Swiss Re

No. 1/2014

sigma

Natural catastrophes and man-made disasters in 2013: large losses from floods and hail; Haiyan hits the Philippines


FEUER

Fostering climate change resilience

Rising temperatures are the central component of climate change.

The term 'climate change' encompasses the changing nature of weather characteristics over long periods of time, usually longer than 10 to 15 years. Since the beginning of industrialization, rapid population growth and human activity has led to a significant increase in greenhouse gas emissions which, alongside natural variability, have pushed global temperatures higher. While temperatures had averaged around 14°C since the last ice age 11 000 years ago, they started to rise in the 20th century. According to the Intergovernmental Panel on Climate Change's (IPCC) Fifth Assessment Report[7], 1983 to 2012 was likely the warmest 30-year period of the last 1400 years in the northern hemisphere. "Likely" as used by the IPCC means a probability between 66% and 100%.

Climate change can lead to changes in the frequency, intensity and duration of extreme weather events …

The rise in global average temperatures changes the energy balance of the climate, leading to higher atmospheric humidity. This disrupts a complex, well-balanced system and will likely lead to shifts in the frequency, intensity and duration of extreme weather events such as floods, heat waves and other natural disasters. These events in turn generate increasing risks such as rising sea levels, drought, crop failures and water shortages. These risks engender significant environmental, social and economic costs. Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions. Indeed, if left unchecked, it is estimated that the overall costs of the effects of climate change could amount to 20% of global gross domestic product by the end of this century.[8]

… which in turn can generate significant social and economic costs.

An important contributing factor to the overall costs is the marked increase of wealth accumulation and settlement in areas highly-exposed to severe weather events. The good news, however, is that up to 68% of climate change risks can be avoided with cost-effective adaptation methods.[9] And, alongside local prevention and mitigation measures, risk transfer to re/insurers is a powerful adaptation measure to offset the impact of extreme weather events.

The reality of climate change

Climate change is caused by greenhouse gas emissions, as a result of human activity.

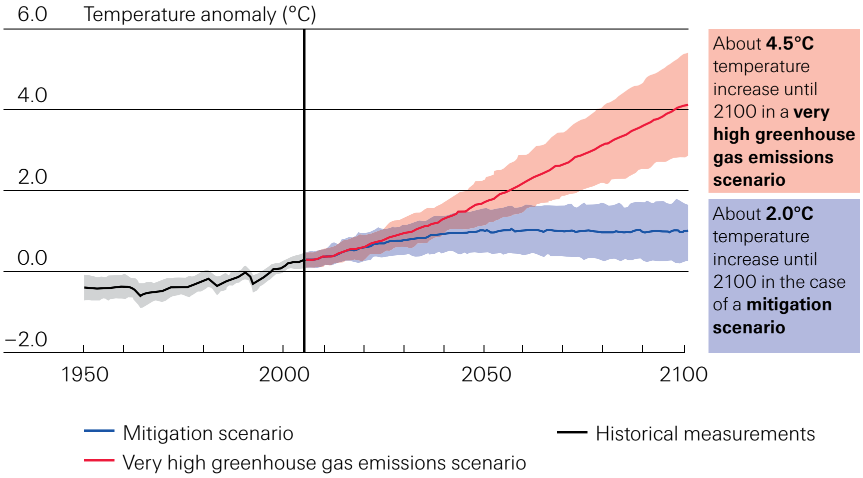
Land and ocean surface temperatures rose by 0.85°C in the period 1880 to 2012. The observed rise is due to increasing concentration of greenhouse gases, mainly carbon dioxide (CO_2), in the atmosphere. Since pre-industrial times CO_2 concentrations in the atmosphere have risen by 40%. The emissions are "very likely" (ie, with a probability of 90% or more) to have been caused by human activity, primarily the burning of fossil fuels and agriculture.[10]

Global mean temperatures are expected to rise by 2°C to 4.5°C by 2100.

