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# MESSAGE

Public discourse on climate change to date has focused mainly on mitigation, or prevention. **Less attention has been given to adapting to a changing climate. This needs to change.**

# Message



**Climate change is the new normal.** Extreme or high-variability weather events create volatility for commodity prices, transport and logistics systems, and the markets which depend on them. To adapt to such fluctuations countries and companies are starting to question how to use natural resources more efficiently, especially energy and water.

Businesses can't change the weather. What they can do is assess trends, identify risks, and build resilience into their operations and supply chains. Their assessments may also reveal opportunities for new products and services to serve the emerging low-carbon economy. Acting on anticipated climate impacts is called adaptation, and is the subject of this report.

Public discourse on climate change to date has focused mainly on mitigation, or prevention. Less attention has been given to adapting to a changing climate. This needs to change. This report aims to increase general awareness about climate change risks to Hong Kong businesses and their supply chain partners. Its purpose is to spur adaptation, or new ways of doing business, by informing investment and sourcing decisions; creating more climate-resilient delivery models; and encouraging more robust, adaptive business operations in the years to come.

The report identifies real, predictable and calculable risks to business continuity. Treatment of these risks has generally

been neglected to date, for a variety of reasons. One is the nascent nature of the field of climate adaptation – it's just beginning to be considered within enterprise risk management functions at larger, more sophisticated companies. Data, especially geographically-specific predictive data, is lacking. Uncertainty levels are still high. The short-term planning horizon characteristic of many publicly traded companies is ill suited for longer-term analysis of climate impacts and consequent investment in resilience. And absent a 'real and present danger', many executives do not feel the urgency or the ownership to act. Climate impacts everyone, and businesses generally see Government as responsible for setting new market standards or parameters to adapt.

Despite these barriers, climate adaptation is garnering increasing attention. Those moving the quickest are usually in (a) countries where the government has prioritized climate change mitigation and adaptation – regulation can be a blunt driver – or (b) industries that are particularly vulnerable (eg, reinsurance) or are highly carbon intensive and reliant on long-term assets (eg, power generation). Some companies are adopting sustainability as a strategy for long-term competitiveness: this philosophy is more likely to embrace climate adaptation along with other forms of eco-innovation. Still others (and their supply chains) have been "hit" by costly climate impacts already and are thus motivated to prevent future loss.

Regardless of the driver, embracing climate adaptation is like embracing any sort of corporate change. It requires leadership at the top, consistency between messages and actions, and relentless follow-through. A good starting place is a risk/opportunity assessment, preferably working across teams, functions and the supply chain. In this emerging field, collaboration is key and the best learning will be co-learning. Once risks are identified and prioritized, teams can work together to assess adaptation actions to address them in the short, medium and long term. Emerging best practice is to share such plans with critical value chain partners, and review them regularly.

The hope is that this adaptation primer will spur conversation and collaboration amongst business partners and government agencies about how to best adapt to an inevitably changing climate.

**Dr Glenn Frommer**  
**Lead, CCBF Adaptation Projects**  
**April 2013**

# Executive Summary

Business action on climate change to date has largely centred on mitigation. Most companies have not yet mainstreamed adaptation, or refined operations to account for the impacts of changing climate. This report illustrates what Hong Kong business might expect from climate change, with a focus on six key industries: property, construction, financial services, manufacturing /supply chain, power generation and transport. It uncovers reasons for the current inaction, including lack of climate impact awareness, confusion between mitigation and adaptation, low risk prioritisation, short-term focus and lack of forward planning. It then elucidates sector-specific actions that can be taken to increase business resilience. General recommendations include:

- Raise awareness about company – and industry-specific – climate risk, through training, enterprise risk management tools, within and across teams, and in collaboration with peers in your industry. Keep abreast of research in both climate science and adaptive technologies, as the field is quickly changing.
- Encourage the Government to assess – and share –

risks. The resulting assessments will create a common set of assumptions upon which communities (or clusters of businesses) can plan more efficiently and effectively.

- Consider future risks, with the help of emerging models and scientific information. Consider future business opportunities as well.
- Research and assess adaptation options that are suitable for your company. The costs are often lower, and the benefits higher, if you invest in the near term for eventualities which may occur over the medium term.
- Integrate climate change into your business strategy and management processes, working with colleagues and senior management to create a climate-aware company culture.
- Start now to safeguard operations, capture emerging business opportunities and strengthen resilience and long-term competitiveness.

Moving forward progressively on climate adaptation has its advantages. Companies which build resilience into their supply chains are less likely to experience weather-related

disruptions, leading to more predictable operations and smoother cash flows. Insurance premiums can be managed or cut. And as city and regional governments around the world start to prepare for climate change, those companies with first mover advantage will be in a position to advise and contribute to their local communities.



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# INTRODUCTION

**Business adaptation to climate change** – actions taken to increase business resilience to actual or expected impacts of inevitable climate change.

**Mitigation of climate change** – actions taken to slow the rate of future climate change by reducing greenhouse gas emissions.

# Setting the scene

Public discourse has focused to date mainly on climate change mitigation (prevention). In response, many businesses are reducing their level of greenhouse gas emissions to slow the rate of future change. Less focus has been given to adapting to a changing climate (preparation). Yet companies around the world are starting to take action to build resilience to inevitable climate change. A few governments, including the UK and China, have accelerated and informed this process by commissioning economy-wide assessments of climate change risks and opportunities, and focusing on corresponding adaptation actions.

**Climate change is the new normal.** It's happening here and now: The observed temperature increases in some parts of Asia during recent decades ranged between less than 1°C to 3°C<sup>a</sup> per century. Sea levels have risen by about 17cm<sup>b</sup> over the last century. Both the pace and volatility of the change are quickening, with enormous associated costs. Global reinsurance company Munich Re reports that in the 10 years preceding 2009, there was an average of 770 natural catastrophes with economic losses of about USD \$115 billion. Natural catastrophes surged from 880 in 2009 to 950 in 2010, with economic loss of USD \$130 billion. 2011 was a record year, with the Thai floods alone costing USD \$40 billion<sup>c</sup> - more than 10,000 factories were forced to close and 25% of the world's supply of computer hard drive components was impacted<sup>d</sup>. Indeed, weather-related disasters have more than tripled in Asia over the last 30 years. With only about 6% of assets insured<sup>e</sup>, the costs are poised to go even higher. More extreme weather is in the forecast. Hong Kong is expected to be 4.8°C hotter and significantly wetter by the end of the century. The implications for businesses are serious. Assets, operations, supply chains and markets will be

impacted. Business continuity, competitiveness and corporate reputation will be placed at risk. But climate change also brings opportunities, for those companies which astutely anticipate and invest. New technologies, products and services will be needed to respond to the changing climate. These trends will be particularly pronounced in emerging Asia, where populations and economies are more acutely vulnerable to climate change.

Companies which anticipate and adapt to a changing climate will be well placed to minimise their business risks and maximize profitable opportunities.

<sup>a</sup> - IPCC 2007a, Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change

<sup>b</sup> - IPCC 2007b, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change

<sup>c</sup> - According to Munich Re, at [http://www.munichre.com/en/media\\_relations/company\\_news/2011/2011-11-11\\_company\\_news.aspx](http://www.munichre.com/en/media_relations/company_news/2011/2011-11-11_company_news.aspx)

<sup>d</sup> - *The Guardian*, Thailand flooding costs Lloyd's of London \$2.2bn, at <http://www.guardian.co.uk/business/2012/feb/14/lloyds-thailand-flooding-2bn-dollars>

<sup>e</sup> - According to Munich Re, at [http://www.munichre.com/en/media\\_relations/company\\_news/2011/2011-11-11\\_company\\_news.aspx](http://www.munichre.com/en/media_relations/company_news/2011/2011-11-11_company_news.aspx)

# Objectives and Structure

## Report Background

The objective of this report is to increase general awareness about climate impacts on Hong Kong businesses and their supply chain partners. It is hoped that the information presented here will inform investment and sourcing decisions, creating more climate-resilient delivery models and more resilient, adaptive business operations in the years to come. The report is meant as an introductory resource for businesses seeking to:

- 1) Improve their understanding of the risks and opportunities of a changing climate on their activities;
- 2) Gain insight to the Hong Kong context, through the analysis and perceptions of some of the first movers on this topic in the Hong Kong business community; and
- 3) Take practical steps toward climate resilience.

The report introduces climate impacts on business, with specific focus on six key sectors of Hong Kong's economy: transport, power generation, construction, property, finance, and supply chain / manufacturing. It then delves into the risks, opportunities and barriers inherent in each sector, highlighting

emerging examples of best business practice and concluding with recommendations for future action.

**Climate Change Impacts: The So What for business** introduces the relationship between changes in the climate, impacts on business (risks and opportunities), and adaptation actions.

The ensuing sections examine the six key sectors of the Hong Kong economy, identified by CCBF<sup>f</sup>. Each includes a

- **Hong Kong view** - detailing the risks, opportunities and adaptation actions of greatest import, as perceived by the Hong Kong businesses interviewed. (Note: Interviews were conducted with CCBF corporate members and thus are not statistically significant. Instead, they reflect current thinking from some leading companies on Hong Kong's climate change challenge.)
- **Sector perspective** - highlighting key implications on the sector of a changing climate;
- **Hong Kong spotlight** - presenting adaptation strategies undertaken by select Hong Kong businesses, and

- **Impacts and adaptation actions** - reviewing the detailed risks and opportunities each sector faces globally and adaptation actions companies are taking around the world to build climate resilience.

Finally, **Conclusions & Recommendations** presents a rationale for why companies do, or do not, address climate risks, and makes recommendations to set Hong Kong businesses on a path to climate resilience.

<sup>f</sup> – In Low Carbon Economy for Hong Kong: Sector Regulation Paper, July 2010, available at [http://www.climatechangebusinessforum.com/en-us/research\\_06072010](http://www.climatechangebusinessforum.com/en-us/research_06072010)

## CCBF adaptation projects

This report was prepared between February and August 2012, based on a global literature review and input from member companies of the Hong Kong-based Climate Change Business Forum (CCBF).

- The literature review included the emerging scholarly, government, and professional reports on climate adaptation as well as company specific literature, such as sustainability reports, and information provided to the Carbon Disclosure Project (CDP).
- Input from CCBF member companies was gathered through CCBF Best Practice Committee meetings, in-person interviews and written feedback from member companies.
- The findings combine the literature review and interviews from CCBF member companies. As such, they generally reflect a sector/sub-sector as a whole and are not necessarily applicable to any specific company.

This study is the first in a series of climate adaptation projects produced by CCBF for the greater Hong Kong business community. It is designed to raise awareness and understanding of climate risk. A second project, anticipated for completion in 2013, will provide a sector-specific climate risk tool. This tool will help businesses assess, and start to address, emerging climate risks. For more about both projects, email [ccbf@bec.org.hk](mailto:ccbf@bec.org.hk).

# Climate Change Impacts: The *So What* for business

## Preparing for the New Normal

### Changes In The Climate

#### Changes in the climate include:

- More frequent, widespread and/or intense **extreme weather events** such as extreme rainfall and floods, droughts, snow storms and heat waves; and
- **Incremental changes** to the climate such as sea level rise and temperature increase<sup>§</sup>

#### Projected changes in Asia:

- Increased variability of precipitation, more intense and frequent extreme rainfall and floods;
- More intense and/or frequent cyclones, storms & storm surges;
- More frequent droughts and less soil moisture;
- Increased temperature and more heat waves; and
- Sea level rise and coastal erosion

#### Projected changes in Hong Kong (2000-2100):

- Increase in the frequency of extreme weather, including very hot days and extremely wet years;

- 4.8°C increase in temperature;<sup>h</sup>
- 0.4 – 2 metres sea level rise;<sup>i</sup> and
- 11% increase in average annual rainfall

### Impacts On Business

Changes in the climate will have both positive impacts (opportunities) and negative impacts (risks) on business operations. The following categorizations are used to classify impacts in this report<sup>i</sup>:

- **Fixed assets:** Impacts on infrastructures, buildings, machinery and equipment
- **Logistics** Vulnerability of a supply chain, including utilities and transport of raw materials or partially or wholly finished goods
- **People** Implications for workforce health and safety, as well as the ability to physically access places of work
- **Operations** impacts on business operations, including production processes and service delivery
- **Markets** Changing demand for goods, services and energy

- **Finance** Insurance costs, availability and cost of finance, and investor pressure.

To ensure business continuity and maximize competitiveness, businesses need to reduce vulnerability to climate risk, and optimize or leverage climate opportunities.

Exposure to climate risk is a function of various factors, including geographic location, types of processes and activities, products and services, market features and available resources.<sup>k</sup> A company-specific assessment is recommended to more precisely identify how these risks will affect an organization and which opportunities are most attractive to pursue.

§ – IPCC 2007a, Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change

<sup>h</sup> – Hong Kong Observatory, *Projections of Hong Kong Climate for the 21st century, Temperature projection & Rainfall projection*, at [http://www.weather.gov.hk/climate\\_change/proj\\_hk\\_temp\\_e.htm](http://www.weather.gov.hk/climate_change/proj_hk_temp_e.htm)

<sup>i</sup> – Future Sea Level in Hong Kong, blog on Hong Kong Observatory web site, B.Y. Lee, Nov 2, 2009, at <http://www.hko.gov.hk/blog/en/archives/00000041.htm>.

<sup>j</sup> – Classification based on UKCIP.

