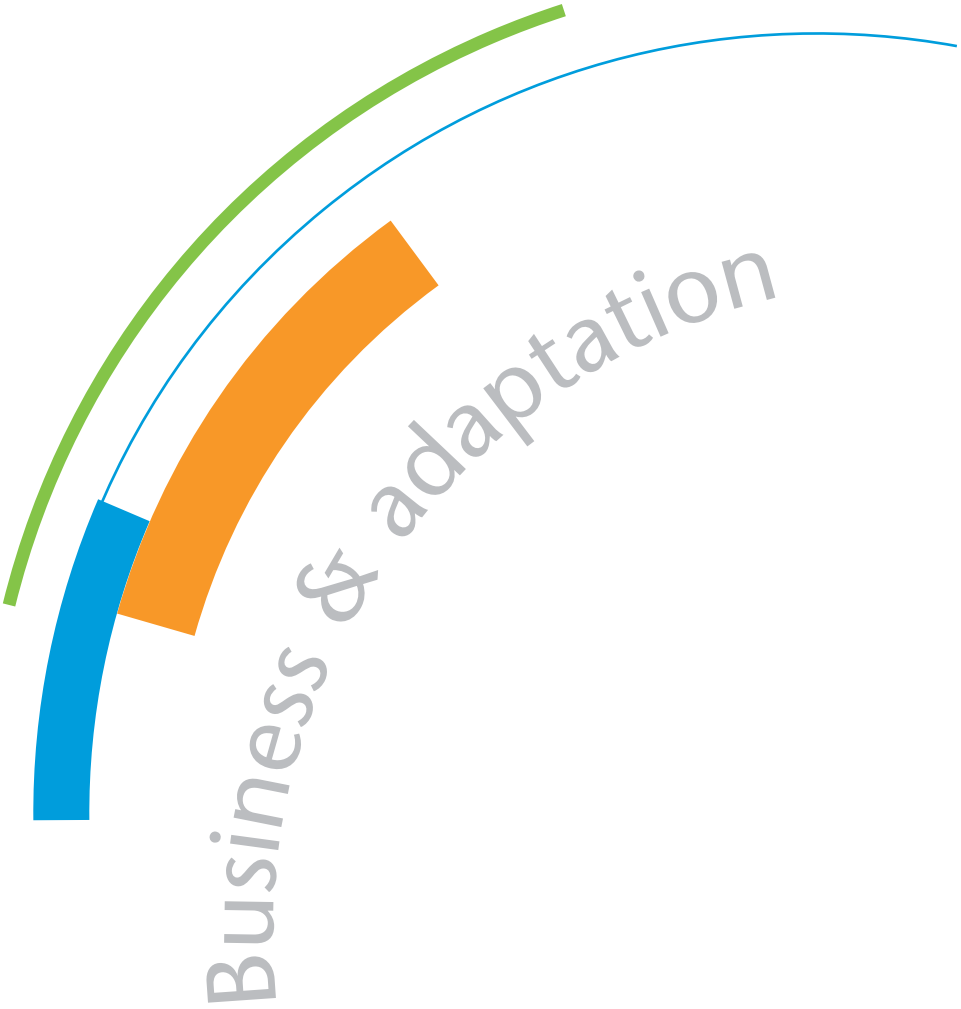
Adaptation

An issue brief
for business

World Business Council for
Sustainable Development



Acknowledgements
We would like extend our appreciation to all the members of the Energy and Climate Focus Area who contributed to this report. The FACT (Focus Area Core Team) provides the CEO-leadership and vision so instrumental to the WBCSD's success.

In this specific initiative, we would like to express our gratitude for the dedicated efforts of the Workstream on Adaptation. The team effort was led by the Workstream Co-Chairs:

- Jan Dell (CH2M Hill)
- Andrew Roberts (ConocoPhillips)
- Claude Nahon (EDF Group)
- Francis Condon (ABN AMRO).

These leadership companies were joined by another 56 member companies who contributed their time, insight and experience. The WBCSD secretariat played an important role in helping facilitate and coordinate this work over the past year and deserves a special thanks, in particular, Stefanie Held, Kija Kummer and Antonia Gawel.

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Introduction

The Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report,[1] *Climate Change 2007: Synthesis Report,* forecasts that climate change will have significant impacts on populations and environments around the world. Furthermore, it is likely that in the absence of concerted efforts to mitigate greenhouse emissions, climate change will have negative effects on business and global markets. It will likely lead to a change in existing business models and current risk management structures.

Members of the World Business Council for Sustainable Development (WBCSD) have acknowledged climate change and its attendant implications. They are beginning to plan accordingly to minimize risks, improve adaptive capacity and resilience, leverage new opportunities and collaborate with the global community.

Over the last two decades, much attention has focused on the scientific evidence of climate change. More recently, attention has transitioned towards efforts needed to reduce anthropogenic emissions of greenhouse gases. There has been considerable progress made in measuring greenhouse gas emissions and developing methods and technologies to reduce them. A priority for business will be to continue to seek and implement pragmatic and sustainable solutions to mitigate the effects of climate change. These solutions include pursuing energy and process efficiency across operations, and developing innovative products and technologies.

Prior to the publication of the IPCC Fourth Assessment Report in 2007, adaptation to climate change had not garnered much attention. Indeed, the focus was on raising awareness and mitigation efforts. However, the Fourth Assessment Report established that even if we do succeed in reducing emissions, some climate change impacts are now unavoidable and solutions will be needed to adapt to them. The necessity for adaptation to climate change impacts gained momentum at the United Nations Framework Convention on Climate Change (UNFCCC) 13th Conference of the Parties (COP13) Meeting in Bali, Indonesia in December 2007. One of the outcomes of this meeting was the establishment of a United Nations Adaptation Fund.

This publication is focused on providing an overview of adaptation from a business perspective.[2] It describes potential impacts of climate changes, risks and opportunities for business, and why business should consider adaptation planning and measures. It summarizes intergovernmental efforts to promote adaptation in vulnerable regions and highlights areas in which business could have a role in promoting adaptation, both at community and global levels.

Executive summary

Impacts of climate change

The Intergovernmental Panel on Climate Change (IPCC) has established that climate change will have serious implications for humans and the environment that surrounds us. According to the IPCC Fourth Assessment Report, *Climate Change 2007: Synthesis Report*,[3] these will include "altered frequencies and intensities of extreme weather events, [which] together with sea rise, are expected to have mostly adverse effects on natural and human systems."[4]

What is adaptation?

Under the definition adopted by the United Nations Framework Convention on Climate Change (UNFCCC),[5] adaptation is a process through which societies make themselves better able to cope with an uncertain future. Adapting to climate change entails taking the right measures to reduce the negative effects of climate change (or exploit the positive ones) by making the appropriate adjustments and changes.

Why is adaptation needed?

It is now acknowledged that even if we do succeed in reducing emissions, some climate change impacts are unavoidable because of the level of greenhouse gas (GHG) emissions in the atmosphere. As a result, adaptation will be necessary because temperatures will continue to rise with the attendant short- and long-term impacts that this will bring. There is an urgent need for adaptation assessment in the short-term, as witnessed by the increasingly high costs of extreme weather events, compounded by rising population densities, eroding natural protection systems and aging infrastructure.

What are governments doing?

Government leadership is emerging and will be essential in establishing clear frameworks for adaptation. For example, under the UNFCCC, governments are committed to cooperating with each other to prepare for adaptation. Several financial mechanisms exist to support this. The UN Adaptation Fund will become operational in 2008 to provide financing for adaptation projects in those developing countries party to the Kyoto Protocol. Unlike other funds, which rely on voluntary contributions from donor countries, it will be funded through a 2% levy on projects developed under the Clean Development Mechanism (CDM). A number of bilateral funding agencies in developed countries have also allocated funding to adaptation activities. Many local, regional and national governments have also undertaken efforts to predict possible climate change impacts in their respective constituencies, and are looking at options for adaptation. Effective business responses can best happen within clear and stable framework conditions.