The IPCC projects that global mean temperatures will continue to rise by between 2°C and 4.5°C by 2100. The extent of increase will strongly depend on the level of greenhouse emissions today and in the future. In the last decade, however, the increase in atmospheric temperature was lower than in the previous one. According to the IPCC, the reason for this is that most of the energy stored in today's climate system accumulates in the oceans, manifesting as warming ocean waters. Since 1971, the global oceans have absorbed more than 90% of the energy stored in the climate system.[11]

[7] Fifth Assessment Report: Climate Change 2013, Intergovernmental Panel on Climate Change (IPCC), 2013 http://www.climatechange2013.org
[8] Stern Review on the Economics of Climate Change, Lord Nicholas Stern, 2006 http://webarchive.nationalarchives.gov.uk/20080814121010/http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm
[9] Shaping Climate Resilient Development, Economics of Climate Adaptation Working Group, 2009 http://media.swissre.com/documents/rethinking_shaping_climate_resilent_development_en.pdf
[10] Fifth Assessment Report, IPCC, 2013
[11] Fifth Assessment Report, IPCC, 2013

Figure 5
Global average surface warming, 1950–2100

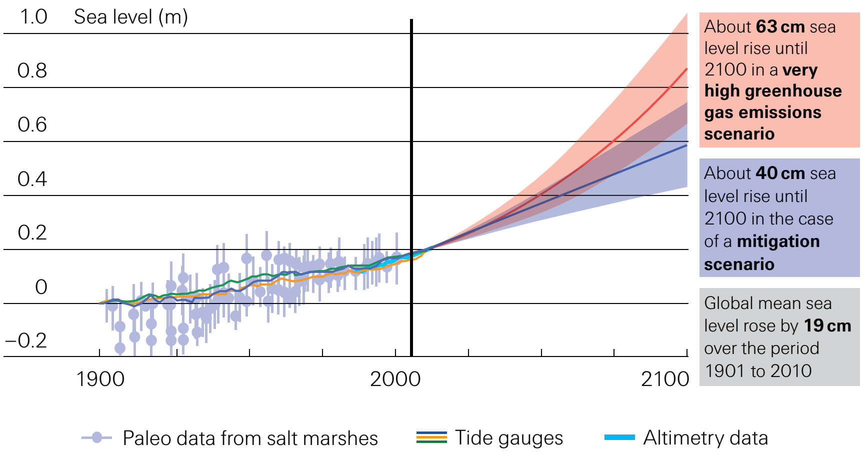


Source: IPCC AR5, September 2013, modified from SPM. 7a Final Draft

Sea levels continue to rise.

The increase of temperature has led to thermal expansion of the oceans. Additionally water that previously was stored in glaciers and ice sheets is melting into the oceans. The now exposed ocean absorbs solar radiation instead of reflecting it as ice would, leading to additional warming, continuing ice melt and rising sea levels. According to the IPCC, the global mean sea level rose by 19 cm over the period 1901 to 2010. It is forecast to rise another 40 cm by 2100 ***if*** society is able to reduce greenhouse gas emissions, and by up to 63 cm if CO_2 emissions continue unchecked.

Figure 6
Rising sea levels, 1900–2100



Source: IPCC AR5, September 2013, modified from Fig 13.27 and Final Draft

Climate change can lead to more frequent and intense rainfall over most land masses.

Furthermore the IPCC says changes in the global water cycles in response to the warming will likely not be uniform. The contrast in precipitation between wet and dry regions and between wet and dry seasons will increase, although there may be regional exceptions. An increase in heavy precipitation events (increase in the frequency, intensity, and/or amount of heavy precipitation) are "very likely" over most of the mid-latitude land masses and over wet tropical regions.[12]

[12] Fifth Assessment Report, IPCC, 2013

IPCC is the international body for the study of the science of climate change.

Intergovernmental Panel on Climate Change
The Intergovernmental Panel on Climate Change (IPCC) is the international body for the study of the science of climate change. The IPCC was set up in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) to provide policymakers with regular assessments of the scientific basis of climate change, its impacts, future risks, and options for adaptation and mitigation. The IPCC embodies a unique opportunity to provide rigorous and balanced information to decision-makers given its scientific and intergovernmental nature.

At the IPCC, 259 authors, 800 experts and 195 countries come together.

Participation in the IPCC is open to all member countries of the WMO and United Nations. It currently has 195 members. IPCC assessments are written by hundreds of leading scientists who volunteer their time and expertise as authors of the reports. They enlist hundreds of other experts as contributing authors to provide complementary expertise in specific areas. Swiss Re experts have served as review authors for IPCC reports.