<sup>k</sup> – UKCIP 2011, Workshop B: Business areas & future climate, Guidance on running a workshop for scoping the potential impacts of future climate change



## Adaptation Actions

Organizations can take various types of actions to adapt to a changing climate<sup>1</sup> in order to:

- Anticipate or respond to specific climate impacts;
- Increase the capacity of an organisation to adapt in the future;
- Help reduce vulnerability to climate risks or exploit opportunities;
- Employ specific technologies and/or involve capital goods;
- Represent changes to information, policy, strategy, and institutional arrangements;
- Protect the value of existing assets and process;
- Create new value through innovation and emerging demand arising from climatic change
- Complement a broader set of sustainability or CSR initiatives.

The report takes a broad perspective and looks at all types of adaptations, highlighting key actions to build resilience.

## Role Of Government

Sustainability, like security, is a public good. Thus governments have a seminal role to play in disseminating information on, and responding to, climate risk.

A small number of national governments – among them the UK and China – and a growing number of cities have undertaken climate risk assessments. Results of such assessments, when broadly shared, can spur region-specific and business-specific analysis and corresponding investment.

### Government “first response” on climate adaptation (as distinct from mitigation) has the benefits of:

- Providing a common scientific frame of reference for climate projections;
- Ensuring assumptions about future risk are consistent across different companies / actors;
- Demonstrating that climate adaptation is an important and urgent goal through demonstrable assessments and investments; and

- Creating an enabling environment for first movers to benefit from opportunities brought by a changing climate.

<sup>1</sup> BSR, *Adapting to climate change: A Guide for the Financial Services Industry*, at [http://www.bsr.org/reports/BSR\\_Climate\\_Adaptation\\_Issue\\_Brief\\_Financial\\_Services.pdf](http://www.bsr.org/reports/BSR_Climate_Adaptation_Issue_Brief_Financial_Services.pdf)

- UKCIP 2010, *Adaptation types*, at <http://www.ukcip.org.uk/essentials/adaptation/adaptation-types/>

- IPCC 2001, *Contribution of Working Group II to the Third Assessment Report, of the Intergovernmental Panel on Climate Change, 2001*, J.J. McCarthy, O.F. Canziani, N.A. Leary, D.J. Dokken, K.S. White (eds) Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA; and

- OECD 2011, *Private Sector Engagement in Adaptation to Climate Change: Approaches to Managing Climate Risks*, Agrawala, S. et al., OECD Environment Working Papers, No. 39, OECD Publishing, Paris

# TRANSPORT

Hong Kong View: Transport Impacts		
Impact area(s)	Risk / Opportunity	Potential Adaptation Actions
 <b>Assets &amp; Operations</b>	<b>Disruption/interruption of service due to:</b> <ul style="list-style-type: none"> <li>- Damaged or degraded infrastructure (own or third-party)</li> <li>- Extreme weather, rendering travel difficult</li> </ul>	<b>Reinforce and protect existing infrastructure</b> <b>Build redundancies, plan alternative routes</b> <b>Update crisis management system to factor in climate projections</b>
 <b>People</b>	<b>Reduced availability of staff due to difficulty in accessing the workplace</b>	<b>Build redundancy in the staff pool</b> <b>Decentralise staff stationing</b>
 <b>Markets</b>	<b>Climate-induced diseases and pandemics leading to demand</b>	<b>Take measures to reduce passenger and staff exposure to pathogens</b>
 <b>Market Opportunity</b>	<b>Demand for new routes and destinations (passenger), demand for transport of new raw materials and products (freight). Preference for low-carbon transport options.</b>	<b>Plan for and develop for new routes and destinations (passenger) and cargo (freight).</b> <b>Invest in more energy efficient assets</b>



# Transport - Sector Perspective

**The transport sector** is fundamental to any working economy. It also contributes 23% to global CO2 emissions.<sup>m</sup> Transport systems are built with durable, long-life assets whose design and use must be carefully planned to ensure they remain serviceable and resilient as conditions change. The urgency to bring climate-smart analysis to transport networks is particularly acute in Asia, where rapid development means billions of dollars are being invested in the short and medium term. Indeed, China will build 45 new airports and spend RMB 700 billion on rail lines annually during the course of its 12th 5 Year Plan (2011-2015).

**Climate change affects** road-based, rail, air and marine transport assets and systems. While such systems are already affected by weather events, the shift in the intensity, duration and/or frequency of extreme weather may stress both materials and systems beyond the point of design standard. Underground trains, for example, can be vulnerable to flooding, particularly in tunnels. MTR Corporation of Hong Kong designs to a standard of the “once in 200 years” flood. Similarly, airport design in coastal regions may also

face challenges from the combined effects of projected sea level rise and storm surge. Hong Kong International Airport is built about 5 meters above mean sea level, to maintain safe operations during times of high water levels.

**Impacts are multiplied** by the inter-linkage of people and goods transported throughout the economy. The knock-on effect of a transport-driven disruption is immediate. For example, blocked roads or stalled trains affect work force availability; docked ships disrupt supply chains and could affect energy supply. Ironically and importantly, transport networks are called upon to perform even more efficiently in a natural disaster or emergency: just when they are most vulnerable.

**To increase resilience**, providers are starting to assess transportation value chains in their entirety, including:

- **Infrastructure and vehicles.** These may be owned by the same entity (e.g. MTR owns the trains as well as the rail tracks and the stations in Hong Kong) or different entities (e.g. Cathay Pacific owns its aircraft while the Airport Authority operates Hong Kong International Airport).

Given inter-dependencies, ensuring the resilience of the overall network requires that adaptation be integrated at all levels and between transport modes.

- **Auxiliary services.** These include, for example, vehicle maintenance and servicing, passenger check-in, baggage handling, security, and other on-board services and support systems for trains, buses, taxis and aircraft. Any impact to such services has repercussions on the system as a whole.

**To leverage climate opportunities**, transport providers can seek new markets for travel and new routes for cargo. Warmer weather may change tourist destinations and seasonality. Previously iced-over or impassable sea lanes could become accessible. Companies monitoring climate impacts and planning with a long-term view will be best placed to benefit from these opportunities.

<sup>m</sup> – According to the Asia Development Bank, at <http://www.adb.org/sectors/transport/main>.





## Making sure the business is climate change-ready

**Challenge: Raising awareness.** Climate adaptation strategies emerge from an informed, solid understanding of climate risks. That understanding starts within. How can a company work climate change awareness into its corporate culture?

**Approach: Communicate, assess and act.**

MTR builds capacity through an extensive internal staff engagement programme, led by designated environmental champions in each division. These champions lead cross-departmental taskforces to review, refine and carry out environmental projects. Staff is also engaged through an online knowledge sharing platform, forming a Community of

Practice for sharing and discussion of innovative environmental ideas. Experience sharing and effective collaboration is critical. Internally, relevant business units contribute to the annual climate risks review, improving understanding about the imminent nature of some climate change events. Such analysis begets specific actions, such as updating response procedures. To keep abreast of global best practices and to share experiences, staff also participate in international organizations such as the Community of Metros (CoMET) and the International Association of Public Transport (UITP) as well as local organizations such as the Climate Change Business Forum.

MTR infrastructure is already designed to withstand high intensity wind and rainfall expected during super typhoons. Assets are designed to withstand 1:200 year rainfall events. Additional resilience has been built in to anticipate the effects of sea level rise. Secondary effects – such as flooding in areas with no railway operations – are assessed regularly.



## Getting it right when things go wrong

**Challenge: Disruptions happen.** How can an airline best handle them in an effective and timely manner?

**Approach: Comprehensive, complementary systems to handle operations and customer service.** Cathay Pacific has a robust emergency response system designed to manage operational incidents such as typhoons and technical delays. Through carrying out contingency plans, teams – both customer-facing and behind-the-scenes in Hong Kong and airports around the world – work together to minimise any inconvenience to passengers. The company also realises the importance of keeping passengers informed of the latest flight status. The Cathay Emergency Passenger Information Centre (CEPIC) is activated as a 24-

hour, toll-free telephone enquiry centre when required, and this is complemented by updates via SMS or email through the **notiFLY** Messaging service.

A typhoon simulation exercise conducted in 2011 offered a holistic view of airport passenger handling constraints during disruption. The exercise offered insight into ports requiring assistance and how to improve communication of accurate and relevant information during a crisis. This preparedness, readiness and handling of disruptions are essential for everyone involved in serving Cathay Pacific customers.



## Global Transport: Impacts and Actions

Impact Area	Risk / Opportunity	Adaptation action
<p>Markets</p> 	<p><b>Freight transport: changes in demand, trade levels and transport routes can affect revenues (positively and negatively), especially for locations and products particularly vulnerable to climate change</b></p> <p><b>Passenger transport:</b></p> <ul style="list-style-type: none"> <li>- Preferences for new routes or destinations due to incremental changes in the climate</li> <li>- Customer and/or regulator demand for lower carbon forms of transport will create incentives for equipment upgrades and preferences for public transportation (and associated marketing opportunities for those taking action)</li> </ul> <p><b>Heat stress and climate induced diseases can reduce the number of passengers, affecting demand and revenues</b></p>	<ul style="list-style-type: none"> <li>- Monitor changes and assess risks to position the company in new markets</li> <li>- Adapt cargo to new demand</li> <li>- Assess possible impacts on existing destinations and identify potential new destinations. Plan change of routes accordingly</li> <li>- Upgrade equipment / vehicles to more energy-efficient, low carbon models. Communicate with clientele</li> </ul> <p><b>Take measures to reduce passenger and staff exposure to pathogens, e.g. air sterilisation in buildings and vehicles, disinfection of commonly touched surfaces in buildings and vehicles</b></p>
<p>Assets</p> 	<p><b>Deterioration or significant damage to infrastructure can disrupt passenger travel and supply chains, causing delays and service interruption. Results may include increased repair and maintenance bills, decreased payload, lost productivity and tarnished reputation.</b></p> <p>Typhoons, heavy rains, flooding, soil saturation, the scouring action of rain/high rivers and canals, erosion, landslides, increasing soil moisture levels, weathering, subsidence, landslides, and salt penetration can damage:</p> <ul style="list-style-type: none"> <li>- <b>Rail:</b> Railbed, bridges, flyovers, electrified tracks with overhead cables, train platforms, embankments and tunnels, as well as trains, signalling equipment and electricity circuits. The result may be failure of track circuits and overhead cables, and inability to send signals.</li> <li>- <b>Road:</b> Road surface, tunnels, earthworks for embankments and bridges, as well as signaling equipment including street lighting, signs, and service station.</li> <li>- <b>Air:</b> Runways, aprons, terminal buildings, access roads and tunnels, as well as signalling and navigation equipment.</li> <li>- <b>Water:</b> Breakwater and sea walls, wave dissipating blocks, parapets, quays, berthing facilities and cargo-handling yards on low elevation, buildings, containers, and apron machinery/ material</li> </ul>	<p><b>Adapt material and equipment specification:</b> Replace or reinforce existing structures and equipment to withstand climatic impacts:</p> <ul style="list-style-type: none"> <li>- <b>Rail:</b> Use heat-resistant and durable material (e.g. corrosion resistant)</li> <li>- <b>Road:</b> Use heat-resistant and durable material (e.g. corrosion resistant, heat-resistant asphalt)</li> <li>- <b>Water:</b> Review material and specifications of quays, revetments, wave dissipating block, and parapets, tower cranes, buried pipes and manholes, and pumps to drain groundwater</li> </ul> <p><b>Install or improve protective structures</b></p> <ul style="list-style-type: none"> <li>- <b>All:</b> Install or improve flood defense (seawalls, coastal protections, dikes, retaining walls)</li> <li>- <b>Road:</b> Build parks, lakes, shading, and roadside vegetation to decrease road exposure to heat. Consider locating roads near natural or man-made ecosystem barriers, e.g. mangroves &amp; natural wetlands.</li> <li>- <b>Build or improve drainage infrastructure</b> and improve pumping of underground systems</li> <li>- <b>Water:</b> Raise facilities to improve drainage and protect aprons and breakwaters against inundation and wave overtopping</li> </ul> <p><b>Install redundant systems</b></p>

[continued >](#)

