perform more detailed due diligence assessments of their proposed property developments and prioritize investment.<sup>14</sup>



06

WHAT NEXT?

The next step for a business is to develop a plan and begin to manage the climate risks and capitalize on opportunities. This document serves as an introduction to help frame the business case to develop a climate resilience strategy.

Use the self assessment tool to gauge the organization's current level of progress.

By adding together the score for each step, the progress Milestone achieved by the organization can be identified. The desired milestone and improvements required can easily be targeted and communicated to executive consideration. For example, company X scored 9 points as follows:

Assess Governance 2 + Assess Risk 2 +  
Assess Opportunity 3 + Assess Action 2 = 9

A score of 9 indicates that the organization is still at milestone 2 or “exploring” what climate resilience means and still needs to prioritize actions, investments and opportunities. The table provides guidance for next steps for each milestone that aligns with an organization’s current level of progress.

Score	Milestone	Next Step Guidance
4-5	1. 'Not on the radar'	Develop executive business case to assess climate risks and opportunities. Summarise annual business losses from climatic events in the last 10 years. Note any trends, insurance implications and how success will be measured.
6-9	2. 'Exploring'	Evaluate and prioritize actions, investments and opportunities. Engage key internal stakeholders that are likely to be responsible for implementation. Communicate action plan and resource implications to executive and key stakeholders.
10-13	3. 'Evaluating'	Implement actions through individual work plans. Monitor and manage performance. Integrate climate resilience into existing frameworks and reporting to investors and broader stakeholders.
14-16	4. 'Executing'	Having a well developed and implemented climate resilience strategy promote and leverage market advantage. Monitor and review priorities for improvements and commercial opportunities.

AECOM has supported over 200 organizations with climate resilience advisory and consulting projects. Contact for more information or if you require support to increase climate resilience outcomes for your organization.



Climate resilient businesses know when and how to respond to a changing climate, and have established strategies and investments to protect people, profit, assets and supply chains.





## ADAPTING TO A CHANGING CLIMATE SELF ASSESSMENT TOOL

**Instructions:** Assess steps (governance, risk, opportunity and action) against the milestones on the left hand column. For each step check one milestone and add up your total scores.

Please tick most the most relevant possible score ☒ 1

	STEP 1: ASSESS GOVERNANCE	STEP 2: ASSESS RISK	STEP 3: ASSESS OPPORTUNITY	STEP 4: ASSESS ACTION
<b>MILESTONE ONE</b> "Not on the radar"  YOU NEED A BUSINESS CASE TO EXPLORE	<ul style="list-style-type: none"> <li>- No recognition of changing climate</li> </ul> <div><input type="checkbox"/> 1</div>	<ul style="list-style-type: none"> <li>- Climatic risks have not been identified</li> <li>- Associated financial, regulatory and reputational risks are not understood</li> </ul> <div><input type="checkbox"/> 1</div>	<ul style="list-style-type: none"> <li>- Commercial opportunities in response to a changing climate not considered</li> </ul> <div><input type="checkbox"/> 1</div>	<ul style="list-style-type: none"> <li>- No actions to adapt have been implemented</li> </ul> <div><input type="checkbox"/> 1</div>
<b>MILESTONE TWO</b> "Exploring"  YOU NEED TO PRIORITIZE THE RISKS /OPPORTUNITIES	<ul style="list-style-type: none"> <li>- Commitment to assess climatic risks and opportunities</li> </ul> <div><input type="checkbox"/> 2</div>	<ul style="list-style-type: none"> <li>- Risks assessed within the organisation's existing framework to allow comparison with other organisational risks</li> </ul> <div><input type="checkbox"/> 2</div>	<ul style="list-style-type: none"> <li>- Business opportunities related to changing climate identified</li> </ul> <div><input type="checkbox"/> 2</div>	<ul style="list-style-type: none"> <li>- Areas for immediate adaptation action have been identified</li> </ul> <div><input type="checkbox"/> 2</div>
<b>MILESTONE THREE</b> "Evaluating"  YOU NEED TO SUPPORT DECISIONS FOR ACTION	<ul style="list-style-type: none"> <li>- Climatic risks and opportunities identified and communicated</li> <li>- Strategic direction for achieving objectives is clearly defined</li> <li>- Public commitment made to manage the climatic risks</li> </ul> <div><input type="checkbox"/> 3</div>	<ul style="list-style-type: none"> <li>- Comprehensive assessment of priority risks and solutions completed</li> <li>- Potential change in function and value of assets over time is understood</li> </ul> <div><input type="checkbox"/> 3</div>	<ul style="list-style-type: none"> <li>- Opportunities for new or enhanced business or service delivery are market tested and evaluated</li> </ul> <div><input type="checkbox"/> 3</div>	<ul style="list-style-type: none"> <li>- Comprehensive and systematic adaptation action plan developed</li> <li>- Responsibility for implementation is clearly defined and funding has been confirmed</li> </ul> <div><input type="checkbox"/> 3</div>
<b>MILESTONE FOUR</b> "Executing"  YOU NEED TO EMBED ACTION AND COMMUNICATE	<ul style="list-style-type: none"> <li>- Climate resilience performance measures monitored, reviewed and integrated into public reporting</li> <li>- Strategic direction drives action across the organisation</li> <li>- Climate resilience is embedded in corporate and business planning</li> </ul> <div><input type="checkbox"/> 4</div>	<ul style="list-style-type: none"> <li>- Climate risks embedded into corporate risk register and monitored</li> <li>- Programs to develop staff skills to increase climatic resilience implemented</li> </ul> <div><input type="checkbox"/> 4</div>	<ul style="list-style-type: none"> <li>- Commercial opportunities taken to market and performance monitored</li> </ul> <div><input type="checkbox"/> 4</div>	<ul style="list-style-type: none"> <li>- Adaptation actions have been implemented for all priority risks</li> <li>- Systems are in place for monitoring implementation and performance</li> </ul> <div><input type="checkbox"/> 4</div>
	GOVERNANCE TOTAL <input type="text"/>	RISK TOTAL <input type="text"/>	OPPORTUNITY TOTAL <input type="text"/>	ACTION TOTAL <input type="text"/>