Humans are "extremely likely" to have been the dominant cause of rising temperatures.

In its Fifth Assessment Report published in September 2013, the IPPC states: "Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased ... It is *extremely likely*[13] that human influence has been the dominant cause of the observed warming since the mid-20th century."

To find out more about the IPCC, see www.ipcc.ch

The dangers and costs of climate change

Climate change poses significant challenges and costs to economies and societies.

The rise in global average temperatures disrupts a complex, well-balanced climatic system and this has the potential to develop into the planet's greatest environmental challenge of the 21st century. Climate change exposes local populations to mounting challenges and costs of protecting assets, including human lives, against weather related risks. The Special Report on Extreme Events[14] published by the IPCC lists the following projected changes in climate extremes as a result of global warming.

- *Very likely* increase in the length, frequency and/or intensity of warm spells or heat waves over most land areas;
- *Likely increase* in the frequency of heavy precipitation events or an increase in proportion of total rainfall from heavy falls over many areas of the globe;
- *Medium confidence* in a projected increase in duration and intensity of droughts in some regions of the world;
- *Very likely* earlier spring peak flows in snowmelt- and glacier-fed rivers;
- *Very likely* that mean sea level rise will contribute to upward trends in extreme coastal high water levels;
- *High confidence* that changes in heat waves, glacial retreat, and/or permafrost degradation will affect high mountain phenomena, such as slope instabilities, mass movements and glacial lake outburst floods; and
- *High confidence* that changes in heavy precipitation will affect landslides in some regions.

[13] In the Fifth Assessment Report (2013), the IPPC states that for each assessment, the confidence level for the given assessment is first assessed (*low*, *medium*, or *high*), as follows. For assessments with *high confidence*, likelihood assessments of a direction of change are also provided (*extremely likely* for 99–100%, *very likely* for 90–100%, *likely* for 66–100%, *more likely* than not for 50–100%, *about as likely as not* for 33–66%, *unlikely* for 0–33%, *very unlikely* for 0–10%, and *exceptionally unlikely* for 0–1%). In a few cases for which there is *high confidence* (e.g., based on physical understanding) but for which there are not sufficient model projections to provide a more detailed likelihood assessment (such as 'likely'), only the confidence assessment is provided. For assessments with *medium confidence*, a direction of change is provided, but without an assessment of likelihood.

[14] Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX), IPCC, 2012, https://ipcc-wg2.gov/SREX

Since pre-industrial times CO_2 concentrations have increased by 40%.

Currently, 195 governments acknowledge that it is extremely likely human influence has been the dominant cause of the observed warming since the mid-20th century. Since pre-industrial times CO_2 concentrations in the atmosphere have increased by 40%, primarily from fossil fuel emissions and secondarily from net land-use-change emissions. Total greenhouse gas emissions since pre-industrial times have added 550 gigatonnes of carbon (GtC). CO_2 emissions from fossil fuel combustion and cement production are 8.3 GtC per year.[15]

Limiting the increase of global average temperature to 2°C by 2050 will require a substantial reduction of CO_2 emissions.

In terms of overall social and economic impact, the point at which climate change becomes dangerous is difficult to assess and is ultimately a societal value judgment. The consensus is that the rise in global average temperatures should be limited to no more than 2°C by 2050.[16] In terms of global carbon emissions, limiting the warming to 2°C corresponds to a global carbon budget – cumulative amount of greenhouse gases that can be released into the atmosphere – of 1200 GtC, with 550 GtC already emitted. This substantial emission reduction, it is hoped, will prevent worst case climate change impacts and still allow societies to cope with the consequences.

If left unchecked, climate-change related losses could be 20% of global GDP by the end of the century.