Business risks and opportunities from the impacts of climate change

The implications of climate change will vary across different business sectors. Some sectors and individual companies may face increasing threats, while others may be less affected and some may even benefit. Climate change is an inexact science and the impacts are still not fully understood. For this reason, the effects of climate change are best evaluated on a sectoral and geographic basis. From a business perspective, climate change is likely to affect the location, design, operation and marketing of infrastructure, products and services. From a human perspective, climate change will have socioeconomic implications for workforces and markets.

Business and adaptation

The business case for adaptation planning is a strong one. Adaptation implementation should be assessed as it could generate tangible and short-term benefits for business operations. It could also yield benefits for local communities. Key drivers of adaptation planning or implementation include: competitive advantage, cost savings, liability management, investor pressure, regulation and community resilience.

Possible areas where business might evaluate adaptation include:

Action within operations and supply chains

Opportunities exist for business to innovate processes, products and services to respond to changing climate and protect existing assets.

Action in partnership with surrounding communities

Healthy and functioning communities surrounding business' operations and suppliers are critical for the well-being of employees, and the ability of business to function. Many businesses already work with local communities on issues of common concern. In the future it may be necessary to increase this collaboration to address emergency response plans, for example.

Actions in collaboration with the global community

Business can work with governments and non-governmental organizations to identify and support the implementation of effective adaptation measures to protect vulnerable countries. Repeatedly we see that better and more effective solutions emerge when there is strong cooperation between business and governments. Business can make a unique contribution to the collective effort through technology innovation, resilient infrastructure and facility design, and major project management.

Most large businesses operate from a number of different locations and deliver to a range of markets. Adaptive action to climate change will therefore need to be tailored to the specific circumstances of each location. Coordinating adaptation efforts company-wide will improve efficiency and enhance opportunities for learning.

Impacts of climate change

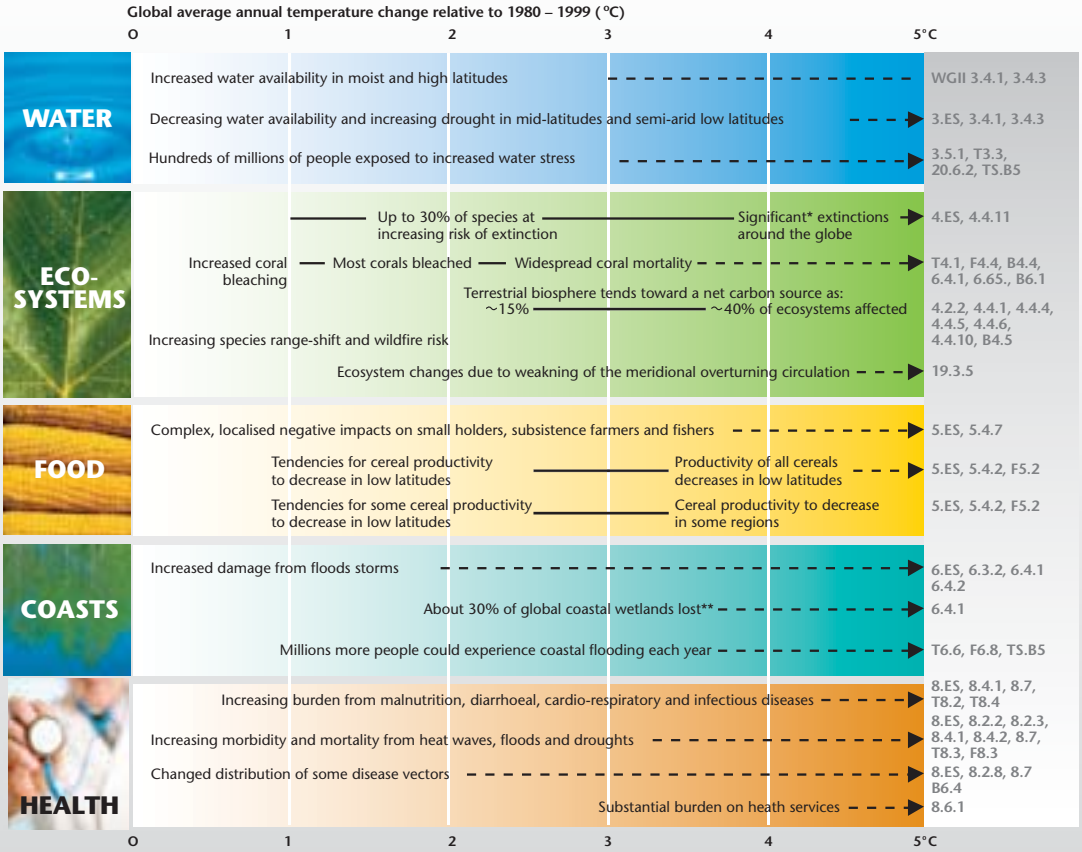
The Climate Change 2007 Synthesis Report of the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC)[6] states that:

"Global atmospheric concentrations of carbon dioxide, methane and nitrous oxide have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning many thousands of years. Most of the observed increase in globally-averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations. It is likely there has been significant anthropogenic warming over the past 50 years averaged over each continent (except Antarctica)."

Atmospheric concentrations of CO_2 have risen from a pre-industrial value of about 280 ppm to 379 ppm in 2005.[7] This increased concentration in greenhouse gases has been linked to a rise in global average air temperature near the Earth's surface of 0.74°C in a 100-year period (1906-2005).[8] The Climate Change 2007 Synthesis Report[9] states that "continued GHG emissions at or above current rates would cause further global warming and induce many changes in the global climate system during the 21st century that would very likely be larger than those observed during the 20th century."

Examples of impacts associated with global average temperature change

(Impacts will vary depending on extent of adaptation, rate of temperature change, and socioeconomic conditions)



Source: IPCC, 4TH Assessment Report, Climate Change 2007: Synthesis Report, page 51.

* Significant is defined here as more than 40%

** Based on average rate of sea level rise of 4.2 mm/year from 2000 to 2080

Where ES = Executive Summary, T = Table, B = Box and F = Figure. Thus B4.5 indicates Box 4.5 in Chapter 4 and 3.5.1 indicates Section 3.5.1 in Chapter 3.

The physical effects of increasing temperature

The potential effects of rising global temperatures include:

- Rising sea levels
- Increased water stress due to changing precipitation patterns and increasing frequency and intensity of floods and droughts
- Increased incidence and severity of storms
- Loss of glaciers and permafrost
- Changes in oceanic circulation systems, which influence the weather
- Increased incidence of flash floods
- Changes in the spread of disease
- Potential changes in climate variability and weather systems such as El Niño.

Uncertainty remains about the potential results of rising temperatures, in terms of magnitude, timeframe and location of impacts.

Predicted impacts on humans and ecosystems

It is predicted that climate change will likely have the following impacts on humans and ecosystems.[10]

- Globally, approximately 20-30% of species assessed so far are likely to be at greater risk of extinction if increases in global average warming exceed 1.5-2.5 °C.
- In Africa, some 75-250 million people could face water shortages by 2020.
- In some African countries rainfall-fed agriculture could drop by 50% by 2020.
- In East, South and South-East Asia,endemic morbidity and mortality due to diarrheal disease, primarily associated with floods and droughts, are expected to rise.
- In Latin America, productivity of some important crops is projected to decrease and livestock productivity to decline, with adverse consequences for food security.
- In Polar Regions, projected biophysical effects are expected to cause changes in natural ecosystems with detrimental results on many organisms including migratory birds, mammals and higher predators.