# Global Transport: Impacts and Actions

Impact Area	Risk / Opportunity	Adaptation action
<p>&gt; <i>continued</i></p> <p>Assets</p> 	<p><b>Heat can cause:</b></p> <ul style="list-style-type: none"> <li>- <b>Rail:</b> rail track buckling</li> <li>- <b>Road:</b> road buckling and rutting, melting of surfaces such as asphalt, structural material degradation of bridge, and weakening of bridge support</li> <li>- <b>Air:</b> weathering and buckling of runways, pavements and concrete facilities<sup>no</sup>;</li> </ul> <p><b>All:</b></p> <ul style="list-style-type: none"> <li>- Interruptions to passenger transport impact the customer experience. It also can put enormous strain on bus, ship, or airport facilities and personnel, particularly if large numbers of passengers are stranded.</li> </ul>	<ul style="list-style-type: none"> <li>- <b>Adapt design standards to withstand higher temperatures and flooding</b></li> <li>- <b>Enhance monitoring of infrastructure, especially after heavy rains and flooding</b></li> <li>- <b>Implement early warning systems, e.g. on extreme weather events and track/road/river conditions</b></li> </ul> <p><b>Increase and adapt maintenance:</b></p> <p><b>Rail:</b> Adapt rail stressing; Regularly inspect and repair tracks, track sensors and signals; Implement differentiated speed limits</p> <p><b>Road:</b> Increase maintenance, cleaning of roads and milling out of ruts</p> <p><b>Air:</b> Increase maintenance and cleaning of runways</p> <p><b>Water:</b> Intensify maintenance of waterways and ports; Increase dredging of silt in water ways and ports; Improve cargo handling to mitigate materials and equipment loss</p>
<p>Operations</p> 	<p><b>Unpredictable and/or extreme weather can lead to difficult driving/flying/navigation conditions. This can create safety hazards, travel disruptions and increased upgrade, repair and maintenance bills.</b></p> <p>N.B.: incremental changes, such as sea level rise, also alter driving/flying/navigation in the longer term</p> <ul style="list-style-type: none"> <li>- <b>Air:</b> Poor visibility due to increased precipitation, lowering of cloud ceiling, increased cloud coverage, snow storms, etc.<sup>Pq</sup> Hydroplaning during take-off and landing due to rainfall increase.<sup>f</sup> Runway length becoming too short for take-off and landing due to reduction in air density (reduced aircraft lift).<sup>stuv</sup> Potential increase in the risk of bird strikes and avian ingestion.<sup>wx</sup></li> <li>- <b>Rail:</b> Obstruction of rail tracks by fallen trees, buildings, and vehicles due to strong winds. Trains pushed off-track due to strong winds.</li> <li>- <b>Road:</b> Obstruction of roads by fallen trees, buildings and vehicles due to strong winds. Vehicles pushed off-road due to strong winds.</li> <li>- <b>Water:</b> Reduced navigability of rivers and channels due to increased silt deposits, reduced clearance under waterway bridges, floating debris, and clogging from aquatic vegetation growth accelerated by heat. Increase in navigable water depths for coastal ports and shipping channel. (NB: this can also contribute to water allocation conflicts.)</li> </ul> <p><b>Unsafe weather such as high winds can prevent airport ground staff from loading planes with baggage and catering, thus delaying take-off</b></p> <p><b>High temperature can increase energy demand for cooling, resulting in higher operational costs. Reduced access to water and higher water prices can increase operational costs.</b></p>	<p><b>Map areas at risk and highly vulnerable, e.g. for flooding</b></p> <ul style="list-style-type: none"> <li>- <b>Plan for evacuation &amp; emergency response:</b> Develop emergency management plans and response programmes for disruptions</li> <li>- <b>Rail:</b> Develop passengers' evacuation plans for underground systems; Improve warning and update systems for dispatch centres, crews and stations</li> <li>- <b>Road:</b> Develop evacuation plans for extreme events; Install signs to warn drivers and pedestrians of zones at risk</li> <li>- <b>Adapt crisis-management system</b> to cope with increased frequency and intensity of extreme events and incremental changes of the climate</li> <li>- <b>Avoid/restrict development of new infrastructures in high-risk areas</b></li> <li>- <b>Anticipate and plan back-up processes</b></li> <li>- <b>Increase efficiency of systems to reduce energy and water demand</b></li> </ul>

*continued >*

# Global Transport: Impacts and Actions

> *continued*

Impact Area	Risk / Opportunity	Adaptation action
Logistics & supply chains 	<p><b>Disruption to utility, fuel and spare parts supply can affect business operations, leading to lost revenues</b></p> <ul style="list-style-type: none"> <li>- <b>Road:</b> Energy supply failure affecting signalling equipment</li> <li>- <b>Water:</b> Energy supply failure restricting port operations</li> <li>- <b>Air:</b> Energy supply failure or severe weather disrupting flight and/or airport operations</li> </ul> <p><b>Linkage to other transport systems, e.g. PRD failures affecting Hong Kong</b></p> <p><b>Disruption of transport of raw materials and finished products can affect supply chains of other sectors</b></p>	<ul style="list-style-type: none"> <li>- <b>Plan alternatives:</b> Diversify supplies of key services (energy, water and communication) and spare parts</li> <li>- <b>Raise awareness and build resilience</b> with key suppliers</li> <li>- <b>Build contingency plans</b> to maintain customer service / enhance customer support in times of disruption from natural disaster</li> <li>- <b>Plan alternatives:</b> Plan alternative routes; Install redundant systems</li> </ul>
People 	<p><b>Disruption to passenger transport can impact work force availability across all sectors</b></p> <p><b>Heat exhaustion for vulnerable passengers and staff due to increased temperature can result in travel disruptions and dissatisfied customers</b></p>	<ul style="list-style-type: none"> <li>- <b>Plan alternatives:</b> Plan alternative modes of transport and routes. Decentralise staff and station staff in hubs</li> <li>- <b>Coordinate</b> with alternative routes</li> <li>- <b>Plan adaptive measures to ensure staff is available when needed</b></li> <li>- <b>Adapt cooling systems:</b> Improve air conditioning for underground networks, stations/airports/ports and/or trains</li> <li>- <b>Provide cold beverages when needed</b></li> <li>- <b>Develop hot weather contingency plans</b></li> </ul>

<sup>n</sup> – Project Performance Corporation, AEA Group (2012), pg 6/18  
<sup>o</sup> – Transportation Research (2011), pg 46/64  
<sup>p</sup> – Japan International Cooperation Agency (2011), pg 260/321;  
<sup>q</sup> – Gatwick Airport Limited (2011), pg 26 & 27 / 52

<sup>r</sup> – Japan International Cooperation Agency (2011), pg 260/321  
<sup>s</sup> – Project Performance Corporation, AEA Group (2012), pg 6/18  
<sup>t</sup> – ICF International (2009), pg 22/25  
<sup>u</sup> – Japan International Cooperation Agency (2011), pg 260/321

<sup>v</sup> – Transportation Research Board (2011), pg 8/64  
<sup>w</sup> – Gatwick Airport Limited (2011), pg 26 / 52  
<sup>x</sup> – Japan International Cooperation Agency (2011), pg 260/321

# ENERGY GENERATION

## Hong Kong View: Energy Impacts

Impact area(s)	Risk / Opportunity	Potential Adaptation Actions
 <b>Assets &amp; Operations</b>	<ul style="list-style-type: none"> <li>- Reduction in/disruption of electricity and town gas service due to damaged production plants, transmission or distribution assets</li> </ul>	<ul style="list-style-type: none"> <li>- Protect existing infrastructure</li> <li>- Train staff for extreme situations</li> <li>- Build climate resilience into new assets</li> <li>- Evaluate resilience to likely climate risks for insurance purposes, and take cost-effective actions</li> </ul>
 <b>Process &amp; Markets</b>	<ul style="list-style-type: none"> <li>- Unexpected fluctuations in electricity demand</li> <li>- Heat-induced reduction in efficiency of electricity generation equipment</li> </ul>	<ul style="list-style-type: none"> <li>- Build additional generating capacity</li> <li>- Develop and deploy new products and technologies to help cope with fluctuations in demand</li> </ul>
 <b>Logistics</b>	<ul style="list-style-type: none"> <li>- Disruption of fuel and/or process water supply</li> <li>- Volatility of quality, price and availability of fuel and/or process water</li> </ul>	<ul style="list-style-type: none"> <li>- Diversify supplier base</li> <li>- Build additional (local) storage capacity. Change cooling system (water vs. air based)</li> </ul>
 <b>Market Opportunity</b>	<ul style="list-style-type: none"> <li>- New market opportunities emerging from a growing preference for renewable, rather than carbon-based, power</li> </ul>	<ul style="list-style-type: none"> <li>- Invest in renewable energy assets and related businesses</li> <li>- Use new experience and diversified portfolio to assist regulators in creating more climate resilient markets</li> </ul>

# Energy Generation

## Sector Perspective

**The energy sector is foundational to sustaining economic activity.** Both developed and developing economies are hugely dependent on energy in many forms, e.g. to produce healthy agricultural yields, to ensure functional transport networks, to manufacture goods and to cool buildings. The focus in this section is on generation, transmission<sup>y</sup> and distribution of electricity and town gas\*.

Like transport, energy generation and distribution assets are large and expensive, and have long productive lives. Given this life span it is critical to build resilience into both existing assets and new infrastructure.

**Climate change** affects both energy companies and their customers. Energy companies' assets may be battered by severe weather, or cut off from needed fuel and chemical supplies by floods or other disruptions to the transport network. Regulation of carbon-intense fuels – through taxes or trading – is planned or ongoing in Korea, China, Taiwan, Australia and elsewhere. Hong Kong may follow. Such systems necessitate recalibration of the business models of

energy-intensive companies, as well as energy companies themselves.

**Impacts are multiplied** by customer dependency. In the warm, wet climate of southeast Asia, cooling and pumping are most urgently needed during severe storms: just when infrastructure is most likely to be interrupted. For example, an increase in the ambient temperature of 1°C in Hong Kong would induce a jump in electricity consumption by 9.02%, 3.13% and 2.64% in domestic, commercial and industrial sectors respectively. Rising fuel prices and the multiplier effect of Heat Island Effect could make these increases even larger. Moreover, pumping of floodwater following storms or very high tides puts an additional strain on the electricity supply at a sensitive moment.

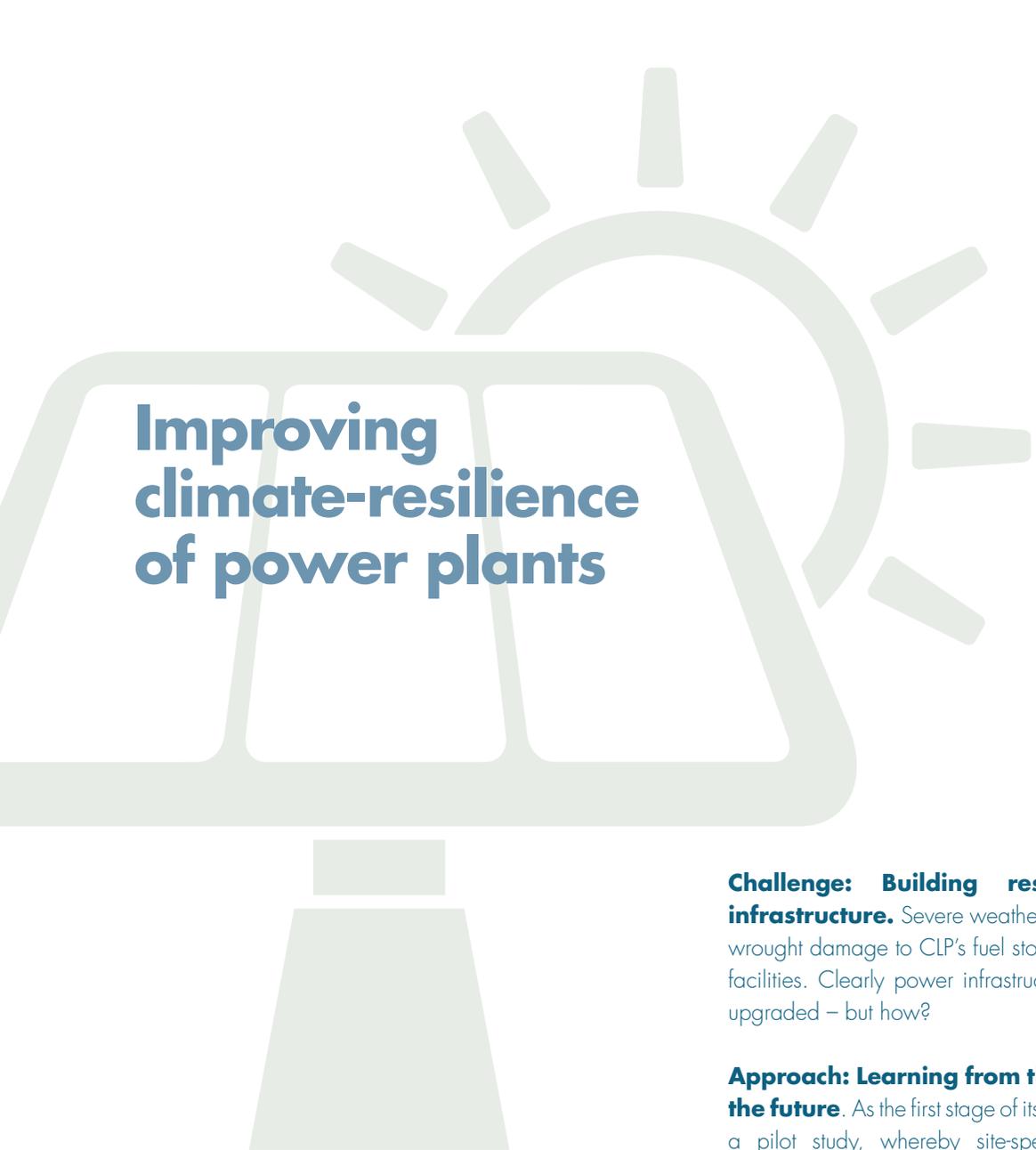
Town gas shows similar dependences. For example, infectious disease due to climate change could increase the need for town gas from the hospital sector. On the supply side, too much water (flooding) could threaten production and maintenance operations while too little

water could increase the cost of town gas production.

Energy companies can expect greater fluctuation, or variability, in demand as the climate changes. They can also expect steep growth. The International Energy Agency projects a 45% surge in global energy demand between 2006 and 2030, with China contributing to over a third of this increase<sup>z</sup>.

**Asset ownership** also complicates the picture, with generation, transmission and distribution facilities potentially owned by different entities with varying degrees of influence in the market. In China, for example, the government owns the transmission and distribution networks, which power companies use to deliver electricity. Building resilience into the entire network requires collaboration and agreement on timing, investment levels and paybacks: a challenging proposition.

