



**CLIMATE AND DISASTER RISK FINANCE  
EXECUTIVE EDUCATION**

# **Climate Change, DRFI and Greening Financial Systems**

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# Learning Outcomes

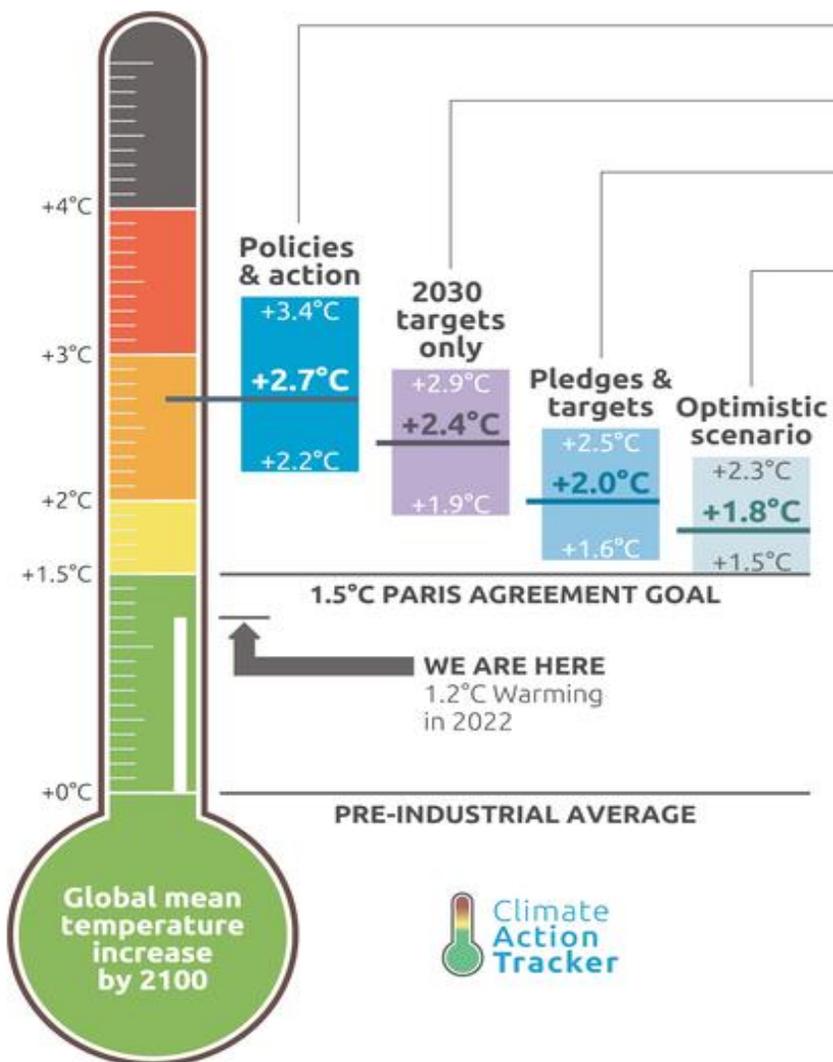
- Understanding where DRFI fits within the broader agenda on climate and green finance and the major issues and trends.
- Adaptation from a Ministry of Finance perspective: the policies, instruments and opportunities
- Introduction to the latest thinking on the interaction between climate and wider environmental risks and implications for DRFI and adaptation

# Overview

1. Introduction: physical climate risks and adaptation
2. Overview:
  - The landscape of greening finance and adaptation
  - Climate financial risks
3. Adaptation: A Ministry of Finance perspective
4. New dimensions
  - Building fiscal resilience in a more complex world – climate and nature

The background of the slide is an aerial photograph of a city at sunset. A prominent skyscraper, the Burj Khalifa, is visible in the center, illuminated with red and blue lights. The city is surrounded by water, and a large green park area is visible in the foreground. The sky is a mix of orange, yellow, and blue.