Socioeconomic impacts of changing climate

Societal impacts and responses to climate change will likely vary, depending on population size and distribution, economic and geopolitical conditions, and distribution of wealth. Possible human impacts include:

- Famine – if demand for food outstrips supply because of crop failures, or greater pressure on food supplies resulting from population migration
- Epidemics – due to changing spread of disease resulting from species migration, higher incidence of flooding, or water contamination resulting from extreme weather events
- Mass migration – changing human settlement patterns resulting from new vectors of human disease, rising sea levels, increased risk of hurricanes and flooding, drying up of rivers and sources fed by glacial melt, saline intrusion and contamination of aquifers
- Conflict – resulting from competition for diminished resources.

By 2050, it is predicted that more than 200 million people may be forced from their native lands by rising sea levels, floods and droughts, with many more potentially facing early deaths from malnutrition and heat stress.[11]

Geographical variation in impacts

Climate change impacts will not be uniform. They are likely to vary from region to region and season to season. Similarly, some business sectors may be at increased risk from climate change, while others may be less affected and/or may even benefit.

Figure 1: Most-vulnerable regions, ecosystems and receptors

The Arctic
High rates of warming and ice melt already witnessed and continuing high rates projected.

Africa, especially the sub-Saharan region
Current low adaptive capacity as well as projected temperature rises and increasing water stress.

Small islands
High exposure of population and infrastructure to the risk of sea level rise and increased storm surge.

Asian mega-deltas
(e.g., Ganges, Brahmaputra and Zhujiang)
Large populations and high exposure to sea level rise, storm surge and river flooding.

Polar, tundra, boreal forest and alpine ecosystems
Likely to shift towards higher latitudes and altitudes. Some may disappear completely as temperatures rise. Permafrost melt, loss of snow caps, ground upheaval, and increasing risk of invasive species are the key threats.

Mediterranean ecosystems
Threatened by rising sea levels, increasing desertification and water stress.

Mangroves and salt marshes
Threatened by rising sea levels and increasing storm surges. Their natural role as a flood barrier could be lost.

Coral reefs and sea ice
Threatened by rising temperatures. Reefs are also threatened by increasing acidification of the ocean. Ecosystem services (i.e., maintenance of fish stocks) are likely to be severely affected.

Human health
Especially in areas with low adaptive capacity, insect and water-borne diseases expand their ranges.

Water resources
Water scarcity in the mid latitudes and dry low latitude regions, due to decreases in rainfall, greater unpredictability of precipitation, and higher rates of evapo-transpiration.

Agriculture
In low latitude regions due to reduced water availability.

Source: IPCC 4TH Assessment Report, Working Group II, Climate Change 2007: Impacts, Adaptation and Vulnerability

What is adaptation ?

Defined by biologists in the early 1800s, adaptation is a responsive adjustment in structure, function, or behavior by which a species or individual improves its chance of survival in a specific Environment.

"It is not the strongest of the species that survives…
nor the most intelligent that survives.
It is the one that is the most adaptable to change."
Charles Darwin

According to the UNFCCC,[12] "adaptation is a process through which societies make themselves better able to cope with an uncertain future. Adapting to climate change entails taking the right measures to reduce the negative effects of climate change (or exploit the positive ones) by making the appropriate adjustments and changes." The definition of adaptation applies to climate variability as well as long-term change.

Adaptation to climate change is not new. Humanity has always faced an uncertain future when coping with variations in and extremes of climate.[13] People, businesses and governments have continually sought ways of surviving and even thriving in periods of drought and flood and other weather extremes. The capacity to adapt enables societies to deal with a range of future uncertainties.

Adaptive practices seek to reduce vulnerability to climate hazards. Adaptation action can occur at a variety of scales or levels:

Scale / level	Examples of adaptation to climate change
Individual	• Reduce water use in times of drought • Switching crop varieties by farmers in anticipation of changing conditions
Business	• Locate and design facilities for increased resilience to extreme weather events • Reduce vulnerability by siting in areas of reduced risk • Train employees to recognize and respond to new disease vectors • Develop low water-intensive products and processes • Geographic diversification of supply chain • Diversification and expansion of infrastructure
City/community/ regional	• Increase volume of aquifer storage for times of drought and expand the capacity of infrastructure • Install early warning systems for extreme weather events • Establish new building codes • Use of non water-based sanitation
National	• Integrate risk management and adaptation into development policy • Upgrade emergency response planning to extreme weather events • Develop national health programs for public awareness and prepare for spread of new diseases
Global	• Build UN Adaptation Fund through Clean Development Mechanism and other flexible mechanisms

According to the 2007 IPCC Fourth Assessment Review Working Group II *Report on Impacts, Adaptation and Vulnerability,*[14] there is growing evidence that adaptation measures that also consider climate change are being implemented, on a limited basis, in both developed and developing countries.

Why would adaptation be needed?

Why would adaptation be needed?

It is now acknowledged that even if we succeed in reducing the level of GHG emissions in the future, the GHG emissions already in the atmosphere will continue to contribute to a rise in temperature, resulting in short- and long-term changes to climate. Relatively small average temperature rises are likely to result in an increase in the frequency and intensity of extreme weather events such as tropical cyclones, floods, droughts and heavy precipitation.[15] The IPCC reports that there has already been an increase in the frequency and intensity of heat waves and heavy precipitation.[16]

The need for adaptation in the short-term is being driven by the increasingly high costs of extreme weather events that are being further compounded by rising population density, eroding natural protection systems and aging infrastructure. In the longer term, adaptation to climate change will be necessary to minimize the impacts of rising sea levels on societies and ecosystems and to protect quality of life.

The Stern Report on the *Economics of Climate Change*[17] highlights that climate change will have serious ramifications for the world economy if society fails to adapt to the changing climate while at the same time taking action to cut greenhouse gas emissions to prevent further changes. According to the UNFCCC,[18] adaptation and mitigation need to be given the same level of importance. Adaptation does not replace mitigation of greenhouse gas emissions. On the contrary, both adaptation and mitigation need to take place simultaneously and complement one another.

A combined strategy for mitigation and adaptation is needed:

- *Mitigating* climate change by reducing emissions will not protect communities from the effects of climate change, but will, at sufficient global scale, reduce the risk of and magnitude of climate change in the future.
- *Adaptation* will not reduce the frequency or magnitude with which climate change events occur but will protect business and society against events such as drought, hurricanes and looding.

Coordination of mitigation and adaptation actions will yield global benefits. It is important that adaptation strategies not hamper mitigation efforts or lock-in rising carbon emissions. At the same time, adaptation to climate change must also avoid inadvertent "maladaptive" practices. Maladaptation refers to adaptation measures that do not reduce vulnerability but instead contribute to increasing it.[19]

UNFCCC

The United Nations Framework Convention on Climate Change, established in 1994, provides an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. The Convention has 192 member parties, or near global membership.[20] Under the Convention, governments are committed to:

- Gathering and sharing information on greenhouse gas emissions, national policies and best practices
- Implementing national strategies to address greenhouse gas emissions and adapt to expected impacts, including the provision of financial and technological support to developing countries
- Cooperating to prepare for adaptation to the impacts of climate change.

Several articles of the Convention deal explicitly with adaptation.

Articles of the Convention referring to adaptation[21]

Article 4.1(b) All Parties are to "formulate, implement, publish and regularly update national and, where appropriate, regional programmes containing measures to … facilitate adequate adaptation to climate change."