<sup>y</sup> – Transmission is a term applicable only to electricity supplier  
<sup>z</sup> – *New Energy Realities – World Energy Outlook 2008*, International Energy Agency, 2008, referenced at [http://iea.org/press/pressdetail.asp?PRESS\\_REL\\_ID=275](http://iea.org/press/pressdetail.asp?PRESS_REL_ID=275).  
 \* – Town gas in this context refers to the gas itself, not the Hong Kong-based company Towngas, which is the sole provider of in Hong Kong



## Improving climate-resilience of power plants

**Challenge: Building resilience into critical infrastructure.** Severe weather events in Taiwan and India wrought damage to CLP's fuel storage and power generation facilities. Clearly power infrastructure resilience needs to be upgraded – but how?

**Approach: Learning from the past & planning for the future.** As the first stage of its process, CLP commissioned a pilot study, whereby site-specific assessments for two power plants previously affected by extreme meteorological conditions were conducted. The risk of physical impacts from past and potential future weather and climate changes were quantified and potential adaptation measures and their

associated costs identified. The results were used to develop the business case for selecting and implementing appropriate adaptation measures. CLP is now expanding the study to cover more of its portfolio with the aim of ultimately developing a strategy to improve climate resilience of not just existing plants but future ones as well.

# Global Energy Generation: Impacts and Actions

Impact Area	Risk / Opportunity	Adaptation action
<p>Assets &amp; Operations</p> 	<p><b>Assets damage or capacity reduction can lead to more downtime, service interruptions, increased repair and maintenance bills, higher depreciation and lost revenues</b></p> <ul style="list-style-type: none"> <li>- Damage can be caused by typhoons, storm surges, flooding, soil saturation and the scouring action of rain/high rivers and canals, erosion, landslides, increasing soil moisture levels, weathering, subsidence, landslides, salt penetration, and droughts</li> <li>- Generation, transmission and distribution facilities can be affected, as well as the fuel supply chain</li> </ul> <p><b>Excessive heat can impact the efficiency and performance of equipment, leading to decreased output and loss of revenues, increased repair and maintenance bills, reduction in asset life time and higher depreciation</b></p> <ul style="list-style-type: none"> <li>- Impacts are mostly on efficiency and performance of turbine (reductions in thermal efficiency and power output), cooling systems, compressors, pumps, and generators. Increased cooling is needed.</li> </ul>	<ul style="list-style-type: none"> <li>- <b>Install or improve protective structures:</b> Install or improve flood defence measures including hard flood defences, 'set-back' flood defences, and removable temporary flood barriers. Raise floor levels in buildings housing critical infrastructure. Increase height of overhead cables. Replace underground cables with larger cables.</li> <li>- <b>Build or improve drainage infrastructure</b> to cope with greater rainfall intensity and install sustainable drainage systems to reduce rapid runoff</li> <li>- <b>Adapt material and equipment specification</b> to give preference to those which demonstrate resilience to extreme weather</li> <li>- <b>Install additional cooling plants</b></li> <li>- <b>Re-examine or purchase insurance policies</b> to cover flood/severe weather damage, business continuity and disruption</li> <li>- <b>Review and improve evacuation procedures</b></li> <li>- <b>Raise awareness and train staff</b> on risks and response strategies</li> <li>- <b>Build resilience in the planning stage:</b> Consider climate risks in planning the location of new facilities. Allow for incremental change in design. Assess critical thresholds in planning/design.</li> </ul>
<p>Markets</p> 	<p><b>Changes in the climate can lead to fluctuations in energy demand</b></p> <ul style="list-style-type: none"> <li>- Increases in the demand or variability of demand for electricity may result from heat waves, urbanisation, and extra electricity needed for desalination and recycling or pumping water (e.g. for agriculture or after floods)</li> <li>- Regulations to de-carbonize business operations and the electricity fuel mix, such as carbon trading or taxing schemes, will affect prices in the short term and lead to refined business models in the medium term</li> </ul>	<ul style="list-style-type: none"> <li>- <b>Build additional generating capacity:</b> Consider smart grids, sub-metering, and renewable energy generation options including distributed generation.</li> <li>- <b>Develop and deploy new technologies</b> such as smart grids to accommodate renewable energy sources. Equip existing grids with intermittent generation capacity, green stand-alone generators and surge protection products. Offer products and pricing to help commercial and domestic customers predict and monitor their use to smooth peak demand and better manage supply.</li> <li>- <b>Influence demand:</b> Provide tariff incentives and information on consumption and price to minimize/smooth costly peaks in demand</li> <li>- <b>Implement new control systems that allow customers</b> to monitor their usage for efficiency, and to generate energy on site</li> <li>- <b>Adapt maintenance programmes</b> to ensure output during hot summers</li> </ul>

[continued >](#)

# Global Energy Generation: Impacts and Actions

Impact Area	Risk / Opportunity	Adaptation action
<p>Logistics &amp; supply chains</p> 	<p><b>Disruption of transport and delivery of fuel to power plants can jeopardise generation activities</b></p> <p><b>Disruptions to supply of other off-site utilities (communication, water and waste treatment) can also impact the operation of power plants</b></p> <p><b>Cooling water is a critical resource at many power plants.</b> Plant owners should be wary about competing with urban centres, agriculture and mining for scarce water supplies – especially in drought-ridden China.</p>	<ul style="list-style-type: none"> <li>- <b>Plan alternatives: Diversify supplier base.</b> Provide additional storage capacity for products and raw materials on site or in alternative location to hedge against disruption of supply. Install additional local fossil fuel storage capability; develop corporate supply chain to remove dependence on third parties. Revise regulations on fuel supply to facilitate diversification of sources.</li> <li>- <b>Purchase insurance policies</b> covering flood damage, business continuity and disruption</li> </ul>
<p>Market Opportunity</p> 	<p><b>Unpredictability in the availability or quality natural resources (fuel, water, wind) may increase commodity prices and hence operational costs, leading to restrictions in resource use and conflicts with communities. Alternatively, resource changes can create opportunities for new generation capacity.</b></p> <ul style="list-style-type: none"> <li>- Volatility of commodities markets and/or reduced supply of fossil fuel is likely to increase wholesale and retail energy prices</li> <li>- Competing water demands along the Dongjiang River in Guangdong Province, from cities, manufacturing, agriculture, and power generation, can place both the quantity and quality of fresh water at risk</li> <li>- Reduced river flows can result in restrictions on water extraction for cooling and reduced resource availability for hydropower, e.g. in Sichuan Province, China</li> <li>- Increased water resources in some regions of the world can open potential for hydropower development. Changes in wind patterns might affect wind power production. New market opportunities will emerge from a growing preference for renewable, rather than carbon-based, power</li> </ul>	<ul style="list-style-type: none"> <li>- <b>Change cooling systems</b> (air-cooled vs. water cooled systems, fresh water vs. sea water, closed system / water reuse)</li> <li>- <b>Install additional local fossil fuel storage capability</b></li> <li>- <b>Build new generating capacity</b> using newly available resources</li> <li>- <b>Monitor levels of resources</b> (e.g. hydrological resources)</li> <li>- <b>Adapt generation:</b> e.g. for hydropower use other water resources, pump water back upstream</li> <li>- <b>Work with Government</b> on a total water management system that is aligned with planning time horizons</li> <li>- Ensure <b>sufficient natural resources</b> (especially water) are available over the lifetime of new assets and are used / reused efficiently</li> </ul>
<p>People</p> 	<p><b>Heat stress, climate induced diseases affecting employees and inability to reach the workspace (e.g. due to transport system failure) can result in decreased productivity and disruption of operations</b></p>	<ul style="list-style-type: none"> <li>- <b>Revise health and safety policies and risk assessments</b> to address implications of changing climatic conditions on operations</li> <li>- <b>Adapt cooling systems</b></li> <li>- <b>Build capacity for off-site monitoring / control of assets</b></li> </ul>



# CONSTRUCTION

## Hong Kong View: Construction Impacts

Impact area(s)	Risk / Opportunity	Potential Adaptation Actions
 <b>Logistics &amp; Operations</b>	<p>Increased construction costs due to fluctuations in:</p> <ul style="list-style-type: none"> <li>- the availability, quality and price of raw materials/commodities</li> <li>- the price of electricity</li> </ul>	<p>Research potential impacts of climate change on raw materials and energy to reduce uncertainty</p> <p>Build resilience in supply chains</p> <p>Adapt processes to reduce consumption and increase water efficiency</p> <p>Initiate energy and resource-efficiency programs to lessen exposure to cost or availability problems</p>
 <b>People</b>	<p>Decrease in work-hours and productivity due to higher temperatures, heavy rainfall and severe weather</p>	<p>Implement alternative construction strategies</p> <p>Revise labour and welfare standards and relevant contract provisions (e.g. working hours, beverages &amp; cooling opportunities on site, incentives for managers to look after the health &amp; welfare of their teams)</p>
 <b>Finance</b>	<p>Increase in claims for indemnities due to damaged to construction works (buildings, civil structures) or longer lead times due to storms or excessively hot weather</p>	<p>Consider resilience in site management during storm season</p> <p>Calculate likely number of storm days into delivery period (negotiate with property developer / client)</p>
 <b>Market Opportunity</b>	<p>Increased demand for drainage and sewage works, desalination plants, infrastructure reinforcement, installation of protective structures, and improvement of building isolation, heating and cooling</p>	<p>Monitor market developments to be well positioned for new work</p>

# Construction Sector Perspective



**The construction sector\*** is both an indicator of economic confidence and growth, and a harbinger of whether an economy has taken a low-carbon path. Construction decisions are a product of regulatory rules and developer demand, which together establish the parameters for building materials, design and resilience.

**Building resilience into infrastructure and buildings** is critical to withstanding weather variability and stress. However, the construction sector faces challenges in considering climate change adaptation, including:

- **Too little client focus.** Client demand to minimise programme (planning & building) time can mean insufficient time for collaboration between construction teams and their clients during building design and material specification;
- **Short term interest in the project.** Construction companies tend to be commercially involved in the construction phase only, and thus lack the incentive to advocate for the long-term climate resilience of the project; and

- **Safety comes first:** A pressing (and necessary) focus on the safety of construction workers is a primary on-site priority. To the traditional list of safety concerns is now added heat stress from climate change.

**Developers and property managers** could drive for adaptation in the construction sector. For example, a developer focus on building insurance, along with an increasingly sophisticated insurance appraisal process, could ensure that sub-standard architecture and construction is devalued or rejected by the market. Similarly, facilities owners and property managers can act as ombudsmen, as they will bear the brunt of risk and cost should a building fail to withstand severe weather.

**To leverage climate opportunities,** construction companies can anticipate and prepare for demand for additional drainage and sewage, desalination plants, reinforcement of civil structures and transport infrastructure, installation of protective structures, and improvement of building isolation, heating and cooling.

In fact, adaptation will not start from scratch. Current disaster management systems and know-how amongst construction companies provide a solid platform for adaptation actions.

\*For the purposes of this discussion, the construction sector includes engineering and physical construction but excludes development and property management functions, which are covered in the property sector.





## Climate adaptation means a better working environment

### **Challenge: Taking care of business when the heat and humidity are on.**

Construction workers bear the brunt of climate change firsthand: when the outdoor temperature exceeds 31 °C and humidity is high, enclosed workplaces are even more extreme. The situation is getting worse as the humidex (combination of heat and humidity) gradually increases and the number of hot / humid days annually rises. Heat stroke and heat exhaustion are amongst the risks; as workers age, the risks increase. Yet the Hong Kong construction industry and its workers have little provision to accommodate slowing down work due to hot and humid weather. Thus at present workers bear the cost as well as the discomfort.

**Approach: Put workers first.** Gammon's findings on hot weather working conditions led the Construction Industry Council to issue guidelines for the Hong Kong construction industry in June 2008. Whilst adopted by certain government and MTR contracts, they remain voluntary.

Gammon's own humidex adaptation strategy is taking action to safeguard worker health and comfort. Gammon mandates additional breaks, ensures workers are properly hydrated and is increasing free blood pressure checks and health evaluations for workers on site. The company also provides designated protected areas for workers to re-hydrate and rest.