# Part 1: Introduction



- Policies & action**  
Real world action based on current policies †
  - 2030 targets only**  
Based on 2030 NDC targets\* †
  - Pledges & targets**  
Based on 2030 NDC targets\* and submitted and binding long-term targets
  - Optimistic scenario**  
Best case scenario and assumes full implementation of all **announced** targets including net zero targets, LTSs and NDCs\*
- † Temperatures continue to rise after 2100  
\* If 2030 NDC targets are weaker than projected emissions levels under policies & action, we use levels from policy & action

## CAT warming projections Global temperature increase by 2100

November 2022 Update

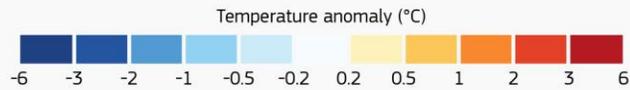
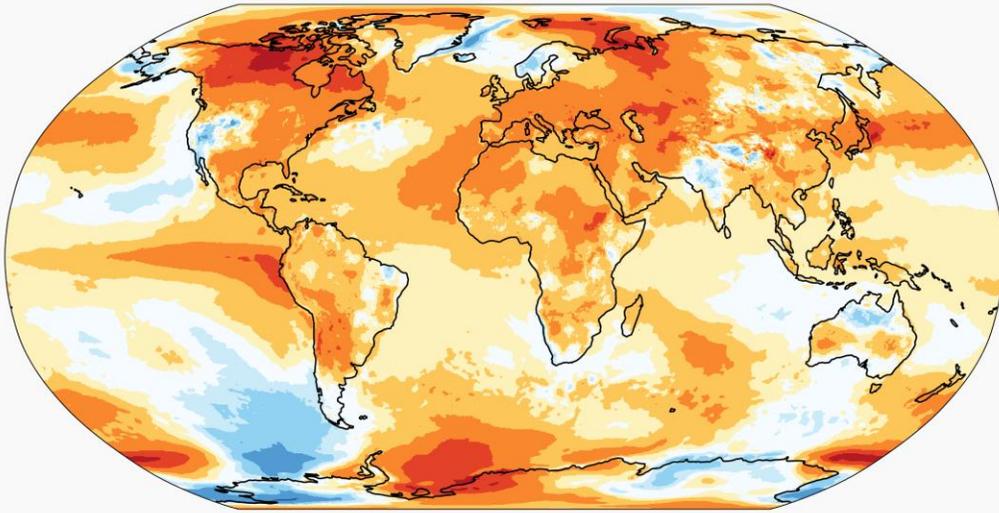
# We are not on course for 1.5C



# Status of global warming

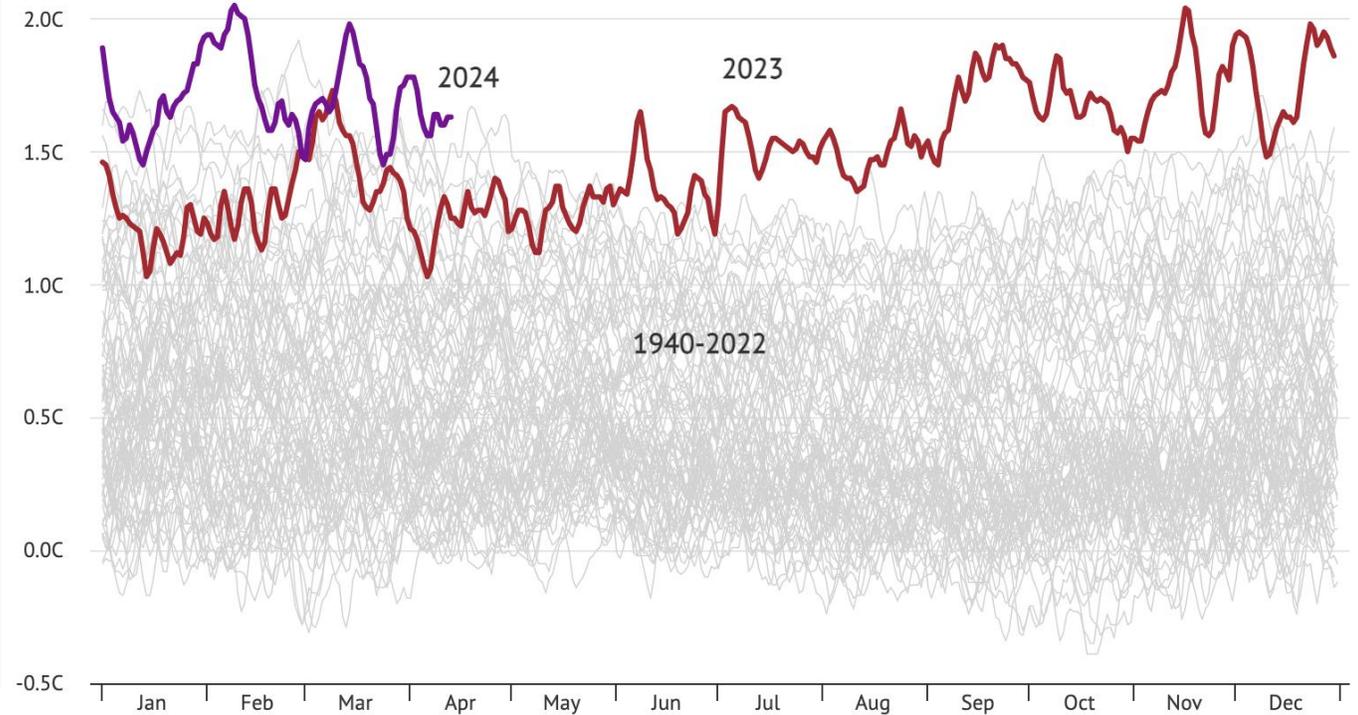
## SURFACE AIR TEMPERATURE ANOMALY • 2023