Article 4.1(e) All Parties shall "cooperate in preparing for adaptation to the impacts of climate change; develop and elaborate appropriate and integrated plans for coastal zone management, water resources and agriculture, and for the protection and rehabilitation of areas, particularly in Africa, affected by drought and desertification, as well as floods."

Article 4.1(f) All Parties shall "take climate change considerations into account, to the extent feasible, in their relevant social, economic and environmental policies and actions, and employ appropriate methods, for example impact assessments, formulated and determined nationally, with a view to minimizing adverse effects on the economy, on public health and on the quality of the environment, of projects or measures undertaken by them to mitigate or adapt to climate change."

Article 4.4 The Developed Country Parties "shall also assist the developing country Parties that are particularly vulnerable to the adverse effects of climate change in meeting costs of adaptation to those adverse effects."

Article 4.8 All the Parties "shall give full consideration to what actions are necessary under the Convention, including actions related to funding, insurance and the transfer of technology, to meet the specific needs and concerns of developing country Parties arising from the adverse effects of climate change and/or the impact of the implementation of response measures."

Article 4.9 All the Parties "shall take full account of the specific needs and special situations of the least developed countries in their actions with regard to funding and transfer of technology."

UN Adaptation Fund

The UN Adaptation Fund[22] was established under the Kyoto Protocol to finance adaptation projects in those developing countries Party to the Kyoto Protocol. The Fund is not financed through voluntary contributions from donors, but by a 2% levy on project credits under the Clean Development Mechanism (CDM). This is the scheme established by the Kyoto Protocol that allows industrialized nations to pay for carbon credits produced by emission-reduction projects in the developing world and offset them against their own emissions targets.

At the COP13 Meeting in Bali, Indonesia, the UN approved a plan for the Adaptation Fund to bolster the defenses of poor countries that lack the money, technology and human resources to cope with climate change. The Fund is intended to finance projects including sea walls to guard against expanding oceans, early warning systems for extreme events, improved water supplies for drought-affected areas, training in new agricultural techniques, and the conservation and restoration of mangroves to protect people from storms.

The Fund will initially be administered by the Global Environment Facility, established by donor governments some 16 years ago to support conservation projects. The World Bank is to act as its trustee and it will be overseen by a 16-member board, drawn from developed (Annex I) and developing (non-Annex I) nations from the Conference of Parties to the Kyoto Protocol.

The Fund will become operational in 2008. As of December 2007, the Fund had US$ 67 million. Future funding levels will be dependent on the continuation of the CDM and the level of demand for credits generated by CDM projects in the carbon market. According to UN projections,[23] the level of funding could be US$ 100-500 million per year in 2030 under a low-demand scenario, and reach US$ 1-5 billion per year under a high-demand scenario.

Most non-industrialized countries (specifically those outside Annex I of the Kyoto Protocol – the group of 36 industrialized countries committed to reducing greenhouse gas emissions under the terms of the Kyoto Protocol) are eligible to apply for assistance from the adaptation fund. However, preference will be given to the Least Developed Countries – a group of the world's 48 poorest countries as defined by the United Nations.

Adaptation funding

Several financial mechanisms to support adaptation exist under the UNFCCC and the Kyoto Protocol, particularly in developing countries. The following four funds contain a total of over US$ 310 million to date:

1. **The Least Developed Countries Fund has already supported the development of National Adaptation Programmes of Action (NAPAs) and will likely assist the Least Developed Countries (LDCs) to implement their NAPA projects. It is based on voluntary contributions from wealthy countries.**
2. **The Special Climate Change Fund is for all developing countries and covers adaptation and other activities. It is also based on voluntary contributions.**
3. **The Adaptation Fund is meant to support "concrete adaptation" activities. It is based on private sector replenishment through the 2% levy on Clean Development Mechanism projects (which channel carbon-cutting energy investment financed by companies in developed countries into developing countries), plus voluntary contributions.**
4. **The Strategic Priority on Adaptation contains US$ 50 million from the Global Environment Facility's own trust funds to support pilot adaptation activities.**

A number of bilateral funding agencies in countries including Canada, Germany, the Netherlands, Japan, the United Kingdom and the United States have allocated funding for adaptation activities, including research and some pilot projects. To date, bilateral donors have provided around US$ 110 million for over 50 adaptation projects in 29 countries. (Source: International Institute for Environment and Development, "COP 13 Briefings and Opinions Papers", December 2007, www.iied.org.)

Business risks and opportunities resulting from climate change impacts

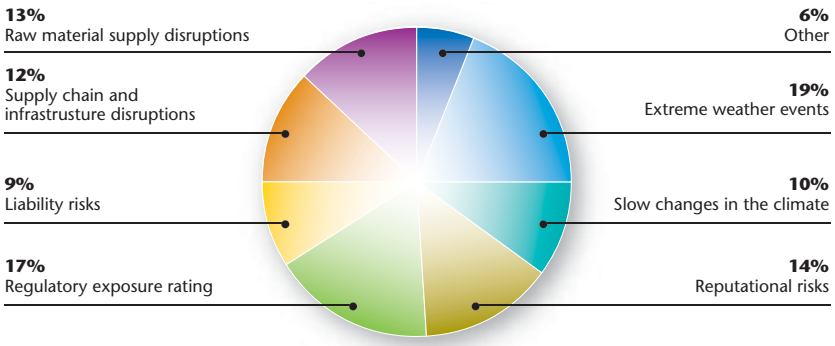
Changes in the Earth's climate system could have repercussions on how business operates. The magnitude and frequency of impacts are uncertain, but consequences with negative effects on business could include:

- Higher temperatures, which could affect the location, design, efficiency, operation and marketing of business infrastructure, products and services
- Water scarcity, which could stymie business operations, particularly those of water-reliant industries
- Rising sea levels, which could affect the location of business operations, submerge or complicate access to raw materials or natural and human resources
- Increased frequency of extreme weather events, which could damage business infrastructure, disrupt logistics, and affect business continuity and costs
- Changes in the distribution of vectorborne disease (e.g., malaria) and greater population migration, with their attendant socioeconomic impacts on workforces and markets.

Company survey of climate change impacts

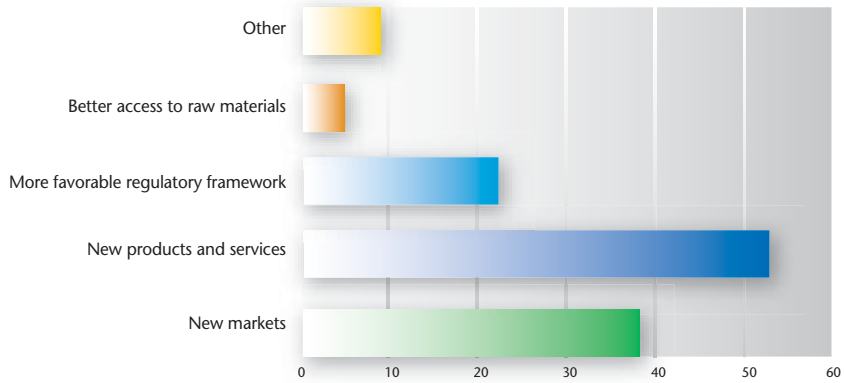
A 2007 survey of WBCSD member companies identified the main perceived risks and opportunities resulting from climate change.

Figure 2. To which type of risks is your company most exposed currently and in the future?



Other: Changes in patterns of electricity use and disruptions in energy supply

Figure 3. What opportunities do climate change / adaptation offer to your company?