A rise in temperature well beyond 2°C, however, would likely cause massive[17] economic and social costs. If left unchecked, the costs of ongoing climate change could rise to around 20% of global GDP by the end of the century.[18]

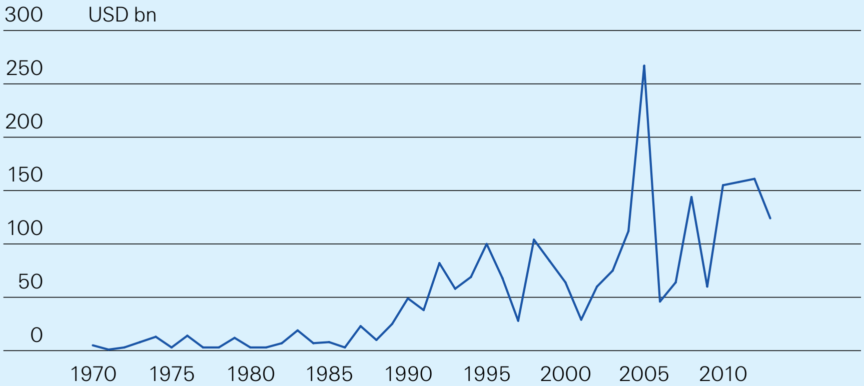
Economic losses have been rising in recent decades.

Extreme weather events: a history of rising losses

Total losses from natural catastrophes such as storms and floods and other weather-related events have risen significantly over recent decades.

Figure 7

Economic losses from extreme weather events, 1970–2013



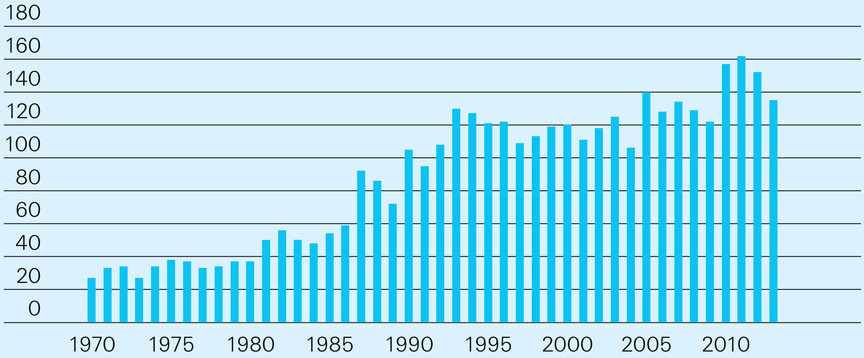
Source: Swiss Re Economic Research & Consulting

There are a number of reasons for the increasing losses:

- *An increase in the number of catastrophic* events. *Sigma* data shows a marked upward trend in the number of weather-related events since 1970. This may in part be due to more comprehensive and inclusive reporting of disaster events and associated losses, in parallel with heightened public awareness of disasters and their consequences.

[15] Fifth Assessment Report, 2013, (IPCC)
[16] Copenhagen Accord, 15th Conference of the Parties, 2009
[17] Turn down the heat, World Bank, 2012 http://documents.worldbank.org/curated/en/2012/11/17097815/turn-down-heat-4%C2%B0c-warmer-world-must-avoided
[18] Stern Review on the Economics of Climate Change, Lord Nicholas Stern, 2006

Figure 8
Number of weather-related catastrophes, 1970–2013



Source: Swiss Re Economic Research & Consulting

- *Rapid urbanization*. For the first time in history more people live in cities than in rural areas. Many of the growing cities are located in high-risk coastal or flood-prone areas.
- *Failure of infrastructure construction to keep pace with rate of urbanization*. People and assets have become increasingly concentrated in urban conurbations, often in disaster-prone regions. In emerging economies, rapid urban expansion has outpaced the construction/establishment of infrastructure and impact-reduction measures such as coastal defences, improved building codes, land-use zoning and planning, improved early-warning systems and disaster preparedness, and response and recovery procedures.
- *Increased vulnerability of assets and goods*. Today's productive processes are more complex, involving assets and inputs with overall higher economic value. The destruction of productive assets in a disaster event can therefore entail a higher overall financial loss than previously. With the interconnectedness of the global economy, the business interruption implications/costs can also be severe.
- *Environmental degradation*. Factors such as soil degradation, deforestation and changes in land-use can heighten the impact of extreme weather events.

