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A global overview of case studies with a focus on infrastructure

Economics of Climate Adaptation – Shaping climate-resilient development

Storms, floods, droughts and other extreme weather events can threaten cities, regions and entire nations. Losses from natural catastrophes are rising, as wealth accumulates in the world's most exposed regions and our climate continues to change.

The good news is that up to 65% of climate risks can be averted. But we have to act now, and we have to act together. Only by combining risk prevention, risk mitigation and risk transfer measures as part of a comprehensive adaptation strategy, we will make urban and rural communities more resilient to the impacts of climate change.

The economics of climate adaptation

Climate adaptation goes hand in hand with economic development planning. It not only helps us secure development gains already made, but also ensures that any future growth is sustainable. National and local decision-makers, such as finance ministers and mayors, ask:

- What is the **climate-related loss** over the coming decades?
- How much of that **loss can we avert,** with which measures?
- What investments will be required to fund those **measures –** and will their benefits outweigh their costs?

The Economics of Climate Adaptation (ECA) methodology is a guide that seeks to answer these questions in a more systematic way. Looking ahead to 2030 or 2050, it provides decision-makers with the facts to understand the total climate risk in their region and design an appropriate adaptation strategy. The ECA identifies actions that minimise weather impacts at the lowest cost to society and enable decision-makers to pro-actively manage total climate risk.

We have so far carried out over 20 ECA studies (see world map). They range from assessments of tropical cyclone and storm surge risk in New York to drought risk in India and flash flood risk in the fast developing city of Georgetown, capital of Guyana.

New York
Tropical cyclones and storm surge risk to a metropolis

Florida
Hurricane risk to public and private assets

US Gulf Coast
Hurricane risk to the energy system

Caribbean
Hurricane risk to small islands

Guyana
Flash flood risk to a developing urban area

The world's average temperature has risen by 0.85°C since 1900.

Extreme weather events have become more numerous and severe.

Hull, UK
Flood and storm risk to urban property

China
Drought risk to agriculture

Samoa
Risk of sea level rise to a small island state

Tanzania
Drought risk to health and power generation

India
Drought risk to agriculture

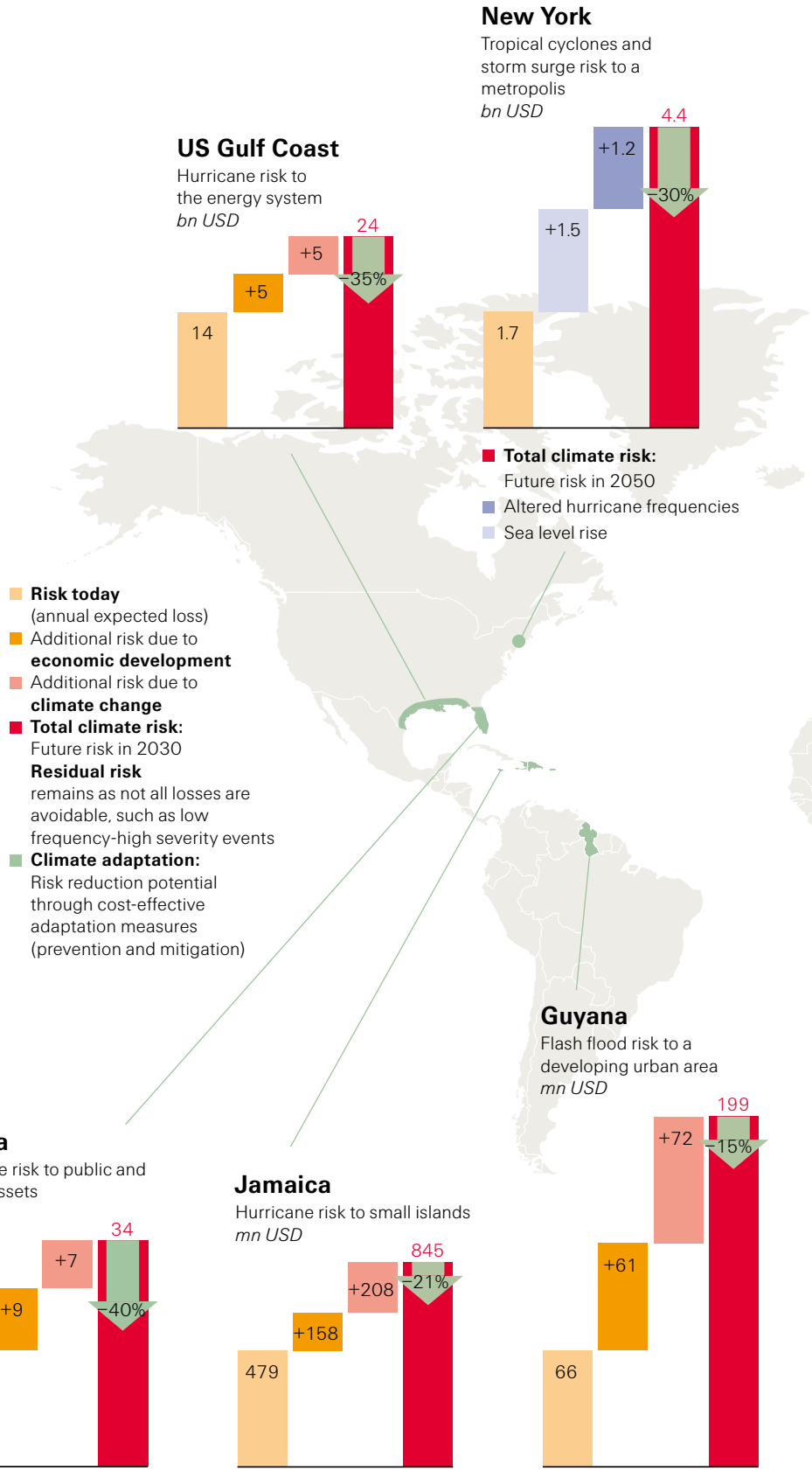
Mali
Risk of climate zone shift to agriculture