Climate change impacts could also affect business through its impacts on key stakeholders:

- Customers affected by climate-related stress, losses, costs and damages may have less disposable income to spend on conventional goods and services
- Investment analysts, who are already asking for disclosure of climate risks and demonstration of an effective risk management strategy, may demand even greater disclosure
- Investors, who may shift away from business perceived to be at high risk from or of contributing to climate change
- Regulators, who are likely to implement new measures requiring new business processes and skills for compliance management which is likely to increase costs.

Figure 4. General business risks and opportunities resulting from climate change impacts

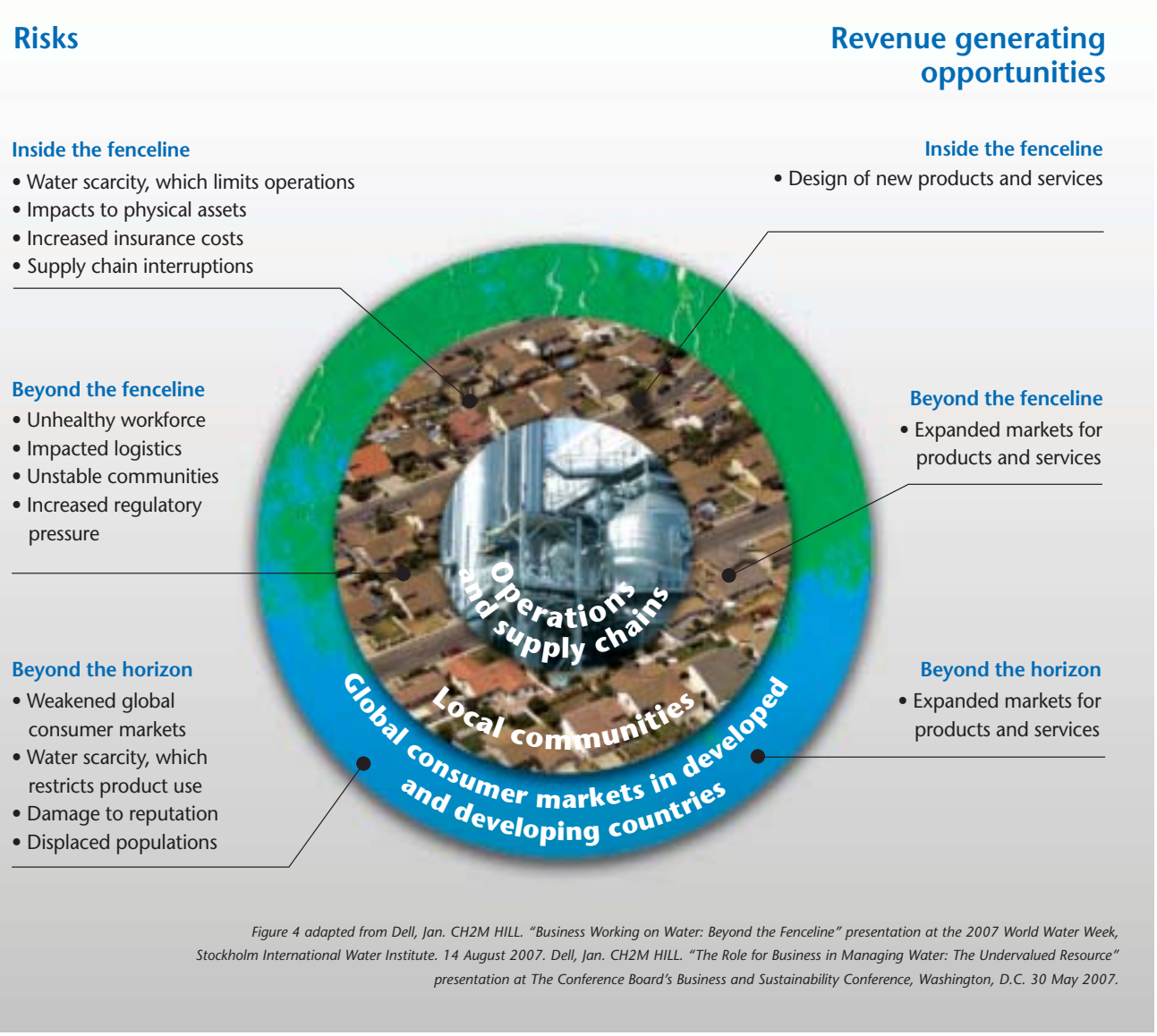


Figure 4 adapted from Dell, Jan. CH2M HILL. "Business Working on Water: Beyond the Fenceline" presentation at the 2007 World Water Week, Stockholm International Water Institute. 14 August 2007. Dell, Jan. CH2M HILL. "The Role for Business in Managing Water: The Undervalued Resource" presentation at The Conference Board's Business and Sustainability Conference, Washington, D.C. 30 May 2007.

Figure 4 provides a summary of general business risks and opportunities resulting from climate change in three spheres of activity and influence. These three spheres have been labeled: "inside the fenceline", "beyond the fenceline" and "beyond the horizon." "Inside the fenceline" refers to a company's operations and supply chain. Within this sphere, a company faces numerous risks but also has significant control or influence through which it can modify its operations and product design, which provides revenue-generating opportunities. "Beyond the fenceline" company risks include, but are not limited to, an unhealthy workforce. "Beyond the fenceline" also offers an opportunity for a company to expand the market for their goods and services. Finally, the largest sphere, "beyond the horizon", refers to global consumer markets in developed and developing countries. Companies need healthy and strong consumer markets that can afford their products and services. Similarly, they depend on suitable infrastructure and, in some cases, access to clean water to enable use of their products. The risks to consumer markets are greatest in developing countries because they lack sufficient adaptive capacity to climate change impacts.

Business sector overview

The impacts of climate change will vary from sector to sector. While climate change presents a threat to some individual sectors and companies, other sectors may face fewer challenges and some may even benefit. The following section describes some of the **possible** effects of climate change. At this point, the risks and opportunities we have identified can be considered as hypothetical or as plausible; our intent is to stimulate, inform and explore the probabilities.

Agriculture, fishing and forestry

Possible impacts of climate change on agriculture, fishing and forestry companies include:

- Temperature increases of 2° C and a subsequent extension of the growing season in mid-latitude to northern regions could increase agricultural yields; however, extreme weather events could reduce or eliminate gains
- Changes in the distribution of pests and crop predators are likely to negatively impact crop production
- Risk of extinction of local fish and game species at the edge of current temperature ranges[24]
- Greatest adverse impacts are likely to be experienced by the economies of central and northern Asia, the western Sahel, coastal tropical regions of South America,[25] and some small island states.[26]

Agriculture is highly adaptable. Numerous opportunities exist for maintaining and increasing yields through optimal management of crop calendars to avoid extreme hot periods, developing new varieties of plants that can tolerate a range of conditions, and good soil management to overcome water stress.[27]

Business risks	Business opportunities
• Loss of competitive advantage from failure to recognize new growing regions • Interruption of supply due to inappropriately sited crops, and over-dependence on high-risk regions • Changes in availability and price of commodities • Business interruption and failure to meet contractual obligations • Irrigation problems due to water stress	• Increased yields due to extension of the growing season and temperature increases • Development of new plant varieties

Energy and utilities[28]

Possible impacts of climate change on the energy and utilities sector include:

- Change in energy demand, in particular, increase in peak demand in the summer for cooling; milder winters in the Northern Hemisphere could result in reduced energy demand
- Increased frequency and severity of extreme weather events, such as high winds and waves, which could affect offshore and port facilities, transport and communication networks, production facilities and other infrastructure
- Change in temperature, affecting efficiency of equipment operation
- Thawing of permafrost, resulting in ground shifts and instability, making exploration and production in northern regions more difficult
- Rising sea levels, threatening electricity generation facilities and refineries in coastal, riparian and estuarine locations
- Increased competition for water resources, leading to potential conflict between users such as power generators (for cooling and hydropower), public water suppliers, and the agricultural community
- Changes to water flows, resulting from increased activity in hydropower stations, higher air speeds through wind turbines, and the availability of solar energy for capture in photo-voltaic cells.