Reference period: 1991–2020 • Data: ERA5 • Credit: C3S/ECMWF



## Daily global temperatures reveal record warmth of 2023 and 2024 so far

Compared to a 1850-1990 average



Source: Copernicus/ECMWF ERA5

## Too little water...

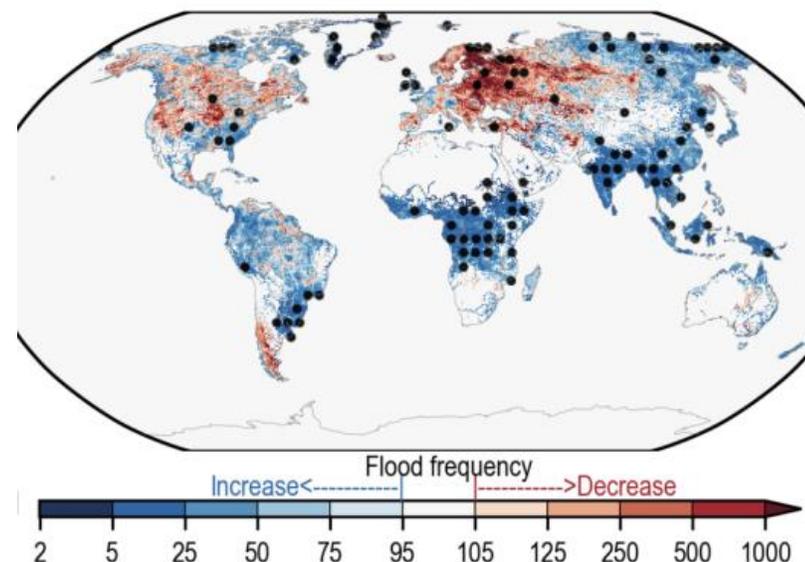
**People:** Between 3 to 4 billion people are projected to be exposed to physical water scarcity at 2°C and 4°

**Agriculture:** Between 1983 and 2009, approximately three-quarters of the global harvested areas (~454 million hectares) experienced yield losses induced by meteorological drought, with the cumulative production losses corresponding to the US \$166 billion