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# Global Construction: Impacts & Actions

Impact Area	Risk / Opportunity	Adaptation action
Logistics and Operations 	<p><b>Fluctuations in the availability, quality and price of raw materials and energy can increase construction costs.</b></p> <p>The construction industry is a large water user. <b>Stress on water resources can lead to delays in construction and delivery</b></p> <p><b>Disruption of construction activities</b> (especially processes dependent on environmental conditions, e.g. laying concrete, asphaltting, operating tower cranes) <b>can result in construction delays and higher costs</b></p> <p><b>Intense rainfalls can pollute sites and water courses when the drainage systems on-site are not completed</b></p>	<ul style="list-style-type: none"> <li>- <b>Research potential impacts of climate change on raw materials and energy to reduce uncertainty</b></li> <li>- <b>Consider potential impacts in the planning stage of projects</b></li> <li>- <b>Build resilience into supply chains.</b> Expand supplier base. Build redundancy amongst at-risk suppliers of critical components or services. Source material locally. Build resilience within existing suppliers by encouraging them to assess climate risk / make appropriate investments, and by ensuring the interface with suppliers is robust in times of extreme weather.</li> <li>- <b>Adapt processes</b> to reduce consumption and increase water efficiency</li> <li>- <b>Develop new technologies/materials and processes</b></li> <li>- <b>Improve sheltering provisions</b></li> <li>- <b>Build bunds to protect site water courses</b></li> <li>- <b>Build additional onsite capacity for storm water retention and drainage</b></li> </ul>
People 	<p><b>Heat stress, heavy rains and climate induced diseases can affect employees' productivity on site, and may prevent them from coming to work, leading to delays and increased costs</b></p> <p><b>Heightened UV exposure for workers may increase the incidence of skin cancer</b></p>	<ul style="list-style-type: none"> <li>- <b>Implement alternative construction strategies</b> that allow staff to work under extreme heat and weather, such as prefabrication and off-site construction, and provision of on-site shading, ventilation, and cooling. Anticipate and manage delays through contractual agreements.</li> <li>- <b>Cooperate with Government</b> to establish laws and regulations on labour welfare standards (e.g. to work restrictions and welfare requirements under certain weather/heat conditions) and relevant contract provisions (e.g. to allow for extension of time under certain climatic conditions)</li> </ul>
Markets 	<p><b>Demand for climate resilient products, such as heat/water/impact resistant materials and low-embodied energy and low-embodied carbon materials, transport types/miles, and building designs is likely to increase</b></p> <p><b>Demand for climate-resilient infrastructure and desalination plants</b></p>	<ul style="list-style-type: none"> <li>- <b>Monitor the market</b> to position the company to benefit from new markets (e.g. increased demand for drainage works, reinforcement of civil structures, installation of protective structures, construction of desalination structures)</li> <li>- <b>Develop new climate resilient designs, products, and projects</b></li> </ul>

[continued >](#)

# Global Construction: Impacts & Actions

Impact Area	Risk / Opportunity	Adaptation action
Process 	<p><b>Disruption of construction activities</b> (especially processes dependent on environmental conditions, e.g. laying concrete, asphaltting, operating tower cranes) <b>can result in construction delays and higher costs</b></p>	<ul style="list-style-type: none"> <li>- <b>Develop new technologies/materials and processes</b></li> <li>- <b>Improve sheltering provisions</b></li>   <li>- <b>Build bunds to protect site water courses</b></li> <li>- <b>Build additional onsite capacity for storm water retention and drainage</b></li> </ul>
Assets 	<p><b>Finished buildings and infrastructure are vulnerable to climate events if risks are not properly addressed at construction stage. This might lead to increased liabilities, indemnity claims and insurance premiums for construction companies.</b></p> <p>Damage can be caused by high winds, flooding, soil saturation and the scouring action of rain/high rivers and canals, erosion, landslides, increasing soil moisture levels, weathering, subsidence, landslides, and salt penetration</p> <p><b>Damage to building material, equipment, sites and vehicles can lead to delays and loss of revenues</b></p>	<p><b>Consider potential impacts in the planning stage:</b></p> <ul style="list-style-type: none"> <li>- <b>Location:</b> avoid construction in high risks areas (flood plains, coastal areas, areas prone to subsidence, etc.)</li> <li>- <b>Site layout:</b> design foundations and underground pipework to cope with subsidence and heave caused by soil shrinkage and swelling</li> <li>- <b>Structure:</b> design and build more aerodynamically efficient structures that assist in minimising wind loads</li> <li>- <b>Materials:</b> develop understanding of the fundamental principles of materials' behaviour and building physics under various climatic conditions (extreme but also higher temperatures, UV radiation, rainfall). Use materials resistant to UV, high temperatures and water. For cyclones: use impact-resistant building materials, better window design, improved fixing systems, aerodynamic building designs that reduce deflection and resonance, and better planning to avoid tunnel effects. For intensive wind storms: employ new roofing technologies</li> <li>- <b>Drainage:</b> design to ensure water can easily escape once flooding has subsided. Consider multiple occurrence flooding in the design stage</li> <li>- <b>Use of the natural environment:</b> conserve or introduce natural barriers to climate disruption, eg trees or mangroves to prevent soil erosion, canals or ponds to capture and reprocess water, etc.</li> <li>- <b>Review/purchase insurance</b> covering transport infrastructure and vehicles</li> <li>- <b>Improve sheltering</b> of building materials, equipment and vehicles</li> </ul>



# PROPERTY

## Hong Kong View: Property Impacts

Impact area(s)	Risk / Opportunity	Potential Adaptation Actions
 <b>Assets</b>	Damage to buildings and reduction in durability of building materials can decrease property value	Build climate change into the risk assessment process for property acquisition Consider measures to reduce risks when refurbishment is planned
 <b>Logistics</b>	Higher energy and water prices can increase costs	Implement electricity and water conservation measures
 <b>Market Opportunity</b>	Higher demand for climate resilient and thermally efficient properties by large commercial occupiers could lead to higher rents, effectively increase the value of resilient buildings	Build a climate resilient property portfolio Communicate the climate resilience benefits of buildings to prospective and current tenants

# Property Sector Perspective

**The property sector**, whose growth reflects growing affluence and population in Asia, both impacts the environment and is impacted by it. Hong Kong, like other coastal cities, is vulnerable to the powerful combination of sea level rise and storm surge. A recent OECD<sup>aa</sup> report finds that 6 of the top 10 port cities at a risk of climate change are in Asia (including India); Hong Kong is #12<sup>bb</sup>. The financial costs of property damage are rising not only with climate variance, but also with the growth in coastal property investment.

The factors driving higher property repair and replacement costs – including cost of land and government policies – make climate change an even more expensive phenomenon.

**Climate change impacts** property not only during extreme weather, but also in normal circumstances. For example, insurance companies are starting to take geographic location and physical resilience into account when writing policies, and companies with large data centres are beginning to inquire as to a building's suitability to withstand external shocks.

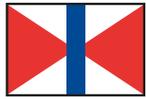
**A lack of incentives and information** hamper action in the sector. One challenge is the focus on short-term return on investment capital. Another is the lack of location-specific data on future climate impacts. It is currently difficult to predict with certainty over the medium to long term. Thus while the life of a building (30-50 years or longer) suggests it will be subject to increased climate pressure, building owners have generally not considered this impact.

**To leverage climate opportunities**, building owners can incorporate likely climate pressures into their design and retrofit projects, and make this investment public, inviting interested tenants to pay rental premiums for this assurance. It is already established that "green" buildings reap a market premium in developed economies. Sustainable building accreditation standards, like BEAM Plus in Hong Kong, adopt a building life cycle management approach, focusing on site issues, material uses, energy and water savings, and indoor environmental quality. These qualities essentially address climate mitigation. Adding resilience – e.g. climate adaptation - could offer risk-sensitive occupants

peace of mind and also help protect rental income and value over time.

<sup>aa</sup> – Ranking Port Cities with High Exposure and Vulnerability to Climate Extremes, OECD Working Paper #1, 19 Nov 2008 at <http://www.oecd-ilibrary.org/content/workingpaper/011766488208>

<sup>bb</sup> – Hong Kong's exposure to climate-induced damage at the time of the report was valued at \$36 billion USD.



# SWIRE PROPERTIES

**Challenge:** Conserving water is an everyday need. Hong Kong depends on China for the majority of its water, yet fresh water is becoming an increasingly scarce and therefore valuable resource in Mainland China. This scarcity has led some users in Hong Kong to begin preparing for higher prices and restricted availability.

**Approach: Conservation & alternatives:** In a bid to set a positive example and reduce its environmental impact, Swire Properties uses sea water rather than fresh water in its cooling chiller equipment, which demands a large amount of water in its daily operations. This initiative led to a saving of over 46 million m<sup>3</sup> of fresh water in 2011. Swire Properties also collects rainwater and air conditioning condensate from

some facilities for use in landscaping, cooling tower make-up or flushing. Furthermore, Swire Properties has extended its water conservation practices to its China projects. For instance, at TaiKoo Hui, the company's largest investment property in Mainland China to date, the rainwater collection system for the cooling tower water supply will save up to 3,112 m<sup>3</sup> of fresh water per year. At the same time, 6,200 m<sup>3</sup> of fresh water will be saved through the recycling of air conditioning condensate for flushing. Greywater reuse will save another 380 m<sup>3</sup> per day, amounting to nearly 140,000 m<sup>3</sup> annually.

## Preparing for the future





## Global Property: Impacts & Actions

Impact Area	Risk / Opportunity	Adaptation action
<p>Assets</p> 	<p><b>Incremental changes and extreme events can damage buildings in the short term and affect their durability in the long term, leading to:</b></p> <ul style="list-style-type: none"> <li>- <b>Loss of occupancy or occupier dissatisfaction</b></li> <li>- <b>Increased capital expenditures, operational and maintenance costs</b></li> <li>- <b>Lower capital values and rental yields</b></li> <li>- <b>Reduced asset life</b></li> <li>- <b>Increased price / decreased options for property insurance</b></li> <li>- <b>Ultimately, decreased returns and value for the property.</b></li> </ul> <p><b>Effects on buildings can include:</b></p> <ul style="list-style-type: none"> <li>- <b>High temperatures</b>, solar and UV radiation on paintwork, exterior finishes and materials (concrete joints, steel, asphalt, and protective cladding), foundation (ground contaminants becoming more active)</li> <li>- <b>Subsidence and heave</b>, especially in densely populated areas with soils that easily shrink, like clay</li> <li>- <b>Heavy rains and flooding</b>, especially in urban locations where drainage systems are unable to cope. Post-storm drainage challenges affect the accessibility of roadways and properties.</li> <li>- <b>Wind, storm and cyclones:</b> which damage property structure or the erosion of hillsides around them</li> <li>- <b>Increase in pest infestations</b></li> </ul>	<ul style="list-style-type: none"> <li>- <b>Assess own risks and risk of tenants and utility providers</b></li> <li>- <b>Build climate resilience into the overall risk assessment for property acquisition</b></li> <li>- <b>Consider measures to reduce risks when refurbishment is planned (e.g. rainwater harvesting, green roofs, permeable paving)</b></li> <li>- <b>Engage with tenants to raise awareness, assess and manage risks</b></li> <li>- <b>Communicate building climate resilience to prospective tenants</b></li> <li>- <b>Make physical changes and report these to attain lower premiums when purchasing insurance</b></li> </ul>
<p>Markets</p> 	<p><b>Higher demand for climate resilient and thermally efficient properties by large commercial occupiers could lead to higher rental income and increase the value of the property</b></p> <p><b>Climate change can have both positive and negative effects on the tourism industry</b>, making some destinations more attractive and others less so and perhaps increasing the effect of seasonality. Impacts will be felt by the hotel, bar and restaurant sectors, as well as supporting sectors (retail shopping, taxi service, etc.).</p>	<ul style="list-style-type: none"> <li>- <b>Build a climate resilient property portfolio</b> to gain early mover advantage</li> <li>- <b>Communicate</b> climate resilience of buildings to current and potential tenants</li> <li>- <b>Analyze and invest</b> in tourist-friendly businesses in areas likely to benefit from climate change; divest from those most likely to be at risk</li> </ul>

*continued >*

# Global Property: Impacts & Actions

Impact Area	Risk / Opportunity	Adaptation action
Logistics and Operations 	<ul style="list-style-type: none"> <li>- <b>Higher electricity and water prices as well as higher electricity and water demand can increase operational costs</b></li> <li>- <b>Demand for cooling increases. Related capital and operational costs, especially for old buildings, increase. Performance criteria and compliance with energy efficiency requirements is impacted.</b></li> </ul> <p><b>Damage and disruption to infrastructure (transport systems, energy supply, water supply, sewerage, urban drainage systems, construction activities and supply chains) can impact rental income and asset value.</b>            Ensuring that occupiers are not affected by disruptions to essential services requires additional investment (e.g. installation of back-up).</p>	<ul style="list-style-type: none"> <li>- <b>Implement electricity and water conservation measures in existing properties</b></li> <li>- <b>Work with construction companies to integrate design methodologies, especially in new buildings:</b> <ul style="list-style-type: none"> <li>• Use passive design strategies - thermal mass, insulation, external shading, cross ventilation</li> <li>• Incorporate renewable energy and/or energy efficient technologies - green roof and roof design technology, PC glazing, low heat producing lighting, equipment and plant; PV, solar, biomass and wind-powered cooling technology; co-generation technology, including waste heat capture technology</li> <li>• Install water efficient systems (dual-flush toilets, aerated tap fittings, showers, appliance)</li> <li>• Recycle water, use rainwater</li> <li>• Introduce green walls, green or white roofs, and other features that reduce the need for cooling</li> </ul> </li> <li>- <b>Consider resilience of the main utility suppliers in the risk assessment exercise</b></li> </ul>
People 	<p><b>High temperatures can lead to overheating of buildings.</b> Over-heating of indoor space is exacerbated by the urban heat island effect, which is due to continue as urban centres become denser and require more cooling.</p> <p>Commercial properties could suffer difficult working conditions, with heat stress for staff, loss of productivity and potential loss of working days. This can lead to decreased returns and value of the property.</p> <p><b>Water constraints due to droughts can lead to discomfort.</b>            Water constraints/restrictions can impact water use in air cooling units, cleaning, sanitation, drinking water, and irrigation. This can lead to increase in water costs and reduction in return and capital value.</p>	<ul style="list-style-type: none"> <li>- <b>Consider measures to reduce risks of heat stress when refurbishment is planned</b> (green spaces, green roofs, passive solar design, natural ventilation, cooling, shading, improved insulation)</li> <li>- <b>Consider green space and 'blue' infrastructure</b> (e.g. rivers and ponds) to help reduce the urban heat island effect</li> <li>- <b>Consider measures to increase water efficiency</b> (see above)</li> </ul>
Finance 	<p><b>More frequent and more severe weather events can lead to higher insurance premiums, changes in exclusion clauses and difficulty in obtaining insurance and mortgages</b></p>	<ul style="list-style-type: none"> <li>- <b>Disclose risk assessment</b> efforts to lenders and insurers.</li> </ul>



# FINANCE

## Hong Kong View: Financial Impacts<sup>cc</sup>

Impact area(s)	Risk / Opportunity	Potential Adaptation Actions
 <b>Assets</b>	Indirect impacts from damage to customers' assets or operations	<p>Build climate change risk and opportunity screening and assessment into investment appraisal processes and structuring of projects</p> <p>Map risks and scenarios for owned assets and clients' assets</p> <p>Raise awareness about climate change in-house and with clients</p>
 <b>Markets</b>	Damage to reputation, legal liabilities, and loss of investor confidence	<p>Mainstream climate change risk management in processes and practices</p> <p>Move early to attract and retain new staff and clients</p>
 <b>Assets, Operations &amp; People</b>	Damage to built assets, operational disruption	<p>Assess risks of owned assets</p> <p>Invest in corporate energy management</p> <p>Install protective structures around data centres</p> <p>Develop contingency plans for IT systems</p> <p>Brief and train staff</p>
 <b>Market Opportunity</b>	<p>Demand for new climate resilient products &amp; funding for adaptation measures</p> <p>Opportunity to increase brand value by positioning the institution as a leader in climate change adaptation</p>	<p>Develop new products that respond to a changing climate and incentivize adaptation strategies.</p> <p>Generate demand for new products</p> <p>Increase awareness internally and among clients</p>

<sup>cc</sup> – While impacts will differ by location and type of financial institution, most impacts will affect most institutions in some manner.