Business risks	Business opportunities
• Business interruption and failure to meet contractual obligations due to extreme weather events	• Increased demand for "green" energy products and services, including energy efficiency products and services
• Interruption in fuel supply due to extreme weather and related events along the supply chain	• Acceleration of shift from solid fuels to electricity to reduce carbon footprint, supported by innovation in energy end use
• Inability to meet peak load due to combinations of rising demand and reduced plant and system capacity during heat waves or extreme weather events	• Increased access to mineral resources in some high latitude areas
• Reduced availability of water for hydropower and/or thermal plant cooling systems, resulting in reduced plant output and/or need to modify the system	• Increased revenues associated with increased demand for energy for cooling during hot weather (although may be offset by other climate-related changes in demand)
• Reputational risk from being seen as a contributor to climate change	
• Reduction in seasonal access to facilities due to infrastructure disruptions (e.g., via ice roads in permafrost regions)	
• Loss in revenue due to climate impacts on customer demand, such as interruption of their businesses, decreased need for heating	
• Coastal facility closure due to flooding and/or sea level rise	
• Supply and demand balance not realized	

Energy and utilities

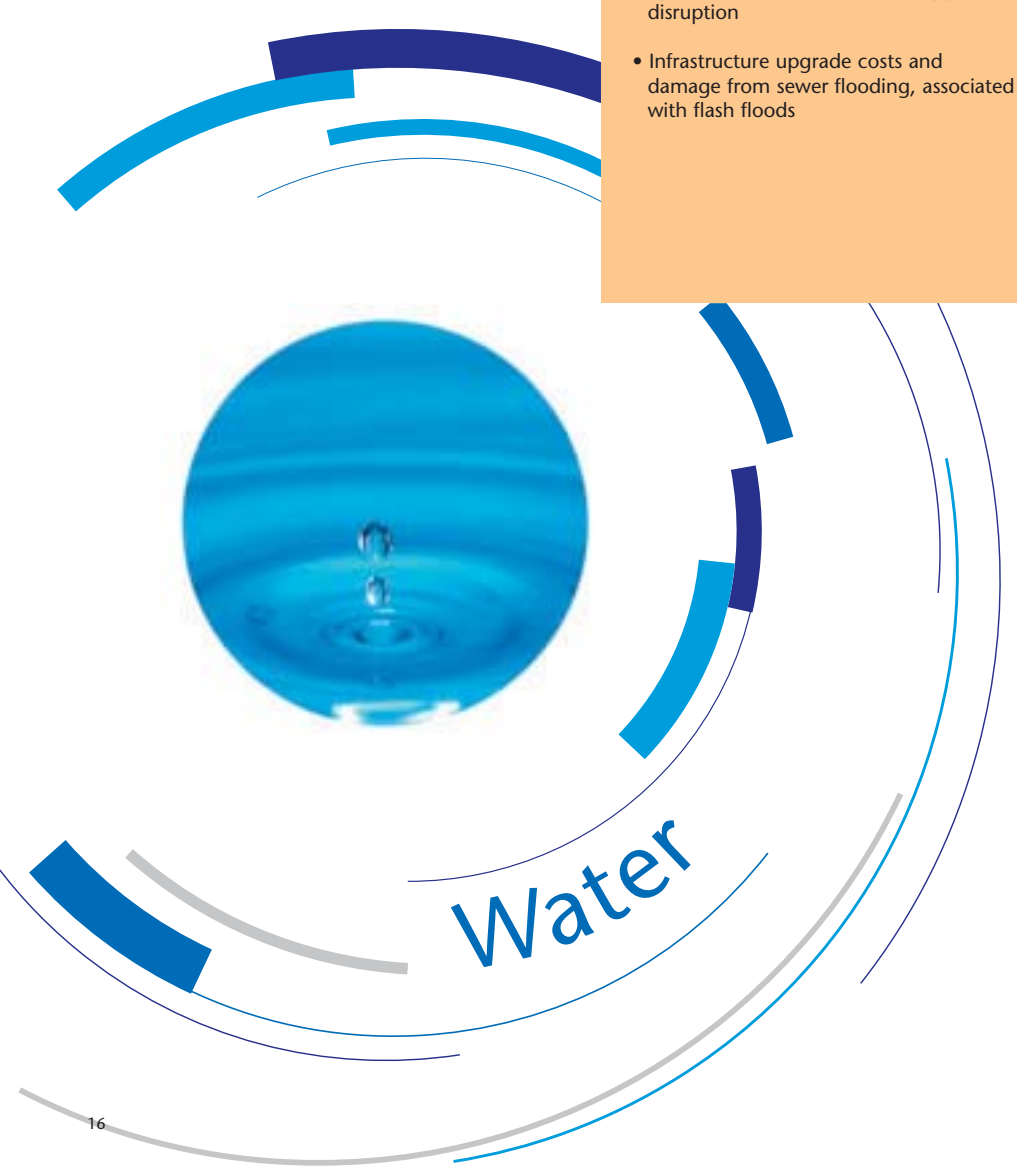
Water

Possible impacts of climate change on suppliers of water and sanitation, and water-intensive industries include:

- Greater demand for water as a result of increased temperatures and changes in water supply; regions dependant on glacial melt water such as the Pacific coast of South America (Andes), or large areas of China, India, Nepal, Bhutan and Bangladesh (Himalayas), may experience water scarcity
- Variance in river flows due to changes in temperature and precipitation, with potential damage to water supply infrastructure during heavy rains or drought
- Salination of groundwater reservoirs due to aquifer penetration by rising seas.

The growing number of extreme weather events, which are also lasting longer – including droughts and floods – may affect the performance and capacity of water and wastewater systems designed for more steady conditions.

Business risks	Business opportunities
• Industrial users in water-scarce areas likely to face increasing pressure to conserve water, and potential for conflict and risks to license to operate • Flooding of water supply works in riparian locations, leading to supply disruption • Infrastructure upgrade costs and damage from sewer flooding, associated with flash floods	• Increased demand for water-saving technologies and services



Healthcare

Rainfall, temperature and humidity have a major influence on the distribution of disease pathogens and pests. Possible impacts of climate change on human health include:

- Reduction in the number of cold-related deaths in some regions; conversely, rising temperatures could have negative effects on human health and mortality, particularly in the developing world
- Rise in the number of deaths resulting from heat waves, as seen, for example, in Western Europe in 2003 and Central Europe in 2007
- Potential increase in disease and premature deaths associated with Lyme disease and tick-borne encephalitis (Europe and North America), dengue fever (Australia and New Zealand) and malaria (Africa)
- Changing distribution of some vectors of infectious disease and allergenic pollen species
- Changing impact on malaria regions, for example, transmission rates in some areas might decrease as a result of reductions in rainfall e.g., Amazonian Brazil, while areas not previously affected may become vulnerable.[29]

Business risks	Business opportunities
• Health & safety risks • Reduced productivity through increased incidence of disease and overheating of working environment • Higher health insurance costs • May be higher expectation on companies for help, from communities in developing countries with limited health infrastructure	• In higher latitudes, reduced healthcare costs as winters become milder • Development of new medicines

Business risks	Business opportunities
• Increased losses could raise the cost of capital and increase the volatility of insurance markets[30] • Insurers may face annual payouts some US$ 30-40 billion higher than at present[31] • Assets may be uninsurable against extreme events	• New insurance products and markets • Increased demand for risk management consulting services

Insurance

Possible impacts of climate change on the insurance sector include:

- Higher insurance payouts resulting from damage to infrastructure by extreme weather events
- Greater uncertainty of risk assessments as the climate changes.