**Energy:** Across many parts of Asia significant impacts on hydropower potential

## Too much water...

(b) SSP2-4.5

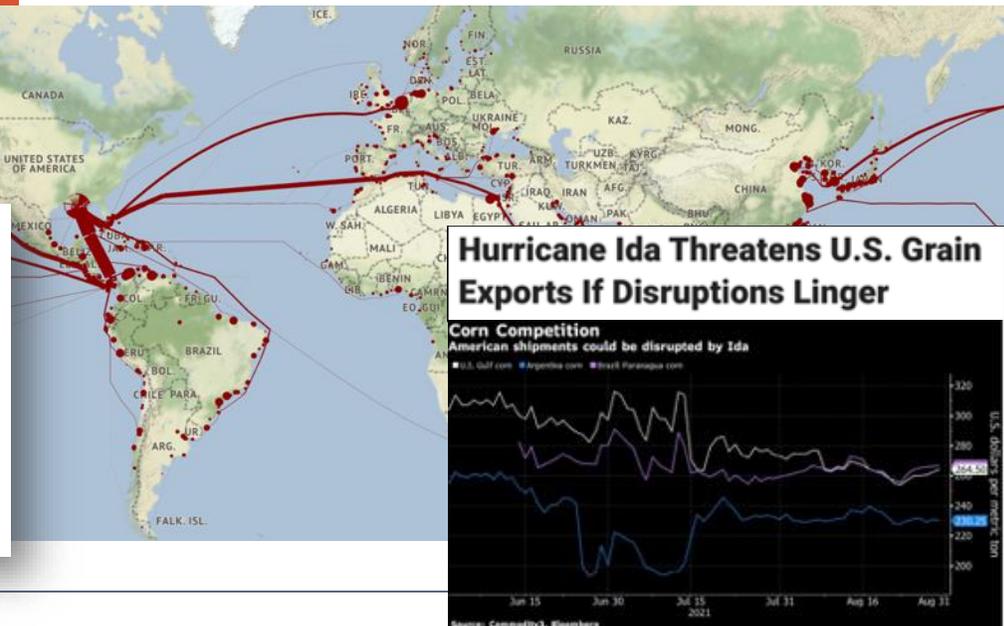
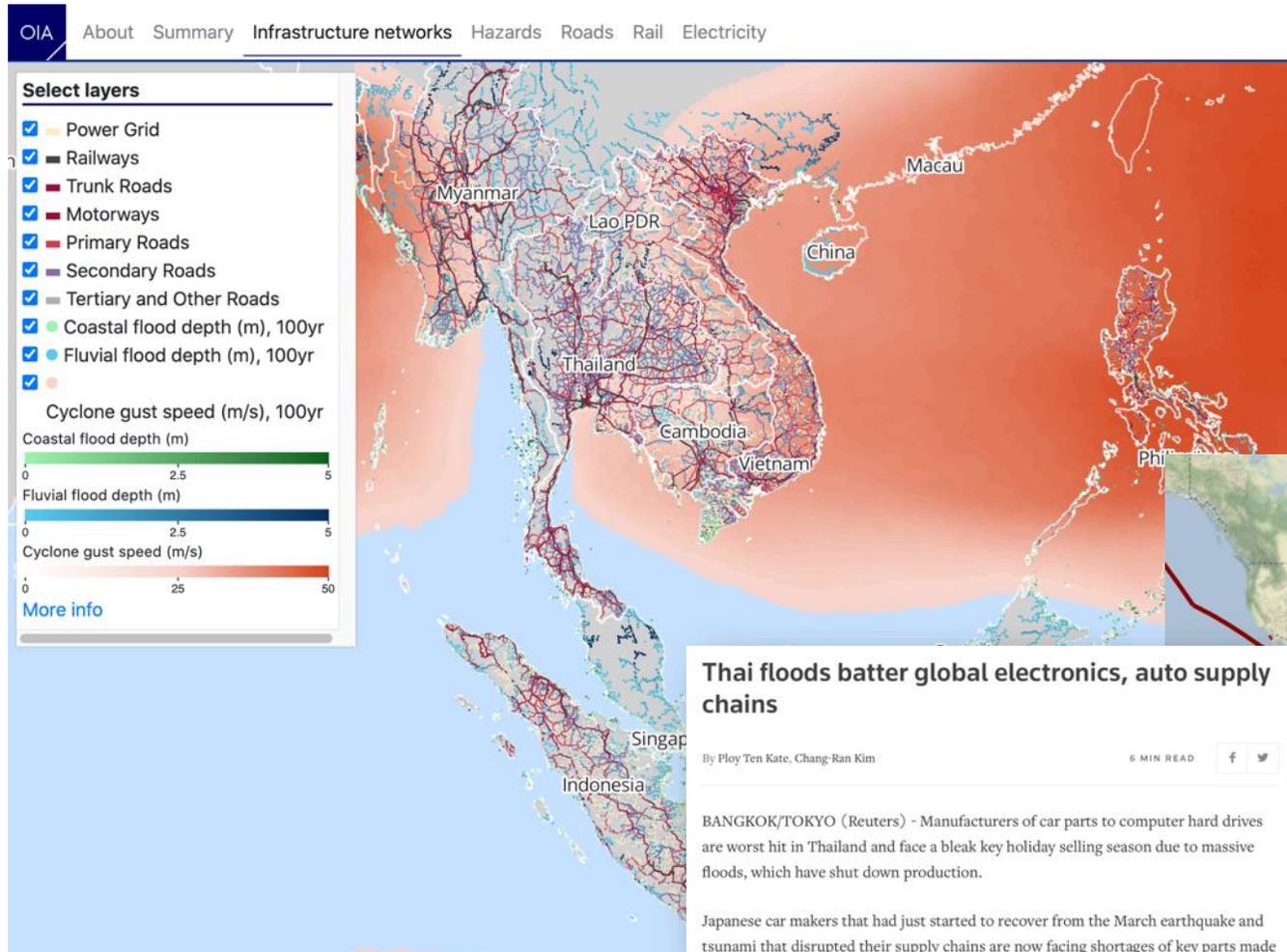