Total climate risk comprises today's risk and the future risk associated with economic growth and climate change.

The total climate risk (red) includes today's risk (yellow), the economic growth (orange) that puts greater population and assets at risk and the aggravating risk through climate change (bright red) within the next twenty years.

With current development continuing until 2030, national and local economies studied are projected to lose between 1 and 20% of GDP (or between 47 million and 26 billion USD) annually as a result of existing climate patterns. Climate change could worsen this picture significantly: an extreme climate change scenario would lead to annual losses from flood, drought, heat waves, and tropical storms between 77 million and 33 billion USD.

However, the cases found that prevention and mitigation measures are available to address a large part of the identified climate risks (see step 2 for more information). Climate adaptation (green) can avert between 15 and 80% of the total climate risk. Residual risk (red) remains as not all losses are avoidable, such as low frequency-high severity events.



ECA integrates adaptation to climate change with economic development and sustainable growth.

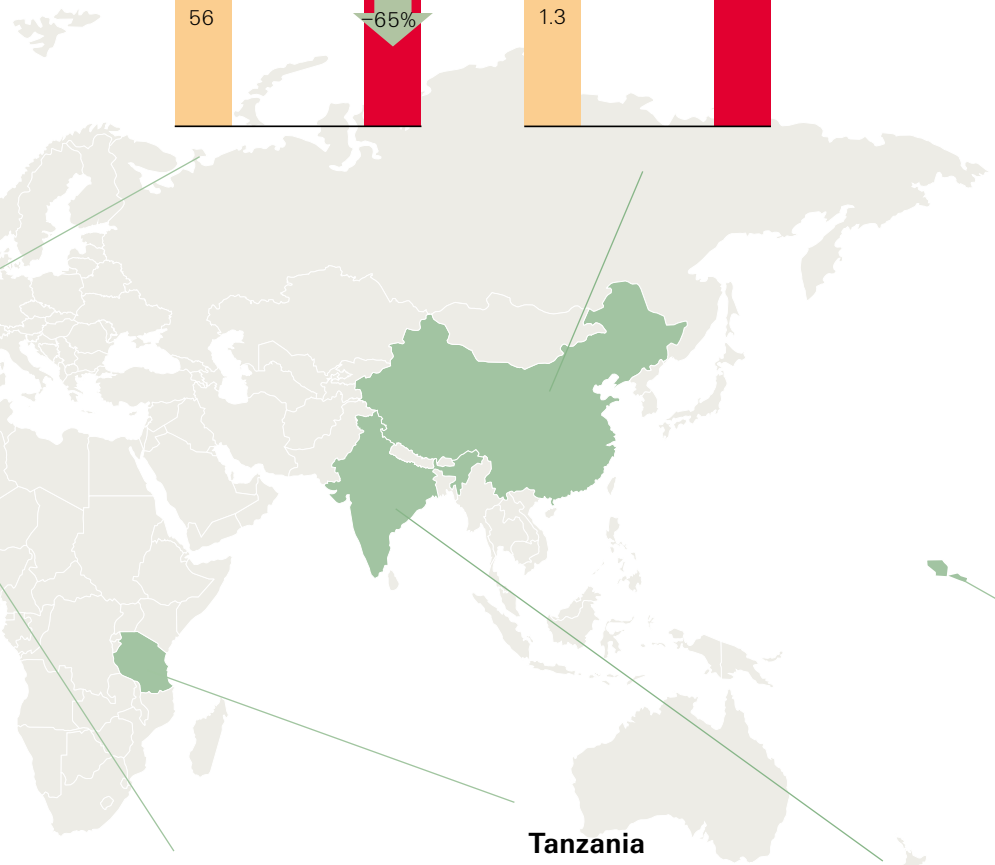
How we do it

For a given region we compile population and assets at risk. Based on the geographic distribution of their exposure, we identify the most relevant climate hazards. Based on historic events and probabilistic natural catastrophe modelling, we calculate the expected economic loss today.

We derive three climate change scenarios, no change, moderate change and extreme change for the year 2030. The scenarios are derived from the latest scientific findings, eg the Assessment Reports issued by the Intergovernmental Panel on Climate Change (IPCC).

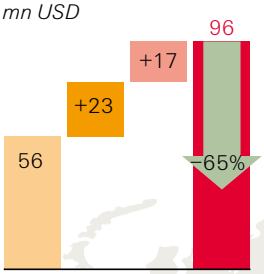
Example scenarios for impacts of climate change on extreme events

- Increased frequency of strong hurricanes (Saffir-Simpson category 4 and 5)
- Increase of storm surge height
- Sea level rise
- Prolonged droughts
- Increase in extreme precipitation