# Financial Sector Perspective

## The financial sector is a critical, invisible infrastructure under-girding modern economies.

It is particularly well placed to play a key role in enabling adaptation across the economy. At the same time, the financial sector is vulnerable to climate change through both its physical assets and its investment portfolios.

Climate change impacts different financial services providers in distinct ways:

- **Insurers and reinsurers** can be affected by increases in weather related claims that cannot be predicted through the analysis of historical data, and by inaccurate pricing of insurance premiums. Some markets might become uninsurable.
- **Lenders** are exposed to both direct and indirect impacts. Direct impacts manifest themselves through hits on internal operations (e.g. damage to buildings and information technology systems) in times of severe weather, floods, etc. Data storage, processing centres and branches may be particularly vulnerable. Indirect impacts affect lenders through client exposure. Investments, portfolios, and assets

are often in sectors and areas adversely affected by climate change – without this risk being recognized and calculated as such.

- **Asset managers** may be vulnerable to indirect impacts through client exposure (e.g. property sector, commodity markets). Regulatory changes may affect investments.

Many financial institutions provide a multitude of services. For example, HSBC has both a lending business and an asset management business. Such institutions may have multiple types of exposure to climate risks.

Adverse impacts to the financial sector can have disproportionate consequences, affecting entire economies. Thus the industry's skill sets in isolating and assessing risk could productively be turned to climate change impacts on their own operations.

To **increase resilience** across investments and economies, banks and other financial institutions can enable businesses to incorporate climate risk assessments into their investments, offer financing for adaptation projects, promote climate insurance

products, and offer consultancy and risk assessment. Impacts and actions will be specific to and vary amongst the various products and services that the sector offers. However, individual institutions can refine their strategies to protect them and their clients against climate risks.

The sector as a whole can not only play a leading role in enabling adaptation but also can maximize the opportunities offered by climate change. Such opportunities include rainfall insurance in drought-prone regions, climate-related micro-insurance, catastrophe bonds, weather derivatives, consultancy and advisory services to other sectors, climate information products, sustainable development funds that invest in clean technologies, funding of infrastructure resilience projects and other adaptation measures for community resilience to climate change.

# Global Finance: Impacts & Actions

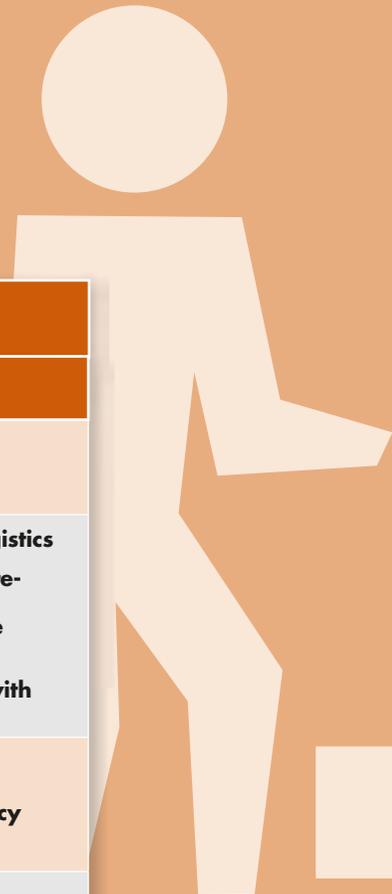
Impact Area	Risk / Opportunity	Adaptation action
<p>Markets</p> 	<p><b>Demand for new climate resilient products &amp; funding for adaptation measures is likely to increase</b></p> <p><b>Positioning the institution as a leader in climate change can increase brand value</b></p>	<ul style="list-style-type: none"> <li>- <b>Develop new products that respond to a changing climate and incentivize climate change adaptation.</b> These include: rainfall insurance in drought-prone regions, climate-related micro-insurance, catastrophe bonds, weather derivatives, consultancy and advisory services to other sectors, climate information products, sustainable development funds that invest in clean technologies, funding of infrastructure resilience projects and adaptation measures for community resilience to climate change.</li> <li>- <b>Research new markets and opportunities</b></li> <li>- <b>Generate demand for new products,</b> e.g. via external outreach and actions to raise clients’ awareness of the impacts of a changing climate through one-to-one consultations, conferences, and research papers</li> <li>- <b>Increase awareness internally.</b> Train staff on climate business opportunities and incentivise them to promote climate business, e.g. through revenue targets. (Note that sustainable, low-carbon or resilient business models may be marketed under other monikers, eg resource efficiency, renewable energy, new materials, etc.)</li> </ul>
<p>Assets &amp; Finance</p> 	<p><b>Impacts to customers can lead to increased exposure, reduced performance and financial losses for investment and lending portfolios and insurance products</b></p> <p><b>This is especially critical for:</b></p> <ul style="list-style-type: none"> <li>- Sectors particularly sensitive to climate (energy, agriculture, water, transportation, tourism, real estate, information and communication technology). In these sectors, costs may rise due to damaged assets or decreased asset performance; to changes in the price, availability or quality of inputs; and to variability of staff productivity. Revenues may decrease due to service disruptions, impacting efficiency and output, and performance of assets. Depreciation rates may increase.</li> <li>- Areas highly vulnerable to climate change (e.g. densely populated coastal regions with weak building codes in areas prone to severe storms; regions vulnerable to water shortages such as India; regions dependent on vulnerable deltas such as the Mekong in Vietnam).</li> <li>- Institutions that both lend and insure. Such institutions may suffer double losses on loan re-payback risk and collateral asset degradation from climate-induced storm damage.</li> </ul>	<ul style="list-style-type: none"> <li>- <b>Promote own and clients’ investments in low-risk sectors and geographic areas.</b> Invest to build climate resilience and/or adaptation (e.g. desalination, water efficiency).</li> <li>- <b>Build climate change into risk and opportunity screening and assessment, investment appraisal processes and structuring of projects</b> on a localised and sector level. For example, develop specific strategies to shift investment away from risky sites and toward climate-resilient areas and assets. Integrate climate change risks in assessment of credit proposal and loan applications.</li> <li>- <b>Require climate risk assessments and safeguards as prerequisite for financing.</b> Adapt or create appropriate benchmarks and investment principles that address climate change.</li> <li>- <b>Map risks and scenarios for own assets and clients’ assets,</b> in relation to ability to pay claims and profitability of investments</li> <li>- <b>Provide financial advisory services</b> to clients seeking to invest in resilience</li> <li>- <b>Raise climate change awareness in-house and with clients</b> and promote risk reduction activities through workshops, training, research notes, assessment tools, and creation of special teams</li> </ul>

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## Global Finance: Impacts & Actions

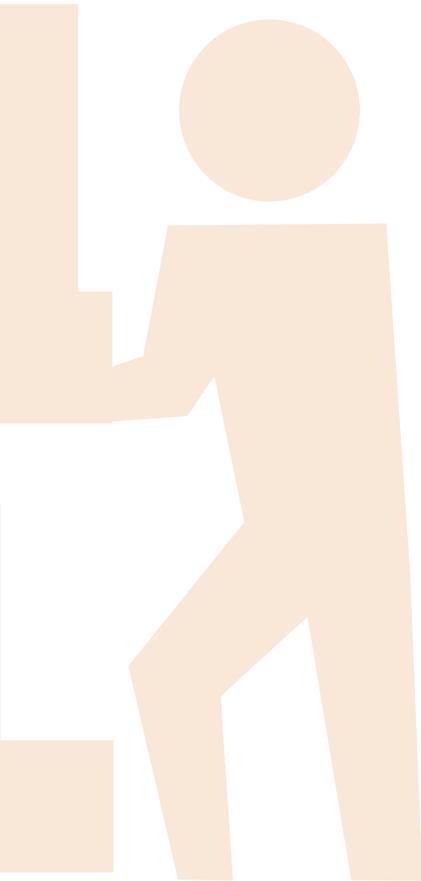
Impact Area	Risk / Opportunity	Adaptation action
<b>Markets</b> 	<p><b>Reputation can be damaged, legal liabilities can increase, and investor confidence can be lost</b></p> <p>Inaction despite sufficient information and knowledge, investment decisions taken/advice given without considering foreseeable impacts, or campaigns against institutions' clients on climate change decisions can damage the reputation of financial institutions</p> <p>Stakeholders' expectations are high. Failure to assess and communicate risk can lead to criticism for supporting non-climate resilient projects, to divestment, to claims of negligence, and to disputes between financial institutions and their clients and/or third parties such as local communities and civil society.</p>	<ul style="list-style-type: none"> <li>- <b>Mainstream climate change</b> risk management in processes and practices</li> <li>- <b>Improve corporate disclosure</b> on climate change risks</li> <li>- <b>Be an early mover</b> to retain and attract new staff and clients</li> </ul>
<b>People</b> 	<p><b>Heat stress, climate-induced disease and inability to reach the workspace can result in decreased productivity and disruption of operations</b></p>	<ul style="list-style-type: none"> <li>- <b>Adapt cooling systems</b></li> <li>- <b>Enable remote working</b></li> <li>- <b>Engage in awareness raising and training</b></li> </ul>
<b>Assets &amp; Operations</b> 	<p><b>Damage to buildings, branch offices, information technology (IT) systems and telecommunication networks can result in potential loss of critical data, missed transactions, disruption to client services and financial losses.</b></p> <p>Critical damage includes blackouts and disruption of data centres due to extreme weather events, reduction in operational efficiency of information technology hardware due to temperature increase, and flooding of office buildings</p>	<ul style="list-style-type: none"> <li>- <b>Assess risks to owned assets</b> and integrate risk analysis into site selection and business continuity planning</li> <li>- <b>Invest in corporate energy management and employee education programmes</b>, implement sustainable building certifications for internal operations to reduce costs and improve brand reputation</li> <li>- <b>Raise awareness about climate impacts</b> with landlords of buildings not owned</li> <li>- <b>Develop contingency plans</b>, including for information technology systems, which recognize and address the changing nature of climate risks</li> <li>- <b>Install protective structures</b> around data centres (e.g. walls), build redundancy in telecommunication networks</li> </ul>

# MANUFACTURING & SUPPLY CHAIN



Hong Kong View: Manufacturing & Supply Chain Impacts		
Impact area(s)	Risk / Opportunity	Potential Adaptation Actions
 <b>Operations</b>	<b>Higher energy demand &amp; prices</b> <b>Decreased water availability</b>	<b>Reduce energy and water consumption</b>
 <b>Logistics</b>	<b>Disruption of transport in &amp; out, i.e. raw materials and finished products</b>	<b>Incorporate redundancy sourcing and logistics</b> <b>Collocate with major suppliers in a climate-resilient facility / area; work with suppliers in vulnerable regions</b> <b>Anticipate and plan for delivery delays with major customers</b>
 <b>Assets</b>	<b>Damage to manufacturing facilities and depots</b>	<b>Install or improve protective structures</b> <b>Build redundancy and develop contingency strategies for critical business operations</b>
 <b>Market Opportunity</b>	<b>Demand for new products/increased demand for existing products (light clothes, emergency preparedness items or personal hygiene products, low-water and energy-efficient products, cooling equipment)</b>	<b>Monitor consumers' attitudes</b> <b>Engage consumers to encourage demand</b> <b>Reposition – adapt existing products and services and develop new ones</b>

# Manufacturing & Supply Chain Sector Perspective



**Manufacturing and supply chain activities** represent more than just one sector: indeed, they underpin the production of products across the economy and across the globe. However, for the purposes of this report we will refer to them as a single economic group (sector).

**Climate change impacts** on the sector are both direct and indirect. Businesses can be directly impacted by disruption to the availability of energy and raw materials, and by severe weather which damages facilities and/or transport systems. At the same time, businesses may experience fluctuation in demand for their products coupled with new demand for more resilient or energy efficient product lines. Individual businesses may invest in resilience to withstand direct impacts, but may find it more difficult to prepare for indirect ones.