**Flooding:** Coastal, fluvial and pluvial

**Soils:** Increased heavy downpours increased rate of soil loss due to erosion, reducing agricultural production

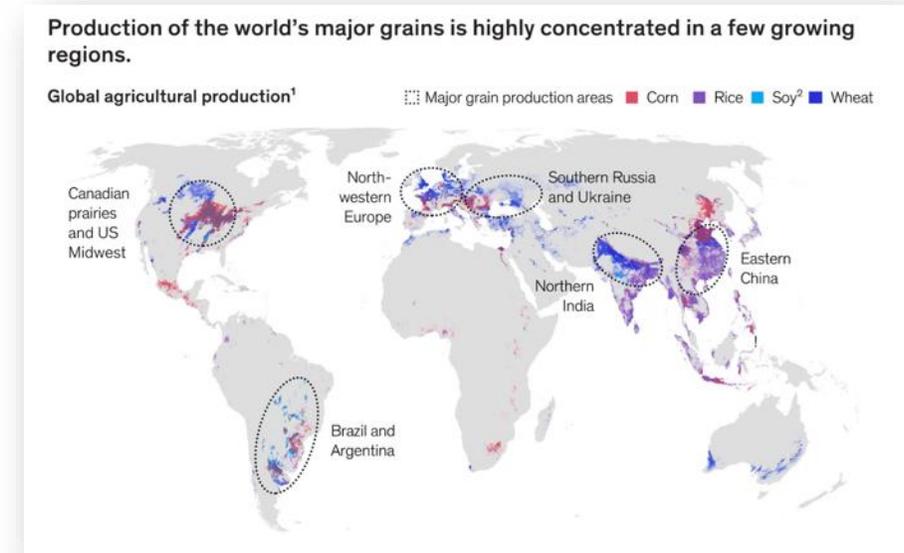
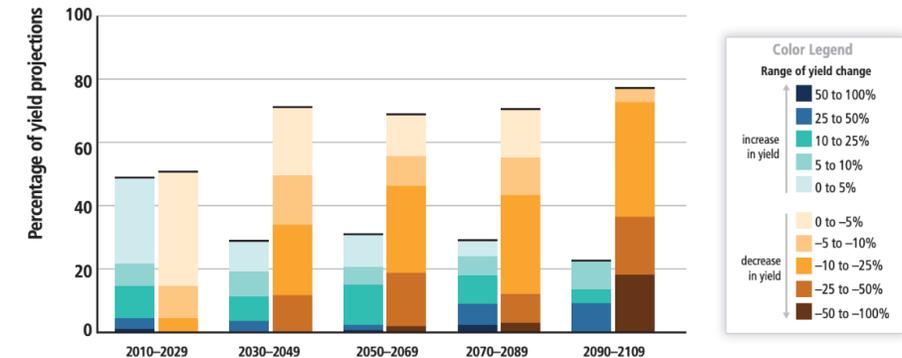
# Disruption to Infrastructure Systems and Supply Chains