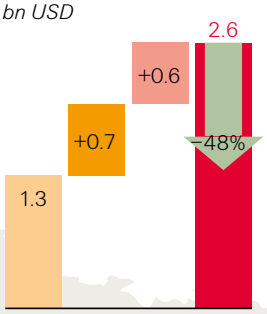
Hull, UK

Flood and storm risk to urban property
mn USD



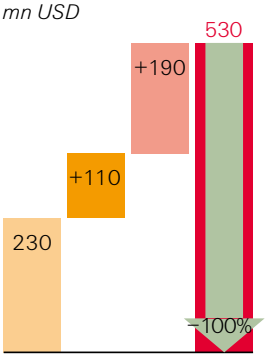
China

Drought risk to agriculture
bn USD



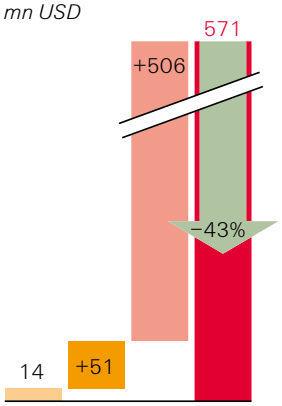
Mali

Risk of climate zone shift to agriculture
mn USD



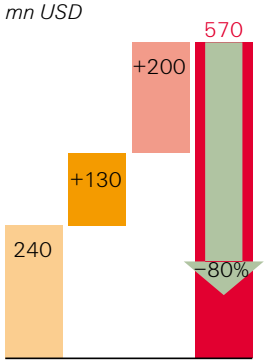
Tanzania

Drought risk to health and power generation
mn USD



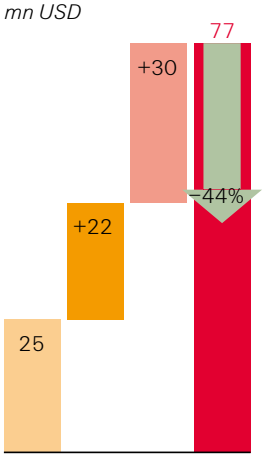
India

Drought risk to agriculture
mn USD



Samoa

Risk of sea level rise to a small island state
mn USD



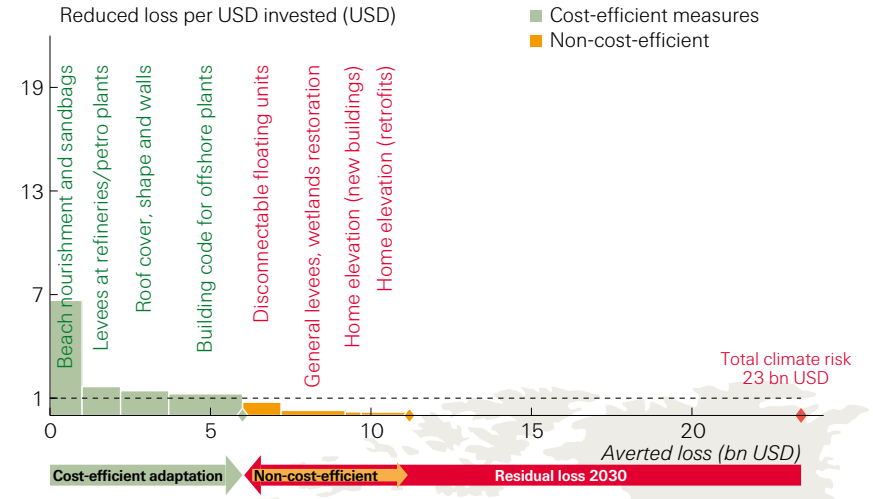
A portfolio of climate adaptation measures is required to address the total climate risk.

We use a cost-benefit analysis to evaluate which investments and measures are the most feasible and cost-effective to adapt to the expected risk.

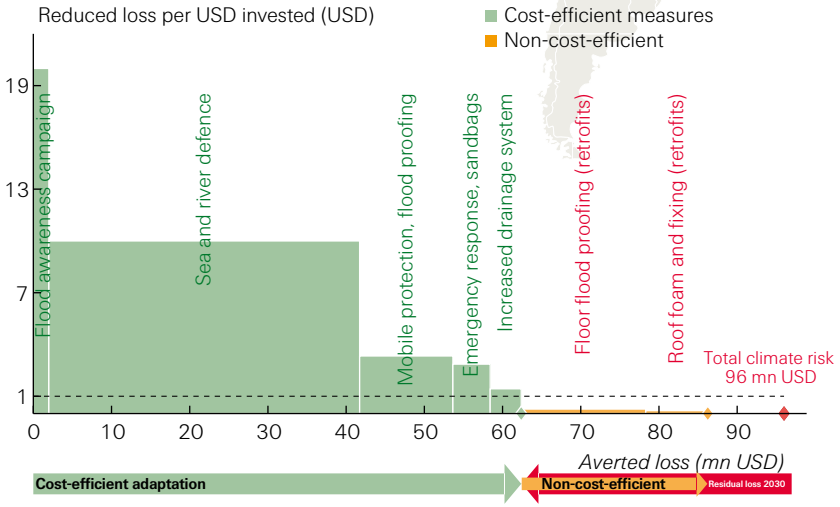
Adaptation measures include infrastructure improvements such as strengthening buildings against storms or constructing reservoirs and wells to combat drought; technological measures such as the improved use of fertilizers; behavioral initiatives such as awareness campaign; and disaster relief and emergency response programmes. Risk transfer or insurance measures also play a key role in addressing rare but severe weather events, such as a once-in-100-year storm surge (see step 3 and the example at the US Gulf Coast).

The output of this cost-benefit exercise is an adaptation cost-curve. This curve is a key source of information – along with policy, capacity and other considerations – that a country, region or city can use to assemble a comprehensive adaptation strategy.