**There are strong interdependencies** between this and other sectors such as transport, energy and property. Any impact to these sectors affects the operation of supply chains and manufacturing. Asia is a key sourcing

region and is therefore particularly vulnerable to disruptions happening around the world.

**Significant opportunities** are available to those who invest. In the manufacturing and supply chain sector, this includes building resilience into not only a wholly-owned business, but also those of supply chain partners. Companies which monitor evolving needs and trends and adapt their strategies accordingly will be well placed to benefit from these opportunities.



# Helping its customers adapt

**Challenge: Preparing for a water-scarce world.**

Fresh water resources are under stress around the world from agriculture, as well as industrial pollution and the demands of a growing, and increasingly wealthy, population. Climate change will only exacerbate this stress. How can a chemical company – which relies heavily on water itself – be part of the solution?

**Approach: Water conservation and purification should become business-as-usual.**

In 2011, BASF set two new goals for 2020: BASF intends to reduce the use of drinking water in production processes by half compared with 2010 and establish sustainable

water management at all sites in water stress areas. In 2011, around 21% of BASF production sites were located in water stress areas, and around 6.5% of water used by BASF was extracted from these areas.

In addition, BASF is helping its customers use water more wisely. For the textile industry, the company has created products to significantly reduce water and energy input to fabric printing and dyeing processes. To address the needs of individuals in polluted areas, BASF invented a high performance filter membrane that converts large quantities of dirty water into drinking water. This purification device can be life-saving in regions lacking potable water, or following

natural disasters. In fact, it served this purpose after Cyclone Nargis hit Myanmar in May 2008.



# Global Manufacturing & Supply Chain Impacts & Actions

Impact Area	Risk / Opportunity	Adaptation action
Logistics & Operations 	<p><b>Higher energy demand (e.g. for cooling) and higher energy prices can increase operating costs</b></p> <p><b>Fluctuations in the availability and price of water can impact business operations.</b> Raw material production and manufacturing processes are especially vulnerable in water-intensive industries and water-stressed regions, when combined with increased competition for water.</p> <p><b>Fluctuations in the availability, price and quality of raw materials can affect business operations.</b> This is especially relevant for cotton, leather, wood fibres for paper, natural fats and oils, fossil fuels and other agricultural inputs</p> <p><b>Disruption of transport of raw materials and finished products can lead to delays and loss of revenues</b></p> <p><b>Disruption of essential services such as energy, water and information and communications technology can affect operations</b></p>	<ul style="list-style-type: none"> <li>- <b>Reduce energy and water consumption in facilities:</b> Use more energy and water-efficient technologies and processes. Implement water conservation measures. Develop on-site power generation and combined heat and power generation.</li> <li>- <b>Research/use more sustainable materials</b></li> <li>- <b>Plan alternatives:</b> incorporate redundancy into the sourcing strategy and logistics network: e.g. Work with suppliers and logistics companies in various countries to balance risks; Provide additional storage capacity for products and raw materials; Plan for alternative transport routes.</li> <li>- <b>Work with suppliers in vulnerable regions</b> to raise awareness, assess and manage risks, and promote implementation of adaptive practices</li> <li>- <b>Collaborate with industry peers,</b> e.g. at a sector level to increase the resiliency of the entire value chain</li> </ul>
Assets 	<p><b>Damage to manufacturing facilities and depots, especially in vulnerable areas such as coastal areas and flood plains, can lead to decreased productivity, business interruption and loss of revenues.</b></p> <ul style="list-style-type: none"> <li>- Damage can be due to flooding, soil saturation and the scouring action of rain/high rivers and canals, erosion, landslides, increasing soil moisture levels, weathering, subsidence, landslides, salt penetration, storm surges and typhoons</li> </ul>	<ul style="list-style-type: none"> <li>- <b>Install or improve protective structures</b> such as flood defences</li> <li>- <b>Conduct regular risk assessment for current sites.</b> Monitor weather-related events which could affect facilities.</li> <li>- <b>Consider climate change risks in the planning</b> of new facilities</li> <li>- <b>Purchase property and business interruption insurance</b> to mitigate financial impact of weather related losses</li> <li>- <b>Build redundancy and develop contingency strategies for critical business operations.</b> For example, build the capacity to quickly shift production to other regions should severe weather strike.</li> </ul>
People 	<p><b>Heat stress, climate induced disease and inability to reach the workspace can result in decreased productivity and operational disruption</b></p>	<ul style="list-style-type: none"> <li>- <b>Revise health and safety policies and risk assessments</b> to address implications of changing climatic conditions on assets and operational processes</li> <li>- <b>Adapt cooling systems</b></li> <li>- <b>Train workers to anticipate and prevent / prepare for these stresses</b></li> </ul>

[continued >](#)

# Global Manufacturing & Supply Chain Impacts & Actions

Impact Area	Risk / Opportunity	Adaptation action
<p>Markets</p> 	<p><b>Changes in the climate can shift business and consumers' needs and preferences and affect demand for products</b></p> <ul style="list-style-type: none"> <li>- Increased demand for products that help consumers adapt to extreme weather, such as light clothes, personal hygiene products, cooling equipment systems emergency preparedness items</li> <li>- Increased demand for products that help consumers reduce their water and energy consumption and respond to shortages (or increasing prices), such as low-water and energy-efficient products</li> <li>- Increased demand for design, production and maintenance/ servicing of the above</li> <li>- Reduced demand for some products, such as products that are not energy and/or water efficient</li> </ul> <p><b>Extreme events can impact consumers' purchasing power.</b> This is especially relevant for companies that project a significant growth in vulnerable emerging markets in Asia.</p> <p><b>Polluting companies risk losing reputation and brand value,</b> especially in water intensive industries such as pulp and paper and textile. Such companies may be considered responsible in times of water stress.</p>	<ul style="list-style-type: none"> <li>- <b>Monitor consumer attitudes</b> to anticipate needs related to a changing climate. Move quickly to benefit from the new markets</li> <li>- <b>Engage consumers</b> to increase awareness, promote behavioural change and change demand</li> <li>- <b>Reposition – adapt existing products and services and develop new ones:</b> e.g. clothes adapted to warmer temperatures, energy and water efficient appliances</li> <li>- <b>Communicate openly with regulators, customers and other stakeholders on the assessed risks and planned actions.</b> Should a severe weather event affect operations, respond quickly and in accordance with previously communicated policies and values.</li> </ul>
<p>Finance</p> 	<p><b>Extreme weather events can result in failure to meet contractual obligations</b></p>	<ul style="list-style-type: none"> <li>- <b>Share climate risk assessments and adaptation plans with B2B customers. Revise contract / delivery terms</b> to acknowledge and manage such risks.</li> </ul>

# CONCLUSIONS & RECOMMENDATIONS

# Perception of climate impacts in Hong Kong

## Perception of climate impacts in Hong Kong

Analyzing the key climate impacts in the previous chapter, a number of trends and observations emerge:

- **Impacts are sector-specific.** Companies in a sector share concerns and to some degree, risks. That said, exposure to specific risks vary widely among companies in the same industry depending on their vertical integration and their geographical profile.
- **Risk management usually focuses on capital-intensive assets.** Therefore, it is not surprising that the top identified risks are impacts to hard assets (and, to a lesser extent, processes). Many companies recognise indirect impacts on logistics and markets as well, but consider them less important – until disaster strikes.
- **Extreme weather attracts attention; incremental changes do not.** Companies are beginning to assess risks posed by extreme weather events but show less concern with less perceptible change. Yet even incremental changes often develop in a non-linear fashion. When they reach critical thresholds, costs and capital investment can skyrocket.
- **Most business focus is on risks rather than opportunities. Large companies often have a well defined process to identify risks.** Their approach to identify opportunities, and capitalize on them in the market or in supply chain innovation, is less structured. New product ideas generated by research and development/market intelligence teams rarely include a climate change perspective.
- **Companies' timeframes for assessment differ as a function of operations.** Companies with long-term locked-in assets (and which lack flexibility to move or adapt) are more likely to implement adaptation actions than companies which can wait to act later. This decision in itself represents a risk calculation.
- **More rigour is applied to risk assessment than assessment of adaptation options.** As mentioned above, risks are usually assessed in a structured way; actions taken to build climate resilience not. Part of the challenge is in assessing adaptation investments, since they are often not labelled as such. Part is also likely due to the newness of climate adaptation as a field of inquiry for enterprise investment and risk assessment.
- **Companies are most likely to act once Government has.** Governments can exert influence in several ways, in addition to regulation. Governments can exercise the power of example (e.g., investing in a scientific assessment of future climate scenarios and identifying vulnerabilities) and the power of the purse (e.g. upgrading bridges, roads and other infrastructure to withstand extreme weather). These actions – without or prior to regulatory requirements - can persuade businesses to conduct their own inquiry and investment programs.

The above observations are based on company interviews. They are not comprehensive. Nevertheless, they provide a useful snapshot of the current state of awareness, and action, in adaptation. It will be interesting to review these findings in a few years time, when management awareness, practical experience, and climate science have evolved

# Reasons for inaction: Hong Kong

**Despite presenting significant risks and opportunities for business - including some short-term opportunities - the vast majority of Hong Kong companies have not yet mainstreamed the impacts of a changing climate in their business activities.**

While this report is not intended to provide an exhaustive list of reasons preventing Hong Kong businesses from adapting to climate change, the research evoked discernable trends which echo trends identified in other, international studies.<sup>dd</sup>

**Lack of awareness.** Climate adaptation is a relatively new concept. People don't feel they understand climate change, let alone have the confidence to act on it. Companies are learning by doing. As most people have not been directly impacted they do not perceive a threat, personally or professionally. Most interviewees highlighted this lack of awareness and understanding of climate change risks and the benefits of adaptation, as barriers to action.

**Confusion: mitigation (preventing) vs. adaptation (preparing).** Companies may consider that they have addressed climate change after they start a few mitigation projects. This is understandable, but inaccurate. Mitigation has been on the public agenda for some time. The benefits of reducing energy and carbon within a business, and setting a pathway to a low carbon economy at a city or regional level, are increasingly well recognized. Adaptation, in contrast, is often over-looked. Lack of actionable information on future climate scenarios, long investment horizons and uncertainty about how to calculate pay-back further complicate matters.

**Low risk prioritisation.** Climate change is not accorded top priority amongst corporate risk professionals. Because it is seldom fully analyzed in enterprise risk management / business continuity assessments, adaptation options are very rarely even tabled. This may stem from:

- Insufficient understanding of climate risks – their size, timeliness, urgency, or impact on a company - leading to a lack of systematic risk identification and quantification; and
- The belief that business processes suited to today's

weather/conditions will continue to endure. As mentioned in the property section above, the challenge is twofold: a lack of incentive for a longer time horizon, and lack of broadly accepted, location-specific data on which to base an assessment.

**Short-term focus and lack of forward planning.**

Even when risks posed by current climate variability are assessed, future risks are rarely considered. In other words: most large companies are prepared to deal with the challenges posed by the current weather. Unfortunately, current (and past) weather is not the best indicator of future climate change.

Even those companies performing future scenario assessments need to contend with uncertainty. The number of assumptions required means results are often considered too speculative to be acted upon. This is not surprising given short term planning and investment cycles, lack of awareness and internal skills, high perceived uncertainty regarding climate predictions, and current financial hardship.



**Weather** – short-term (minutes to weeks) variation of state of the atmosphere (including temperature, precipitation, and wind)

**Climate** – “average weather” over a longer period of time, generally 30 years

**Climate change** – statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer)

*Based on World Meteorological Organization*

**Everyone is in this together.** There seems to be an implicit series of assumptions that flow thus: (a) climate change means extreme weather; (b) Hong Kong has historically withstood extreme weather quite well; (c) if an extreme weather event in Hong Kong caused real damage everyone would be affected and the government would step in. Part of the problem with this logic, of course, is that few businesses have their entire value chains in Hong Kong, and governments in other parts of the world may not be as efficient or effective in rescuing their populations from natural disasters

<sup>dd</sup> – Acclimatise et al., 2009, *Managing the Unavoidable: investment Implications of a Changing Climate*, Acclimatise, Henderson Global Investors, Insight Investment, Railpen Investments, USS, UK.;  
– PwC 2010, *Business leadership on climate change adaptation, Encouraging adaptation and action*, London, UK;  
– OECD 2011, *Private Sector Engagement in Adaptation to Climate Change: Approaches to Managing Climate Risks*, Agrawala, S. et al., OECD Environment Working Papers, No. 39, OECD Publishing, Paris, France; and  
– National Round Table on the Environment and the Economy 2012, *Facing the Elements: Building Business Resilience in a Changing Climate*, Ottawa, Canada

# Motivations for action

While climate change adaptation has yet to be mainstreamed into business activities, a few companies have started taking action.



## Learning the hard way: Adaptation post-facto

Once a company has suffered a costly climate impact, motivation to prevent future loss isn't a problem. The problem is inspiring those yet to be hit. A robust future scenario planning exercise could induce action, as could the example of a competitor. Regardless of the motivation, in climate change as in safeguarding health, prevention is key.

## Taking a holistic approach: Integrating climate change into business strategy

The more holistic a company's approach to climate change, the greater its confidence that it can reap both defensive (cost-avoidance) and offensive (innovation-related) rewards. Such strategies need to be refined over time, as the market and the environment evolve.