For example, in Ho Chi Minh City, direct infrastructure asset damage from a 100-year flood could rise from about \$200—\$300 million today to \$500 million to \$1 billion in 2050, while knock-on costs to the economy could rise from \$100—\$400 million to between \$1.5 billion and \$8.5 billion



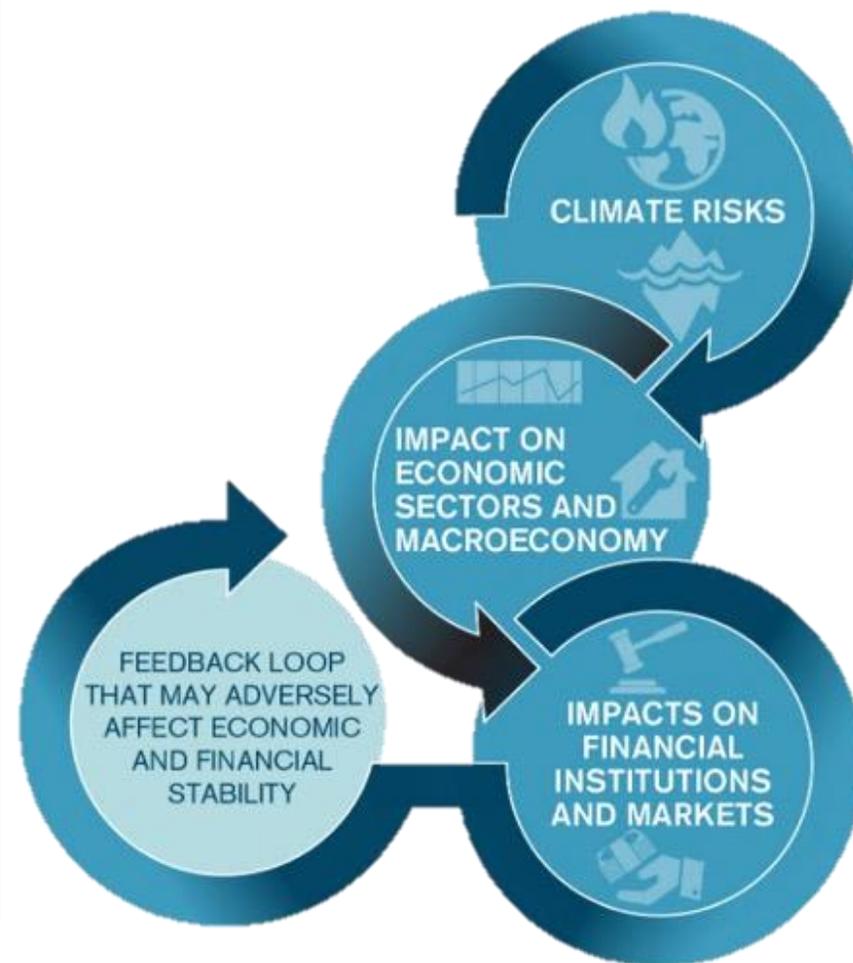
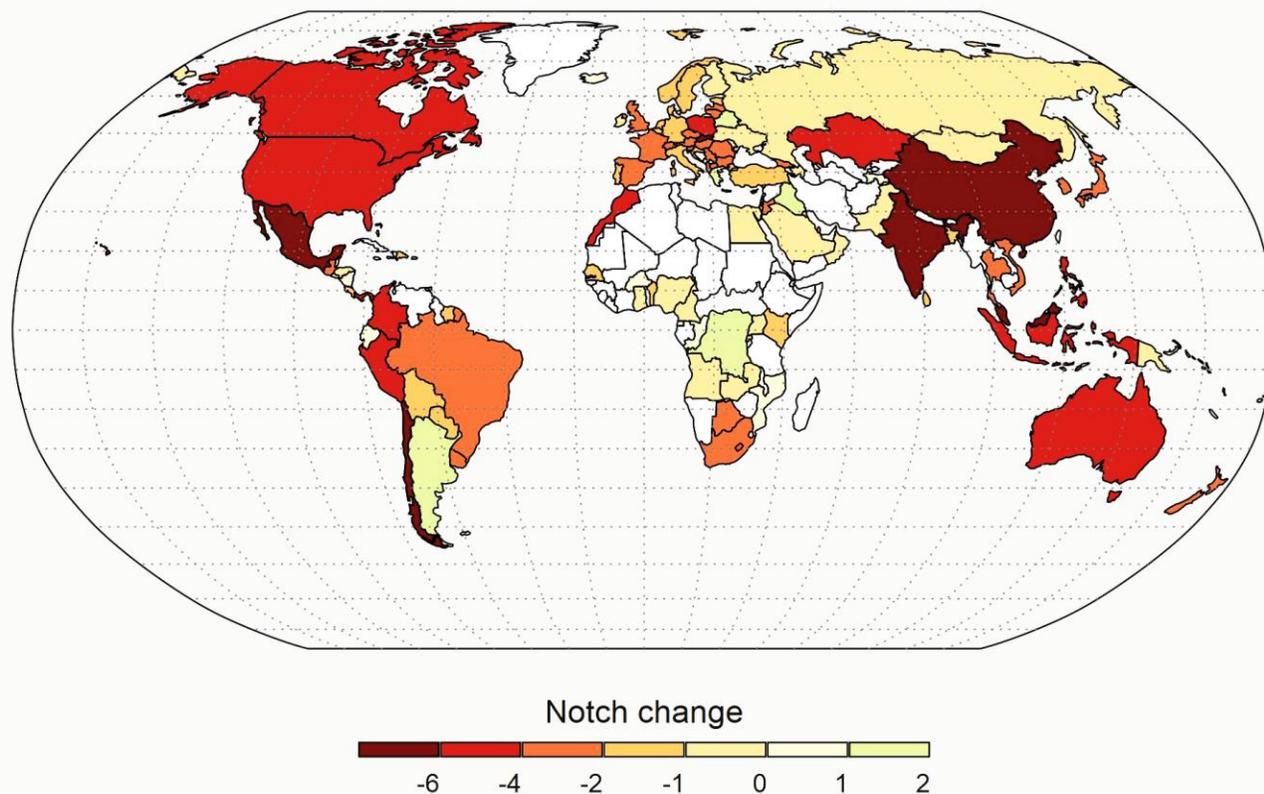
# Growing Risk of Complex Global Shocks