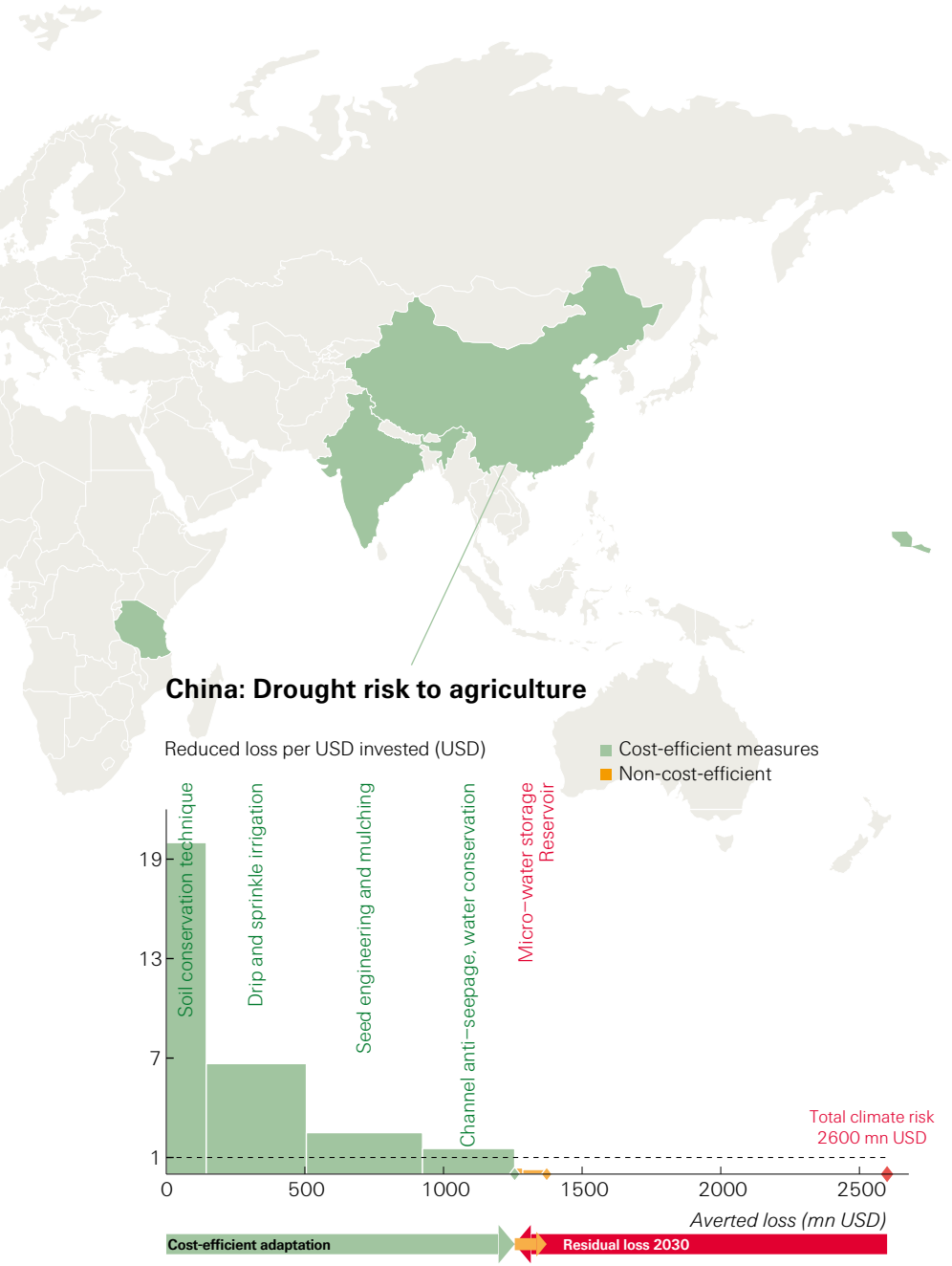
US Gulf Coast: Hurricane risk to energy system



Hull, UK: Flood and wind risk to urban property



Up to 65% of future climate losses can be averted using cost-effective adaptation measures.



China: Drought risk to agriculture

How we do it

We identify a comprehensive inventory of local adaptation measures, many of which span both climate adaptation and economic development, with the participation of local and international experts as well as officials and population. We then derive a shortlist of measures based on an assessment of existing literature and local interviews.

For the cost-benefit analysis, the benefit is calculated as the averted loss and any additional revenues if applicable. The costs include capital and operating expenses as well as any potential operating savings derived from the measures. The stream of costs is discounted back to today's dollars using local discount rates.

Each adaptation measure is plotted on the adaptation cost curve, ranging from the most cost-efficient on the left of the curve to the least cost-efficient measures on the right. The horizontal axis depicts the total climate risk and indicates the extent of the loss averted by each measure.

Not all losses are avoidable, especially those caused by low frequency, high severity events.

Step 3: Covering residual risk

Risk transfer efficiently provides additional protection for low-frequency, high-severity events.