Business risks	Business opportunities
• Supply chain interruption and inefficiency of the distribution network • Increased costs associated with health and comfort of workforce • Loss of competitiveness due to lack of responsiveness to changes in consumption patterns • Damage to products during transport and warehousing	• New product and service opportunities

Retail

Possible impacts of climate change on the retail sector include:

- Damage to infrastructure along the retail product supply chain caused by extreme weather events
- Changing shape, size and location of markets for goods and services as regional impacts are felt and consumption patterns change
- Changing customer expectations as consumers avoid products perceived to be causing climate change.

Tourism

Possible impacts of climate change on the tourism sector include:

- Variations in climate in weather-dependent tourist destinations (e.g., beaches, ski resorts, etc.)
- Damage to tourist infrastructure (e.g., water availability, greater electricity demand)
- Reduced accessibility and scenic appeal due to extreme weather events.

Business risks	Business opportunities
• Stranded assets in former tourist regions • Winter sports destinations facing challenges as snowfall lessens and becomes unpredictable • Obsolescence of destinations as they become too hot, water scarce or at risk from wild fires and the spread of formerly tropical diseases	• A pole-ward shift in conditions favorable to many forms of tourism is likely

Logistics/distribution and transport

Possible impacts of climate change on the logistics/distribution and transport sector include:

- Disruption of ground and marine transportation systems as a result of severe weather (e.g., strong winds unbalancing freight trucks, sea storms disrupting shipping, and local drought affecting the navigability of inland waterways).
- Inundation of transport routes, transport infrastructure and distribution facilities and flood damage caused by rising sea levels.

Business risks	Business opportunities
• Distribution networks disrupted by extreme weather events resulting in delays, supply disruption, loss of goods • Some access routes permanently affected by ingress of water, loss of permafrost, subsidence, drought, etc. • Failure to meet contractual obligations due to disruptions caused by climate impacts • Regulatory changes on energy efficiency and GHG emissions	• Creation of new shipping routes as sea ice patterns change • Creation of new markets for automotive equipment suitable for specific climatic conditions

Business risks	Business opportunities
• Business interruption, asset damage and failure to meet contractual obligations due to extreme weather events • Interruption in fuel supply due to extreme weather and related events along the supply chain • Reduced availability of water for production operations, resulting in reduced plant output and/or need to modify equipment • Loss of revenue due to reduced availability of water for product use at customer location • Loss of revenue due to climate impacts on customer demand including extreme weather events and health impacts • Coastal facility closure due to flooding and/or sea level rise • Food processors will face risks from impacts to agriculture and reduced water supply • Reduced demand for heating equipment systems and some energy-intensive products	• Increased demand for low-water and other sustainable products and services, including energy efficiency products and services • Increased demand for cooling equipment systems and services during hot weather • Increased demand for resilient materials including building supplies • Increased demand for infrastructure and manufacturing systems' retrofit, which could increase demand of equipment components

Industry/manufacturing

Possible impacts of climate change on the general industrial and manufacturing sector include:

- Increased costs resulting from higher energy demand, particularly increased peak demand in the summer for cooling
- Disruption of coastal manufacturing facilities, transport networks, production facilities and infrastructure resulting from growing frequency and severity of extreme weather events, such as high winds and waves
- Greater level of risk to coastal, riparian and estuarine production facilities as a result of rising sea levels
- Higher costs, levels of competition and potential conflict for water resources between users including industrial facilities, power generators (for cooling and hydropower), public water suppliers and the agricultural community.

Business and adaptation

The business case for adaptation planning is a strong one. The key drivers of adaptation and potential rewards include: competitive advantage, cost savings, liability management, investor pressure, regulation and community resilience. Adaptation action can generate tangible short- and long-term benefits for business operations. It can also yield benefits for local communities. Minimizing risk and leveraging opportunities of the type described in the sector overview section require the building of adaptation strategies into risk management and business planning processes across the value chain.

Areas for business adaptation action

Along with efforts to reduce emissions, there are three spheres of risk and influence where business can take action to contribute to adaptation: "inside the fenceline" (within their own operations and supply chains), "beyond the fenceline" (in partnership with surrounding communities), and "beyond the horizon" (in collaboration with the global community).