**TOTAL ADAPTATION SCORE:**  
(ADD STEP 1-4 TOTALS TOGETHER)

# CLIMATE RESILIENCE FRAMEWORK



Once an organization has used the self-assessment tool, it can apply the climate resilience framework to guide activity to increase resilience, and periodically review performance against the tool. The Climate Resilience Framework is based on AECOM's extensive experience in assessing climatic risk and implementing resilience strategies. It is a simple 6 step process tailored for the business sector.

## 01 Scoping

- Discuss project drivers with your project team and other stakeholders to create a shared vision
- Review approach options and requirements, and select an appropriate methodology
- Define scope of work in terms of the climate variables and hazards to be considered, and over what timeframe (e.g., present time, 2030, 2070)
- Determine the scope including relevant business and site elements and systems

## 02 Screening risk

- Consider basic climate trends for your region for each of the relevant climate hazards (i.e. temperature, precipitation, flooding, drought, sea-level change and wind)
- Screen business and site elements, and systems against each of the relevant climate hazards to determine high-level climatic risks and priorities for detailed risk assessment
- Identify and review relevant climate policy, regulatory and planning approvals requirements

## 03 Science

- Determine whether climate data can be gathered and analyzed by internal staff or needs to be outsourced
- If gathered internally, collect climate projections based on a moderate to high emissions scenarios for appropriate years and scale. Gather historical climatic data, both the long-term average (past 100 years or as available) and the recent trends (past 30 years)
- Consider whether other data studies should be collected to support the project, for example, reports on flooding and inundation mapping, urban heat island, erosion, etc. Also consider whether GIS would be useful to spatially display collected information

## 04 Detailed risk assessment

- Select the business and site elements and systems that have greatest potential risks to specific climate variables or impacts, making use of the results from the screening phase to focus analysis

- Identify or confirm the stakeholders that need to be involved in determining priority risks or valuing the implications of these risks
- Conduct assessment of climate risk to organization, site or project. Use detailed spatial and/or impact modeling data to inform the site or project specific risk. Any impact modeling data should include future climatic conditions such as flood, groundwater re-charge modeling etc.
- Prepare necessary documentation to meet any regulatory, planning, approval and investor requirements
- Ensure climate risks are integrated into wider risk management processes. Assign risks to organizational groups to ensure they are considered part of the ongoing business process. (e.g., procurement, insurance, capital planning, logistics etc.)

## 05 Resilience options

- Identify or confirm the stakeholders within (or outside) your business that need to be involved in determining and implementing resilience options, or may benefit from their implementation.
- Review risk assessment for priority risks requiring resilience solutions. Identify potential options
- Research characteristics of resilience options in terms of "effectiveness in responding to climate risk", "value for money", "practicality of implementation" All business benefits should be considered when assessing resilience options. Evaluate (rank) resilience options
- Integrate preferred climate resilience measures into business planning processes, operational procedures and capital project design
- Document how selected resilience options address climate risks. Where risks are not addressed, provide the rationale supporting this decision for transparency purposes

## 06 Implementation

- Justify large climate resilience investments with cost benefit analysis if required. Allocate resources to implement lower cost/high benefit options
- Assign responsibility for embedding climate risks into relevant operational plans
- Document implementation of resilience options and reduced risks achieved for communication to investors, insurers and customers
- Ensure handover notes are clear in presenting the climate risks in operations
- Ensure appropriate monitoring and review arrangements are in place. Build in a review of climate science on a five-year basis

“ Climate resilient businesses know when and how to respond to a changing climate, and have established strategies and investments to protect people, profit, assets and supply chains.

## SOURCES

1. [Fortescue Metals](#)
2. [Asset Owners Disclosure Project](#)
3. [Munich Climate Insurance Initiative](#)
4. [SM Supermalls](#)
5. [World Trade Center Campus](#)
6. [Toyota](#)
7. [Nestle](#)
8. [BASF](#)
9. [Rio Tinto](#)
10. [Carrefour Group](#)
11. [Brisbane Airport](#)
12. [Consolidated Edison](#)
13. [Thames Water](#)
14. [LendLease](#)





## About AECOM

AECOM is a premier, fully integrated professional and technical services firm positioned to design, build, finance and operate infrastructure assets around the world for public- and private-sector clients. The firm's global staff — including architects, engineers, designers, planners, scientists and management and construction services professionals — serves clients in over 150 countries around the world. AECOM is ranked as the #1 engineering design firm by revenue in *Engineering News-Record* magazine's annual industry rankings, and has been recognized by *Fortune* magazine as a World's Most Admired Company. The firm is a leader in all of the key markets that it serves, including transportation, facilities, environmental, energy, oil and gas, water, high-rise buildings and government. AECOM provides a blend of global reach, local knowledge, innovation and technical excellence in delivering customized and creative solutions that meet the needs of clients' projects. A *Fortune* 500 firm, AECOM companies, including URS Corporation and Hunt Construction Group, have annual revenue of approximately \$19 billion.

More information on AECOM and its services can be found at [www.aecom.com](http://www.aecom.com).

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