Attractive adaptation measures range from strengthened flood defences and improved building codes to beach nourishment and roof cover retrofits. And yet, while cost-effective 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 risks that are unlikely to occur or that can only be averted at an enormous cost.

For such rare events, risk transfer can efficiently provide additional protection by capping losses and smoothing the costs of climate events to individuals, corporations and governments. It can thus protect livelihoods against catastrophic events and increase the willingness of decision-makers to invest in economic development.

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 minimising residual risks through prevention measures is equally important.

Step 3 is an additional analysis to assess the benefits of risk transfer in specific ECA cases. It has been conducted for Samoa, the US Gulf Coast and Hull.

Example US Gulf Coast: The 100-year loss at the US Gulf Coast could add up to 213 billion USD

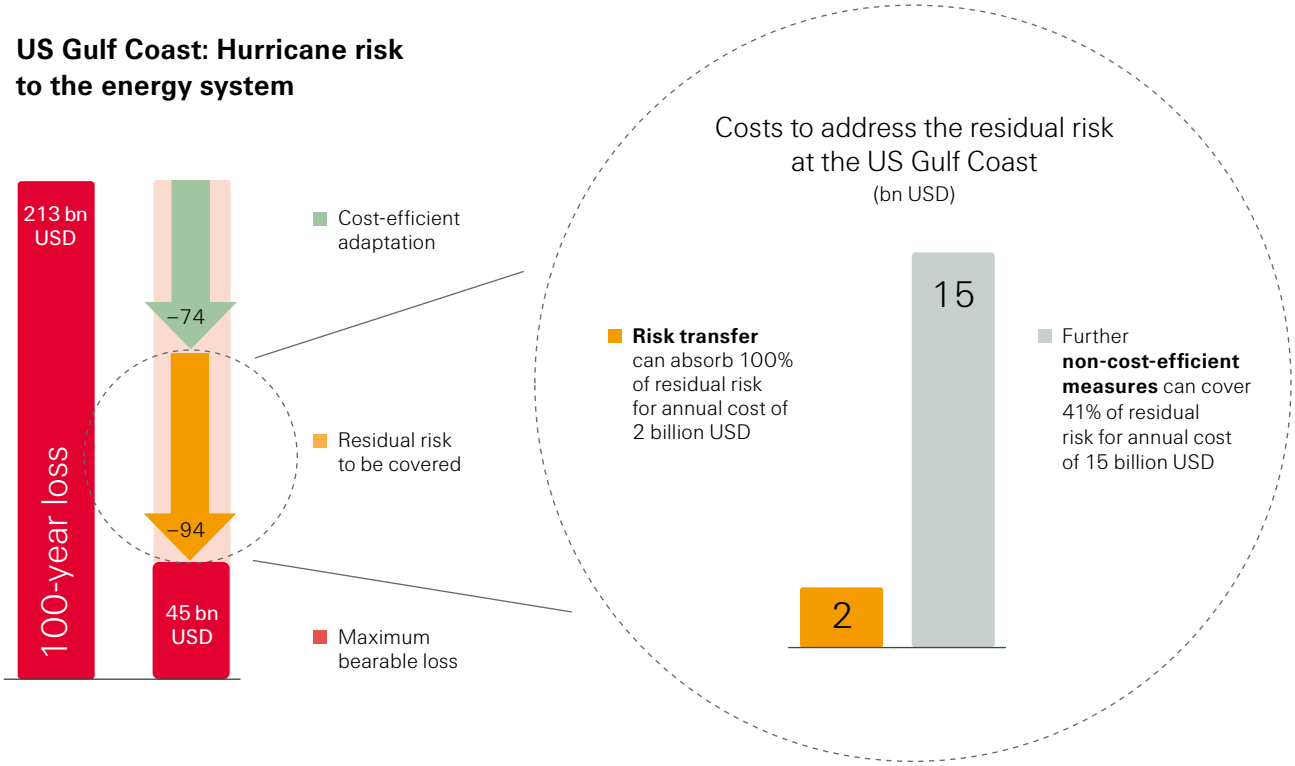
America's Energy Coast – a strip of land comprising coastal Texas, Mississippi, Alabama and Louisiana – harbours over 2 trillion USD in infrastructure assets. Its economy is largely supported by the US oil and gas industry, which owns around 90% of industrial assets. Severe wind and storm surge from hurricanes threaten people, assets and the region's economy.