## Learning from the others: Sharing (best and worst) experiences

Companies exposed to practices in other sectors and regions of the world – through international research activities, trade associations or their own corporate

activities – often have a more sophisticated and textured understanding of the implications of a changing climate for their business. Companies with an internal culture of exchange and sharing tend to be more engaged in climate change adaptation.

## Regulation: A risk, but also a driver

Business interviewees recognize regulation (e.g. on greenhouse gas emissions, building standards, health and safety) as a risk, but also as a driver for action. There are currently no regulatory requirements that increase climate resilience in Hong Kong per se. CCBF research shows that Hong Kong businesses support more stringent regulations: in fact, they are seeking further Government leadership to prepare Hong Kong and the Pearl River Delta for climate change.

## Starting at Home: Company culture and leadership

Explicit, clearly articulated and oft-repeated senior management support is necessary for culture change. This is as true for instilling a climate-smart business culture, as

it is for any other kind of corporate change. "Inputs" of leaders' time and attention, amplified by training, financial incentives, recognition and other non-monetary rewards, and inter-team experience sharing, impact mindset and behaviour throughout the organization. When leaders start seeing new ideas bubble up from various divisions, they will know that the culture change has taken root.

## Making adaptation a competitive advantage: Reputation and brand value

As customers become more environmentally conscious, their expectations of prominent companies evolve. Companies which have done their homework in creating climate-smart operations or products can earn the trust, and business, of these discerning customers.

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 cc – The Hong Kong Business Survey on Energy Efficiency and Climate Change; see: <http://www.climatechangebusinessforum.com/en-us/research-11102011>.

# Recommendations

As the saying goes, “Climate is what you expect. Weather is what you get.” As the weather becomes more extreme, businesses will need to expect, and prepare for, a “new normal” of variability.

The following recommendations can help businesses build resilience:

## Raise awareness

People cannot act without information. Increasing awareness and understanding about company-specific risks and opportunities is the first step to enabling adaptation. Companies can for example:

- **Invest in training.** General climate and sustainability courses are offered by several reputable institutions in Hong Kong, including universities and the Business Environment Council;
- **Use Enterprise Risk Management (ERM)** tools to identify and assess potential climate risks for your company. CCBF is developing a climate risk assessment tool specifically designed for businesses operating in Hong Kong and the Pearl River Delta;
- **Work across teams** and with senior management, suppliers and customers to understand and quantify impacts and opportunities;
- **Exchange experience,** collaborate with peers and

contribute to international initiatives on climate change in your sector;

- **Research impacts specific to your sector,** locally and internationally; and
- **Keep abreast of climate science** and international experience in adaptation. For example, check out the UN Private Sector Initiative<sup>ff</sup>, a database of business actions on climate change.

## Encourage Government to assess – and share – climate risks

Climate risks vary by geography. Government is best placed to do a comprehensive risk assessment. Such an assessment should be shared with legislators, executive branch departments and local businesses and community leaders. The business community can then play a part by disseminating the results through business associations and chambers of commerce, and in participating in cross-functional advisory groups to guide community-wide adaptation efforts.

## Consider future climate risks

Weather-proofing your business for the next 2 to 5 years is not sufficient. Sustainability requires a longer look into the future. While the future is, by definition, uncertain, businesses can rely on authoritative resources to build viable projections. One such resource is the Intergovernmental Panel on Climate Change (IPCC), the internationally recognised entity that produces climate scenarios. Its fifth assessment report is due in 2014. The scenarios presented there will be useful tools for business planning. Individual government-commissioned studies are another resource<sup>gg</sup>. Likely drought, flood and temperature fluctuations are particularly relevant for the planning, project appraisal and design stages for long-life assets or investments.

# Recommendations

## Research and assess risks, opportunities and adaptation actions that are suitable for your company

Climate impacts and adaptation actions are sector- and company-specific. The costs and benefits of adaptation, including low-hanging fruit, tend to be company – or even site - specific. Appropriate actions will depend on both a risk assessment and corporate risk appetite. Identify and assess the costs and benefits of adaptation actions relevant for your company.

## Integrate climate change in your business strategy and management process

Get buy-in from the senior management and start building a climate-aware company culture. Integrate climate risks into your overall risk and opportunity assessment and management systems, as well as reporting. Look for strategies that both build resilience and bring co-benefits:

- **Actions to mitigate climate change**, such as energy conservation, may also build resilience;

- **Policies to increase workers' welfare**, such as measures to prevent heat stress and staff absenteeism, increase a company's ability to ensure business continuity;
- **Measures to address short-term water shortages** can also help prepare for longer-term changes in water availability, especially in vulnerable regions.

## Start now

Do not wait until climate change strikes your business. Start now. The evidence is overwhelming, and the growing insurance claims for natural disasters speak to the cost of inaction. As general awareness of climate risk grows, business climate resilience will be critical to attract and retain investors, staff and clients. The reward for early action will be in safeguarding operations, capturing emerging business opportunities and strengthening long-term competitive advantage.

<sup>ff</sup> – [http://unfccc.int/adaptation/nairobi\\_work\\_programme/private\\_sector\\_initiative/items/6547.php](http://unfccc.int/adaptation/nairobi_work_programme/private_sector_initiative/items/6547.php)

<sup>gg</sup> – Examples include assessments for China (news report at <http://www.reuters.com/article/2012/01/18/us-china-climate-idUSTRE80H06J20120118>), the UK (available at <http://www.defra.gov.uk/environment/climate/government/risk-assessment/>), and France (<http://www.drias-climat.fr/>).

# References

## General

Acclimatise et al., (2009) *Managing the Unavoidable: investment Implications of a Changing Climate*, Acclimatise, Henderson Global Investors, Insight Investment, Railpen Investments, USS, online, UK.

Acclimatise & ACCA (2009) *Adaptation, Climate Change Briefing Paper*, London, UK.

OECD (2011) *Private Sector Engagement in Adaptation to Climate Change: Approaches to Managing Climate Risks*, Agrawala, S. et al., OECD Environment Working Papers, No. 39, OECD Publishing, Paris, France.

Hong Kong Observatory (2012) *Projections of Hong Kong Climate for the 21st century, Temperature projection & Rainfall projection*, online.

IPCC (2001) *Contribution of Working Group II to the Third Assessment Report, of the Intergovernmental Panel on Climate Change, 2001*, J.J. McCarthy, O.F. Canziani, N.A. Leary, D.J. Dokken, K.S. White (eds) Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

IPCC (2007a) *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson (eds), Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA

IPCC (2007b) *Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007*, Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.), Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

MunichRE (2011) *Munich Re NatCatSERVICE*, online.

National Round Table on the Environment and the Economy (2012a) *Facing the Elements: Building Business Resilience in a Changing Climate (Advisory Report)*, Ottawa, Canada.

National Round Table on the Environment and the Economy (2012b) *Facing the Elements: Building Business Resilience in a Changing Climate (Business Primer)*, Ottawa, Canada.

PwC (2010) *Business leadership on climate change adaptation, Encouraging adaptation and action*, London, UK.

The Guardian (2011) *Thailand flooding costs Lloyd's of London \$2.2bn*, online.

UKCIP (2010) *Adaptation types*, online.

UKCIP (2011) *Workshop B: Business areas & future climate, Guidance on running a workshop for scoping the potential impacts of future climate change*, Oxford.

## By sector - Transport

ADB (2011) *Guidelines for climate proofing investment in the transport sector, Road infrastructure projects*, Manila, Philippines.

BSR (2011a) *Adapting to climate change: A Guide for the Transportation Industry*, online.

CDC (2009) *Climate change vulnerability and adaptation possibilities for transport infrastructures in France*, Climate Report 18, Paris, France.

CDP (2011a) *Investor CDP 2011 Information Request – MTR Corporation*, online.

CDP (2011) *Investor CDP 2011 Information Request – Cathay Pacific Airways*, online.

CH2M HILL (2011) *Climate change and airport: adaptation planning*, Vanderbilt P., online.

Defra (2012a) *UK 2012 Climate Change Risk Assessment, Transport, Summary*, UK.

Gatwick Airport Limited (2011) *Climate change adaptation report at Gatwick airport*, Gatwick Airport, UK.

GTZ (2009) *Adapting Urban Transport to Climate Change, Module 5f, Sustainable Transport: A Sourcebook for Policy-makers in Developing Cities*, Eschborn, Germany.

ICF International (2009) *What does climate change means for airport planning?* Ang-Olson, J., online.

IFC (2011) *Climate risk and business, Ports, Terminal Marítimo Muelles el Bosque Cartagena*, Colombia, Washington D.C., USA.

Japan International Cooperation Agency (2011) *Climate Finance Impact Tool for Adaptation*, Office for Climate Change, JICA Global Environment Department, report available at [http://www.jica.go.jp/English/our\\_work/climate\\_change/pdf/adaptation\\_all.pdf](http://www.jica.go.jp/English/our_work/climate_change/pdf/adaptation_all.pdf).

Project Performance Corporation, AEA Group (2012) *Results of ACRP Synthesis 11-03/S02-06: Airport Climate Adaptation and Resilience*

Transportation Research Board (2011) *Adapting Transportation to the Impacts of Climate Change, State of the Practice 2011*, Transportation research circular Number E-C152, June 2011, Washington D.C., United States

Tyndall Centre (2009) *An Inventory of adaptation to climate change in the UK: challenges and findings*, Tyndall Centre Working Paper 135, E.L. Tompkins et al., Norwich, UK

## By sector - Power Generation

Acclimatise (2009a) *Building Business Resilience to Inevitable Climate Change, Carbon Disclosure Project Report*, Global Electric Utilities, Oxford, UK.

Acclimatise (2009b) *UK energy generation, Understanding the investment implications of adapting to climate change*, Oxford, UK.

BSR (2011b) *Adapting to climate change: A Guide for the Energy and Utility Industry*, online.

Defra (2012b) *UK 2012 Climate Change Risk Assessment for the Energy Sector*, full report, UK.

# References

CDP (2011b) Investor CDP 2011 Information Request – Power Assets Holdings Limited, online.

CDP (2011c) Investor CDP 2011 Information Request – CLP Holdings, online.

CLP (2011) Climate Change Business Forum meeting, Climate Adaptation Experience Sharing, Simeon Cheng, CLP Holdings Limited, Hong Kong.

World Bank, ESMAP (2011) World Bank Study, Climate Impacts on Energy Systems, Key issues for energy sector adaptation, Ebinger J. & Vergara W., Washington D.C., USA.

---

## By sector - Construction

Australian Institute of Architects (2011) Climate Change Adaptation for Building Designers: An Introduction, D. Environment Design Guide 66, Snow, M. Prasad, online.

Defra (2012b) UK 2012 Climate Change Risk Assessment for the Business, Industry and Services Sector, full report, UK.

Defra (2012c) UK 2012 Climate Change Risk Assessment for the Built environment Sector, full report, UK.

Greater London Authority (2005) Adapting to climate change: a checklist for development, Guidance on designing developments in a changing climate, London, UK.

Technology Strategy Board (2010) Design for future climate, Opportunities for adaptation in the built environment, Gething B., Swindon, UK.

Tyndall Centre (2009) An Inventory of adaptation to climate change in the UK: challenges and findings, Tyndall Centre Working Paper 135, E.L. Tompkins et al., Norwich, UK

## By sector - Property

Acclimatise (2009c) UK commercial property, Understanding the investment implications of adapting to climate change, Oxford, UK.

Jones Lang LaSalle (2010) From Sandbags to Solar Panels, Future-proofing UK real estate for climate change resilience, Advance, online.

Swire Properties (2011) Sustainable Development Report 2010, Hong Kong.

CDP (2011d) Investor CDP 2011 Information Request – Swire Pacific, online.

---

## By sector - Finance

NBS (2009) Business adaptation to climate change, A systematic review of the literature, London, Canada.

SBI and UNEP Finance Initiative (2011) Advancing adaptation through climate information services, Results of a global survey on the information requirements of the financial sector, Oestrich-Winkel, Germany & Geneva, Switzerland.

BSR (2011) Adapting to climate change: A Guide for the Financial Services Industry, online.

IFC (2010) Climate risk and financial institutions, Challenges and opportunities, Washington D.C., USA.

Defra (2012) UK 2012 Climate Change Risk Assessment for the business, industry and services sector, full report, UK.

CDP (2011e) Investor CDP 2011 Information Request – HSBC Holdings plc, online.

## By sector -Manufacturing & Supply Chain

BSR (2011c) Adapting to climate change: A Guide for the Consumer Products Industry, online.

CDP (2011f) CDP Water Disclosure 2011, BASF, online.

CDP (2011g) CDP Investor Disclosure 2011, BASF, online.

Defra (2012) UK 2012 Climate Change Risk Assessment for the Business, Industry and Services Sector, full report, UK.

NBS (2009) Business adaptation to climate change, A systematic review of the literature, London, Canada.



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### About CCBF

The Climate Change Business Forum (CCBF) convenes some of Hong Kong's most astute businesses to collaborate on tackling climate change. As a think tank on the transition to a low-carbon economy, the forum seeks to be a resource to Hong Kong's business community and government. CCBF was established in 2008 by the non-profit Business Environment Council.

### About the author

Noémie Klein has worked on climate change mitigation, and more recently adaptation, since 2006. She joined Ecofys (London), a consultancy specialised in sustainable energy and climate policies, in 2012. At Ecofys she is focused on market-based mechanisms and policies to achieve greenhouse gas reductions. Prior to joining Ecofys, Noémie was based in Hong Kong, where she established her own climate change consultancy. Noémie has an MSc in Environmental Technology from Imperial College London and an MRes in Environmental Sciences from University Paris 7.



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