- **Sixty percent of global food production occurs in just five countries:** China, the United States, India, Brazil, and Argentina. Four grains make up half of calories
- **The likelihood of a 15% shock to grain production** (a 1 in 100 year event over 1998-2017) doubles by 2030 with possible knock-on effects to prices
- **Negative economic shocks of this size could lead to widespread social and political unrest.**



# Interconnected risks

Impacts of Climate Change on Sovereign Credit Ratings





## Domestic and Regional Physical Risks and Opportunities

Damages to assets, changing productivity, changing commodity prices depending on adaptation investment

## Global Transition Risk and Opportunities

Changing pricing, policy and sentiments (domestic and international) and opportunities through new markets

Potential fiscal risks and changing costs of financing

Increased volatility from international system creating risks to prices and inflation

Potential financial risks from global transition and local physical climate risks

Opportunities for new markets and external financing

Opportunities and need for investment in adaptation and energy transition

# Part 2. Wider Landscape of Finance

# Finance: Shock Absorber

**Managing shocks to people, planet and prosperity: the benefits of inclusive and pre-arranged finance**



Access to finance for all is strongly linked with social resilience, prosperity and ability to build back post-disaster



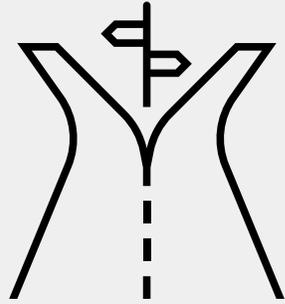
Insurance and risk financing can provide financial protection to people, businesses and governments