In the case of a 100-year loss, cost-efficient adaptation measures such as beach nourishment, improved building codes and levees at refineries can avert more than 35% of the loss.

Insurance is a useful component in a given adaptation portfolio

The region's public authorities assessed the maximum affordable damage from a single event to be around 45 billion USD. The remaining 94 billion USD in economic damage is residual risk that needs to be addressed through non-cost-efficient measures or risk transfer. Further physical measures, such as home elevation and opening protection (for example, shutters) could cover only 41% of the residual risk amounting to 15 billion USD costs annually. Risk transfer, however, presents the most efficient solution by being both cheaper with 2 billion USD a year, and more comprehensive in coverage than other measures considered.

US Gulf Coast: Hurricane risk to the energy system



Read more

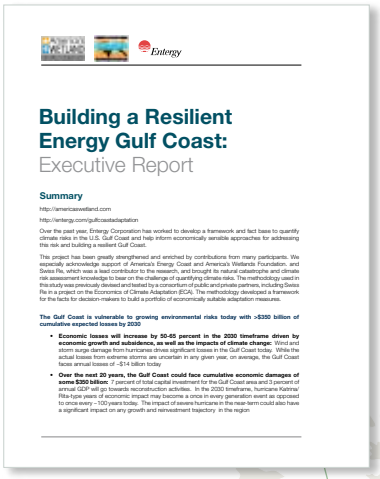
The Economics of Climate Adaptation (ECA) Working Group

is a partnership between the Global Environment Facility, McKinsey & Company, Swiss Re, the Rockefeller Foundation, ClimateWorks Foundation, the European Commission, and Standard Chartered Bank.

US Gulf Coast

Hurricane risk to the energy system

http://media.swissre.com/documents/Entergy_study_exec_report_20101014.pdf



New York

Tropical cyclones and storm surge risk to a metropolis

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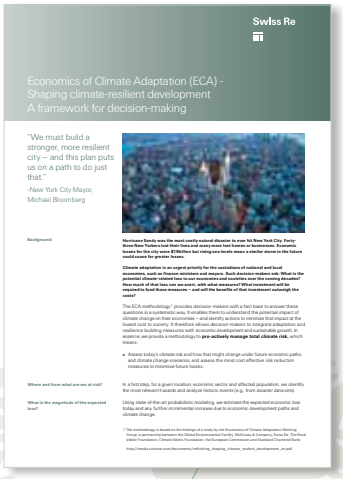


ECA full report

featuring the first 8 case studies, 164 pages

http://media.swissre.com/documents/rethinking_shaping_climate_resilient_development_en.pdf

Caribbean

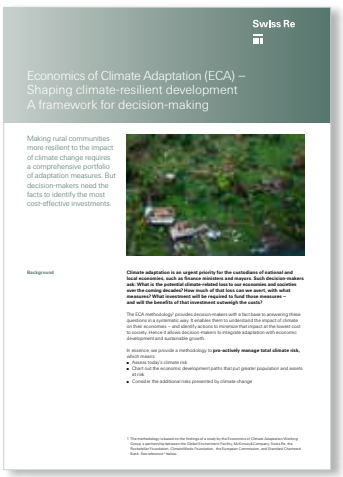
Hurricane risk to small islands

http://media.swissre.com/documents/ECA+Brochure-Final.pdf

Guayana

Flash flood risk to a developing urban area

http://media.swissre.com/documents/Economics_of_Climate_Adaption_Guyana_Factsheet_en.pdf



Mali

Risk of climate zone shift to agriculture

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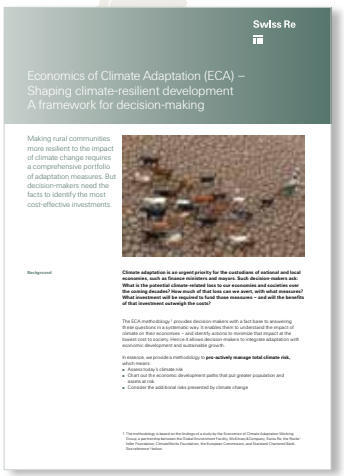