Figure 5. Areas for business action on adaptation

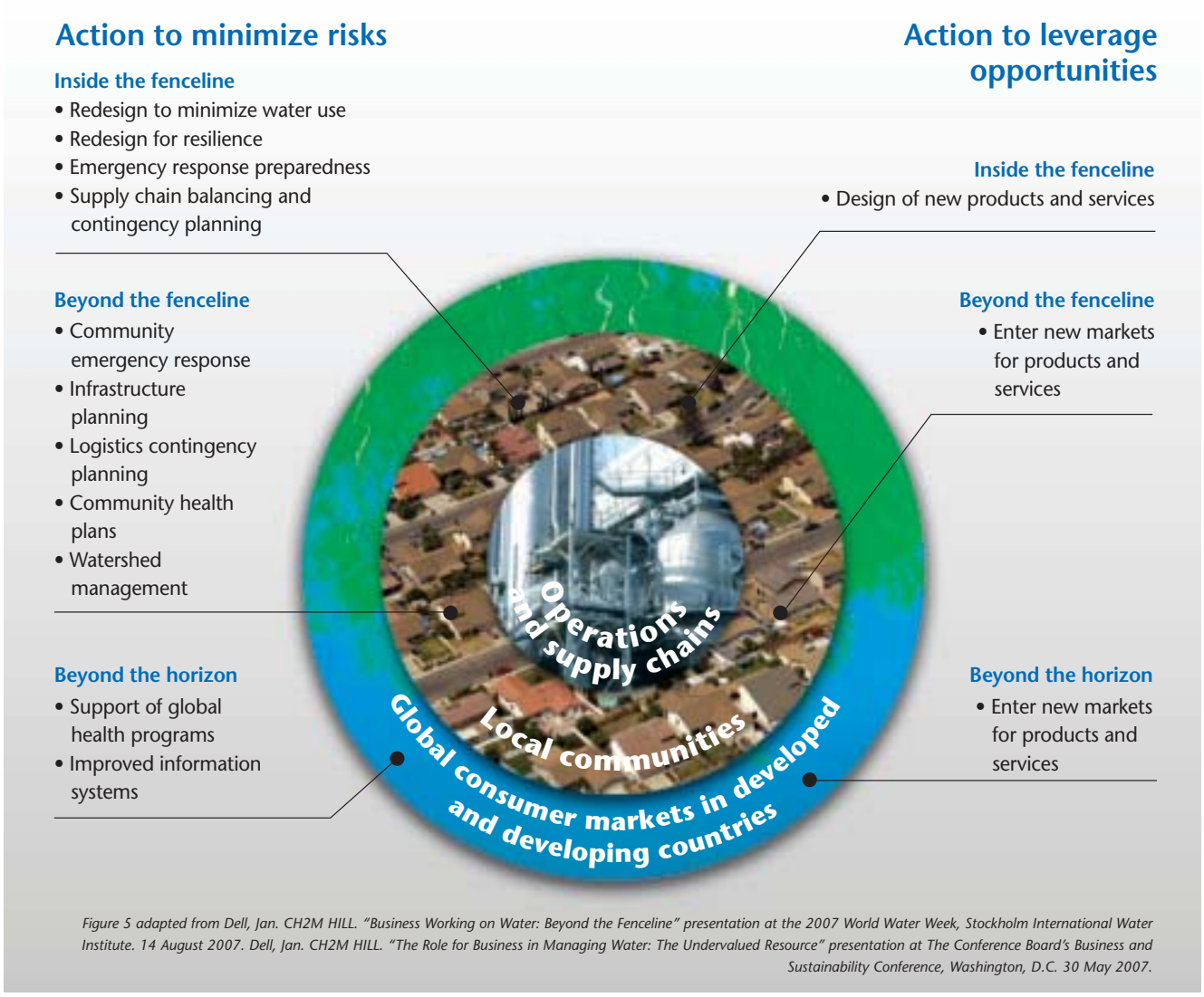


Figure 5 adapted from Dell, Jan. CH2M HILL. "Business Working on Water: Beyond the Fenceline" presentation at the 2007 World Water Week, Stockholm International Water Institute. 14 August 2007. Dell, Jan. CH2M HILL. "The Role for Business in Managing Water: The Undervalued Resource" presentation at The Conference Board's Business and Sustainability Conference, Washington, D.C. 30 May 2007.

Figure 5 provides a summary of adaptation actions that business can take to minimize risk and leverage opportunities in these three spheres of risk and influence.

Action within operations and supply chains – "within the fenceline"

Opportunities exist for business to innovate processes, products and services to respond to the changing climate and the need to protect existing assets. Business can show leadership by examining short- and medium-term risk factors. Quantitative assessments of the costs and benefits of adaptation are currently limited. Similar long-term issue risk management strategies and actions indicate that there are real gains to be made from integrating climate risk into decision-making. Making cost-effective expenditures on near-term projects can also yield significant long-term benefits.

Action in partnership with surrounding communities – "beyond the fenceline"

It may not be sufficient for business to restrict strategies for dealing with short- and long-term climate change impacts to its own facilities. Effective business operations require a stable and productive workforce, reliable infrastructure for energy delivery, adequate networks for the transport of goods and raw materials to market. Healthy and functioning communities near business operations and suppliers are critical to the well-being of employees and, by association, the ability of facilities and supply chains to operate. It is imperative therefore that surrounding communities also be able to withstand severe weather events and recover quickly in their aftermath, as well as adapt to physical effects and long-term impacts such as sea level rise. Many businesses already work with surrounding communities on issues of shared concern; however, in the future they may need to collaborate more closely with local communities to develop more comprehensive contingency and emergency response plans. To address both short-term and long-term impacts, business must be an active stakeholder in local government plans to design strong and resilient community capacity and infrastructure.

Action in collaboration with the global community – "beyond the horizon"

Developing countries are likely to be the most vulnerable to climate change. This is because they have fewer resources to adapt - socially, technologically and financially. A large amount of work has been carried out by many countries to assess impacts and vulnerabilities to climate change, as well as consider possible adaptation options. As noted by the UNFCCC,[32] developing countries have very different individual circumstances and the specific impacts of climate change in different countries will depend on the type of climate they experience as well as their geographical, social, cultural, economic and political situations. As a result, it is now firmly recognized that different countries will require different adaptation measures tailored to their individual circumstances.

The Assessments of Impacts and Adaptation to Climate Change (AIACC)[33] project, sponsored by the IPCC, comprised twenty-four national and regional assessments in Africa, Asia, Latin America and small island states in the Caribbean, Indian and Pacific Oceans. It was undertaken to better understand which communities are most vulnerable to climate change and to examine adaptation strategies. Comparison and synthesis of individual contributions have yielded nine general lessons for adaptation by vulnerable communities:

1. Adapt now
2. Create conditions to enable adaptation
3. Integrate adaptation with development
4. Increase awareness and knowledge
5. Strengthen institutions
6. Protect natural resources
7. Provide financial assistance
8. Involve those at risk
9. Use place-specific strategies.

The United Nations Development Programme (UNDP) 2007/2008 Human Development Report,[34] which focused on climate change, proposed that the foundations for successful national-level adaptation planning can be summarized under the four "I"s:

- **Information** for effective planning
- **Infrastructure** for climate-proofing
- **Insurance** for social risk management and poverty reduction
- **Institutions** for disaster risk management.

The UNFCCC, which provides the basis for international action on climate change, is assisting with adaptation efforts in developing countries. The newly formalized UN Adaptation Fund (see page 11) will provide funding for adaptation efforts in least developed countries.

The UNFCCC, with the Expert Group on Technology Transfer, has carried out an extensive review of adaptation technologies and assessed their possibilities in five sectors: coastal zones, water resources, agriculture, public health and infrastructure.[35] The UNFCCC found that most methods of adaptation involve some form of technology – which in the broadest sense includes not just materials or equipment but also diverse forms of knowledge. Some forms of technology for adaptation are familiar and time-tested, such as building houses on stilts or cultivation using floating vegetable plots. But other forms are much more recent, involving advanced materials science or remote satellite sensing.

In *Weathering the Storm: Options for Framing Adaptation and Development*, the World Resources Institute (WRI) reviewed 135 examples of adaptation efforts drawn from the developing world. In line with current approaches to development, they found that adaptation efforts are highly integrated and most projects use multiple strategies and address multiple sources of vulnerability. Many cross sectoral boundaries and address more than one impact associated with climate change.[36]

The 2007 *Survey of Climate Change Adaptation Planning*,[37] which focused primarily on urban areas in Western developed countries, particularly the United States, found that options available to planning officials have become better defined over time as they have been studied but the uncertainties arising from the variability in levels of vulnerability remain a challenge to adaptation planning.

Programs to improve the resolution of climate change modeling and advances in certainty projections of impacts are underway by the world's scientific community. As the specifics and certainty of the predicted impacts gain clarity through increased scientific research, businesses can collaborate with the UNFCCC, governments and non-governmental organizations to identify and support the implementation of effective adaptation measures to protect vulnerable countries. Business can offer unique skills to the collective effort, including: technology innovation for resilient materials, technology innovation to increase resolution of climate modeling, resilient infrastructure and facility design, improved information systems and major project management.

Future action

Climate change is one of the most critical challenges facing our world. In the future, WBCSD members will further investigate the business case for adaptation, identifying how companies may improve their resilience and adaptive capacity by addressing risks as they become better defined through improved climate change modeling. WBCSD members are committed to helping business and other stakeholders come together to better define needs and find solutions to the challenges of energy and climate change, including adaptation measures within operations and supply chains, with surrounding communities and with the global community to support vulnerable countries.

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About the WBCSD

WBCSD

The World Business Council for Sustainable Development (WBCSD) brings together some 200 international companies in a shared commitment to sustainable development through economic growth, ecological balance and social progress. Our members are drawn from more than 30 countries and 20 major industrial sectors. We also benefit from a global network of about 60 national and regional business councils and partner organizations.

Our mission is to provide business leadership as a catalyst for change toward sustainable development, and to support the business license to operate, innovate and grow in a world increasingly shaped by sustainable development issues.

Our objectives include:
Business Leadership – to be a leading business advocate on sustainable development;
Policy Development – to help develop policies that create framework conditions for the business contribution to sustainable development;
The Business Case – to develop and promote the business case for sustainable development;
Best Practice – to demonstrate the business contribution to sustainable development and share best practices among members;
Global Outreach – to contribute to a sustainable future for developing nations and nations in transition.

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Printer	Atar Roto Presse SA, Switzerland Printed on paper containing 50% recycled content and 50% from mainly certified forests (FSC and PEFC) 100% chlorine free. ISO 14001 certified mill.
ISBN	978-3-940388-25-4

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