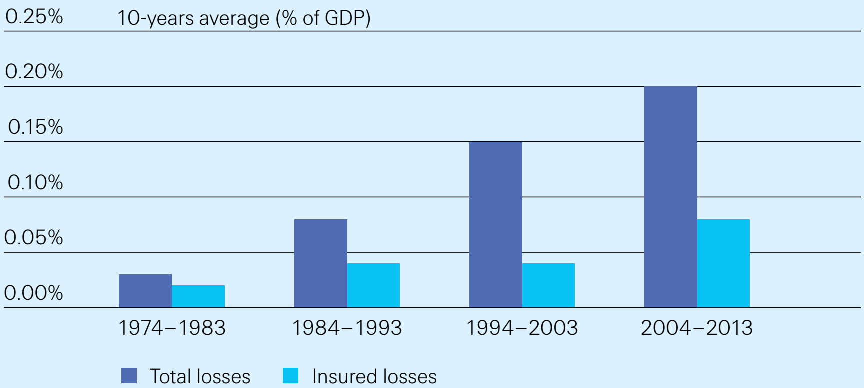
In the future climate change will be an increasingly important loss-generating factor.

In the future, climate change is expected to gradually lead to shifts in the frequency, intensity, spatial extent, duration and timing of extreme weather events. If no mitigating action is taken, these events will be an increasingly important contributing factors to rising losses from natural catastrophe events.

The protection gap relating to weather events has widened also.

In addition to widening economic losses, the level of insured claims generated by extreme weather events has risen over time also. However, the rate of growth of total losses has outpaced the growth of insured losses. Figure 9 compares the real growth in global total losses resulting from weather-related natural catastrophes with associated insured losses, as a percentage of GDP, over the period 1974 to 2013. As shown, the protection gap, that is the difference between insured and total losses, has widened over time, highlighting the ongoing under-insurance of society at large.

Figure 9
Total global losses versus insured losses resulting from weather-related catastrophes, 1974–2013



Source: Swiss Re Economic Research & Consulting

Fostering climate change resilience

"We need to avoid the unmanageable in order to manage the unavoidable." (James Hansen[19])

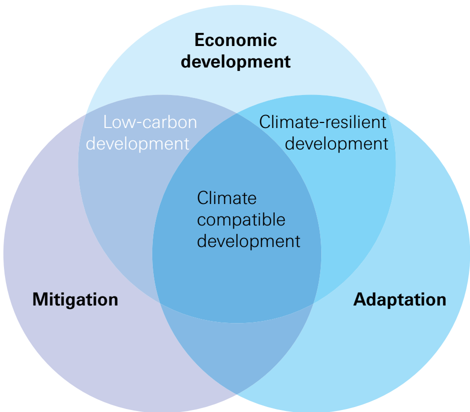
Carbon dioxide remains in the atmosphere for 100 years or more, thus creating a cumulative effect. Even if all emissions are stopped immediately, most aspects of climate change will persist for many centuries. That does not mean, however, that nothing can be done. Risk prevention and avoidance measures as well as disaster risk management measures can be implemented to build resilience to the impacts of climate change. Two kinds of measures need to be implemented together:

- *Climate change mitigation* – reducing greenhouse gas emissions as substantially and quickly as possible; and
- *Adaptation to climate change* – undertaking measures to deal with the impact of climate change. Adaptation measures include infrastructure improvements such as strengthening buildings against storms or constructing reservoirs and wells to combat drought; technological measures such as improved fertilizers use; systematic or behavioral initiatives such as awareness campaign, and disaster relief and emergency response programs. Risk transfer or insurance measures also play a key role in addressing low-frequency/high-impact weather events such as a once-in-100-year storm surge.

Both mitigation and adaptation are essential and complementary.

Climate-resilient development combines adaptation to climate change with economic development. Though adaptation will be indispensable, it cannot be a substitute for mitigation. As economies develop, they also need to change production and consumption patterns to reduce carbon emissions.

Figure 10
Climate-resilient development combines adaptation and economic development.



Source: Swiss Re, Our positions and objectives

[19] James Hansen http://www.columbia.edu/~jeh1

The ECA offers the facts to understand climate risk and identifies the actions to economically minimize weather impacts.

Economics of Climate Adaptation

The re/insurance industry can take a leading role in tackling climate change. With understanding of the risks and tailor-made risk transfer options, the industry can compile data for climate adaptation and to protect livelihoods from catastrophic events. In a seminal study on the "Economics of Climate Adaptation"[20] (ECA) in 2009, Swiss Re and other leading organizations developed a methodology to quantify local climate risks and provide decision-makers with the necessary facts to design a cost-effective climate adaptation strategy. With a time horizon of 2030 or 2050, the ECA offers countries and local decision-makers the facts and framework to pro-actively manage climate risks and to systematically integrate adaptation to climate change within development processes.