Hull, UK

Flood and storm risk to urban property

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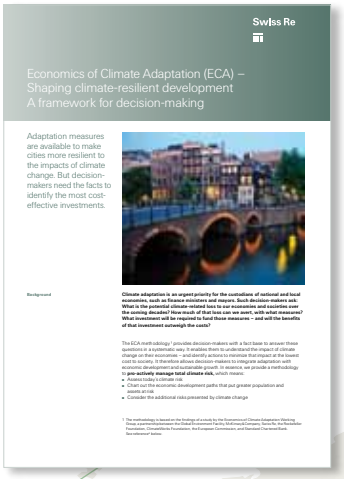

India

Drought risk to agriculture

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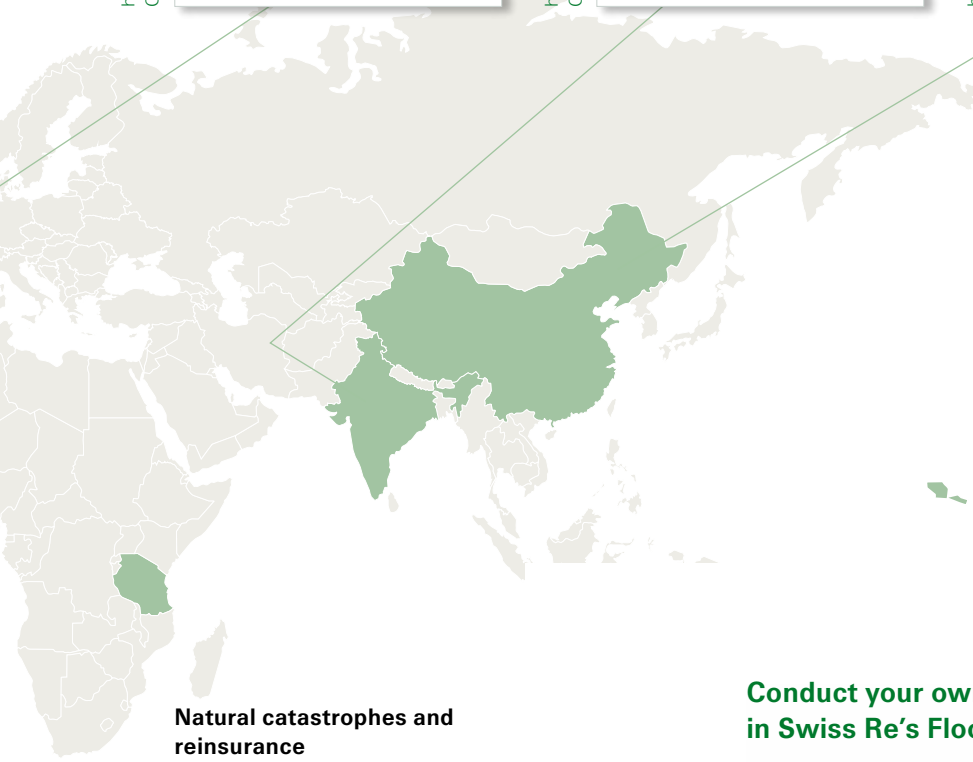
China

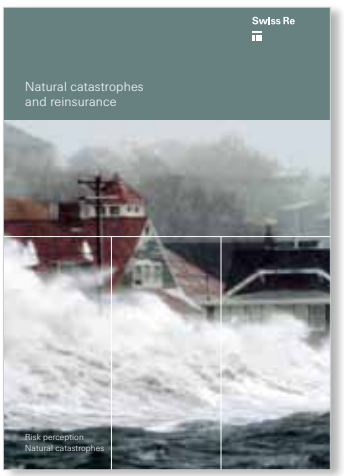
Drought risk to agriculture

http://media.swissre.com/documents/rethinking_shaping_climate_resilient_development_en.pdf#page=74



Natural catastrophes and reinsurance

http://media.swissre.com/documents/Nat_Cat_reins_en.pdf



Conduct your own Economics of Climate Adaptation in Swiss Re's Flood App

Step 1:
Analyze the total climate risk

Step 2:
Adapt cost-efficiently to the risk

www.swissre.com/floodriskapp

The Economics of Climate Adaptation approach presents a strong case for immediate action. Well-targeted, early investments to improve climate resilience – whether in infrastructure development, technology advances, capacity improvements, shifts in systems and behaviours, or risk transfer measures – are likely to be cheaper and more effective for the world community than complex disaster relief efforts after the event.

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