Up to 68% of climate-change generated losses can be avoided with cost-effective adaptation measures.

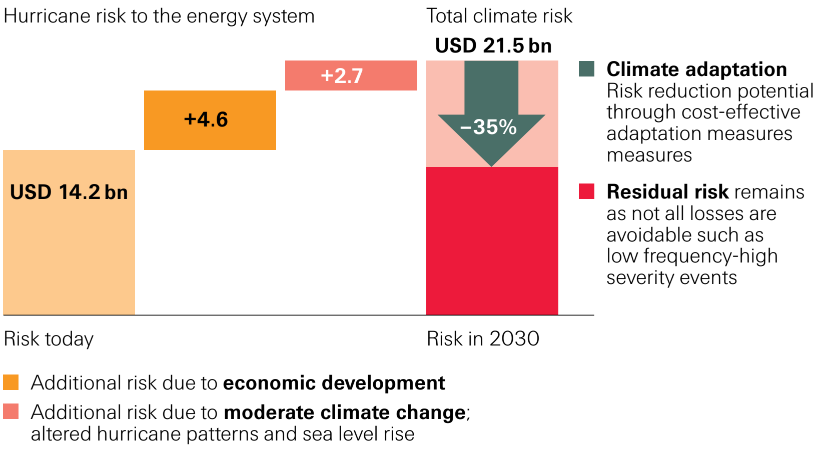
Case studies in 20 different regions around the globe, ranging from New York City, the Caribbean, to Northern England and Maharashtra in India, show that up to 68% of loss from climate change can be prevented using cost-effective adaptation measures. In a first step, the ECA methodology assesses the total climate risk. The total climate risk starts with today's climate risk, charts out the economic development paths that put greater population and assets at risk and considers the additional risks presented by climate change. A second step builds a balanced portfolio of adaptation measures assessing the loss aversion potential as well as the costs for each measure.

Case study: the US Gulf Coast

The US Gulf Coast is exposed to hurricane and storm surges.

One of the locations assessed using the ECA methodology was the US Gulf Coast – a strip of land comprising coastal Texas, Mississippi, Alabama and Louisiana. This is America's energy coast, which is a major part of the US oil and gas industry. Entergy Corp., America's third-largest utility company, commissioned a study[21] to assess the impact of natural hazards on the Gulf Coast's economy. The area already faces significant risk of hurricane wind and storm surge damage. Based on the ECA methodology, the report estimates today's average weather-related economic loss for the US Gulf Coast to be USD 14.2 billion per year.

Figure 11
Total climate risk at the US Gulf Coast



Source: Swiss Re, ECA Group, Building a Resilient Energy Gulf Coast

[20] Shaping Climate Resilient Development, Economics of Climate Adaptation Working Group, 2009 http://media.swissre.com/documents/rethinking_shaping_climate_resilent_development_en.pdf
[21] Building a Resilient Energy Gulf Coast, ECA Working Group, 2010 http://media.swissre.com/documents/Entergy_study_exec_report_20101014.pdf

Economic loss potential from weather events is estimated at USD 14.2 billion per year today, rising to USD 21.5 billion by 2030 or USD 23.4 billion per year in the case of extreme climate change scenario.

The economic loss potential may rise to USD 21.5 billion per annum by 2030, taking into account an estimated additional USD 4.6 billion in potential average yearly loss generated by the increase in asset accumulation as a result of economic development during that period (see Figure 11). Additionally, a moderate climate change scenario featuring rising sea levels, more severe hurricanes and land subsidence adds another USD 2.7 billion for a total amount of USD 21.5 billion expected annual losses by 2030. Assuming an extreme climate change scenario (not shown in Figure 11), the ECA methodology estimates that the average annual economic loss could rise to as much as USD 23.4 billion by 2030.

Cost-efficient adaptation measures

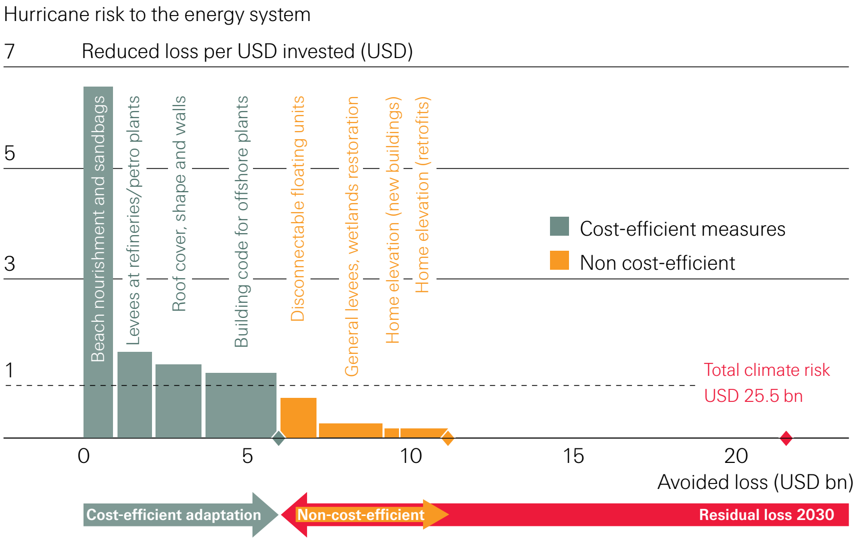
The ECA methodology identified over 20 adaption measures for the US Gulf region case study.

The ECA methodology identified over 20 adaptation measures for the US Gulf and assessed their risk reduction efficiency. The cost-benefit ratio is the loss reduction compared to the mitigation costs, including capital and operating expenses. A cost-efficient measure will prevent more losses than the mitigation costs. The reduced losses per US dollar invested are shown in the adaptation cost curve (see Figure 12).

Cost-efficient adaptation measures could reduce damages by 35%.

The study shows that a number of cost-efficient adaptation measures are available and that together these could lower damages by 35%. Among the most attractive adaptation measures are beach nourishment, levees at refineries, roof cover retrofits and improved building codes. Beach nourishment, for instance, can lower losses by USD 1 billion annually for an annual cost of only USD 0.15 billion, or USD 6.70 for every US dollar.

Figure 12
Adaptation cost curve for the US Gulf Coast



Source: Swiss Re, ECA Group, Building a Resilient Energy Gulf Coast

Risk transfer

Risk transfer is an important adaptation measure for natural disaster events.

While cost-efficient adaptation/prevention measures are available in different locations, no individual, business and public institution can afford to prevent losses from every conceivable risk event. This is especially true for events that are unlikely to occur or that can only be avoided at an enormous cost, as is the case with natural disasters. In these cases, re/insurance can play an important role in helping individuals, communities and businesses recover from the devastation wreaked by severe weather events.

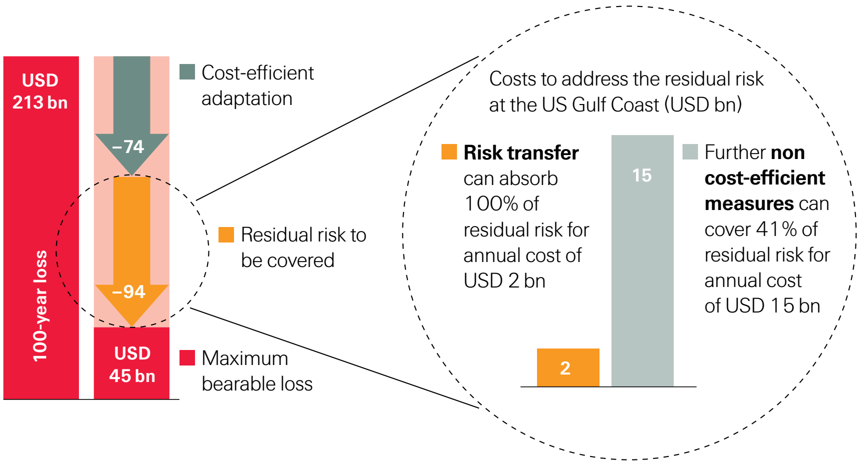
Risk prevention and risk transfer are mutually reinforcing.

Transfer of such risks is an efficient way to obtain additional protection for low-frequency natural catastrophe events. Important, however, is that risk prevention and risk transfer are mutually reinforcing. While insurance is a useful component in a given adaptation portfolio, keeping insurance prices in check by minimizing residual risks through prevention measures is equally important. The ECA study shows that a balanced portfolio of prevention, intervention and insurance measures is available to pro-actively manage total climate risk and to strengthen the region's resilience.

Risk transfer can be a more cost-efficient solution.

Going back to the US Gulf example, the ECA study estimates a once-in-100-year economic loss of USD 213 billion for the region, comprising additional risk due to economic development and assuming a moderate climate change scenario. Cost-efficient adaptation measures could lower this by about USD 74 billion for such low-frequency/high-impact events. Meanwhile, the region's public authorities assessed the maximum affordable damage from a single event to be around USD 45 billion. The remaining USD 94 billion in economic damage is residual risk that also needs to be addressed through non-cost-efficient measures or risk transfer. Non-cost-effective measures costing USD 4.7 billion per year, such as home elevation and opening protection (for example, shutters) for all existing buildings, could cover only 41% of the residual risk. Risk transfer, however, presents a more cost-efficient solution by providing more comprehensive coverage for only USD 2 billion a year.

Figure 13
US Gulf Coast: hurricane risk to the energy system



Source: Swiss Re, ECA Group, Building a Resilient Energy Gulf Coast

Implementing adaptation measures is less expensive than waiting.

The ECA case studies highlight economic development and climate change as the key drivers for future climate-related losses. The analysis presents a strong case for immediate action. Implementing adaptation measures, including risk transfer, can help build global resilience to climate change. It is also less expensive than doing nothing and dealing with the rising costs only after they are incurred.

Understanding climate change is critical to developing good risk-transfer solutions.

The role of re/insurers

Natural catastrophes such as floods, storms and earthquakes constitute key risks in property & casualty (P&C) re/insurance. Understanding natural catastrophe risks and the impact of climate change is critical to assessing the re/insurance industry's P&C business accurately and to structuring sound risk-transfer solutions. This is why some re/insurers invest in proprietary, state-of-the-art natural catastrophe models and collaborate with universities and scientific institutions. Urbanization, the clustering of properties and commercial activity and migration to high-risk areas such as coast and flood plains need to be closely monitored. This enables the industry to stay abreast of the latest knowledge on the economic impact of natural disasters, including the effects of climate change.

Risk models will adjust to the continuing rise in natural catastrophe losses.

While the impact of climate change will manifest itself over the coming decades, most of the industry's business is renewed annually and risk models are refined regularly. Risks are usually covered for 12 months by re/insurance and up to five years by catastrophe bonds. Thus, re/insurance premiums do not reflect long-term expected loss trends. Instead, for underwriting and risk management purposes, the models provide an estimate of today's risk. However, as natural catastrophe losses continue to rise, risk models will gradually reflect this trend as they are updated.

The re/insurance industry is highly exposed to future impacts of climate change.

The re/insurance industry – given its role as ultimate risk taker – is highly exposed to the future impacts of climate change. In the last 20 years, concerns around climate change have increasingly featured in re/insurers' long-term risk management strategies. Along with economic losses, insured losses from weather events have also increased significantly over recent decades. *Sigma* data shows that in the period 1974 to 1983, insured losses from weather-related events averaged 0.018% of global GDP. The 10-year average in 2004 to 2013 rose to 0.077% of global GDP.

Re/insurers can play a central role in building global resilience to climate change.

Even so, the gap between economic and insured losses remains large, and natural disasters continue to place a significant burden on the public sector, uninsured individuals and businesses. Risk transfer can protect livelihoods from catastrophic events and increase the willingness of decision-makers to invest in economic development. Additionally risk transfer puts a price tag on risk and thereby incentivizes investments in prevention measures. In continuing to further push the boundaries of insurability, the re/insurance industry can make an effective contribution by developing the numerous business opportunities that climate change has and will create in the future. In this way, re/insurance is a powerful tool to strengthen the resilience of local and national economies, and humanity at large.

Swiss Re Ltd
Economic Research & Consulting
P.O. Box
8022 Zurich
Switzerland

Telephone +41 43 285 2551
Fax +41 43 282 0075
sigma@swissre.com