A stable financial sector is vital for economic development, stability and jobs

# Finance: Investment and Development

Building resilient capital for people, planet and prosperity



Investing in physical capital



Investing in natural capital

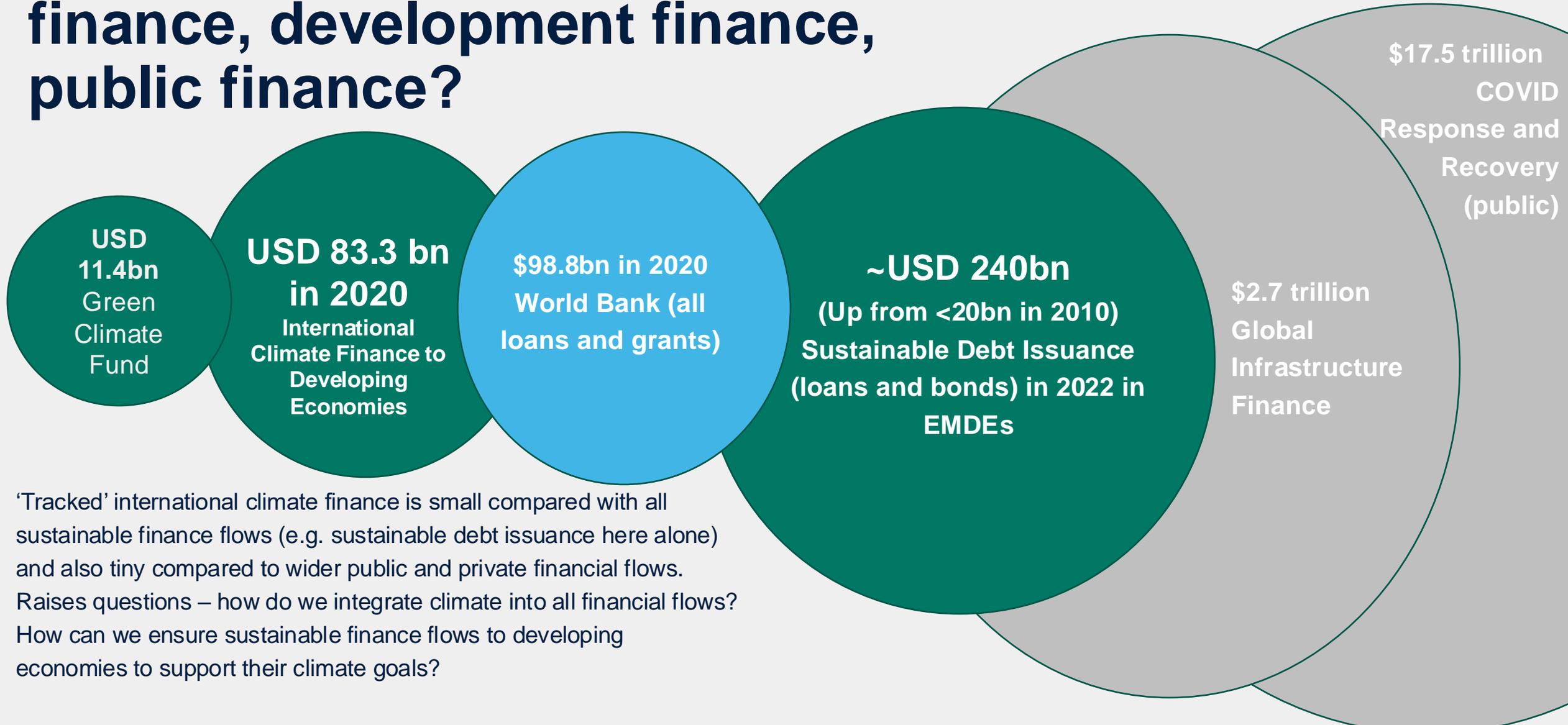


Investment and micro-finance creates jobs, prosperity and resilience



Higher income drives higher social resilience

# Climate finance, sustainable finance, development finance, public finance?



‘Tracked’ international climate finance is small compared with all sustainable finance flows (e.g. sustainable debt issuance here alone) and also tiny compared to wider public and private financial flows. Raises questions – how do we integrate climate into all financial flows? How can we ensure sustainable finance flows to developing economies to support their climate goals?

# Climate Risk is Current Underpriced in the Market



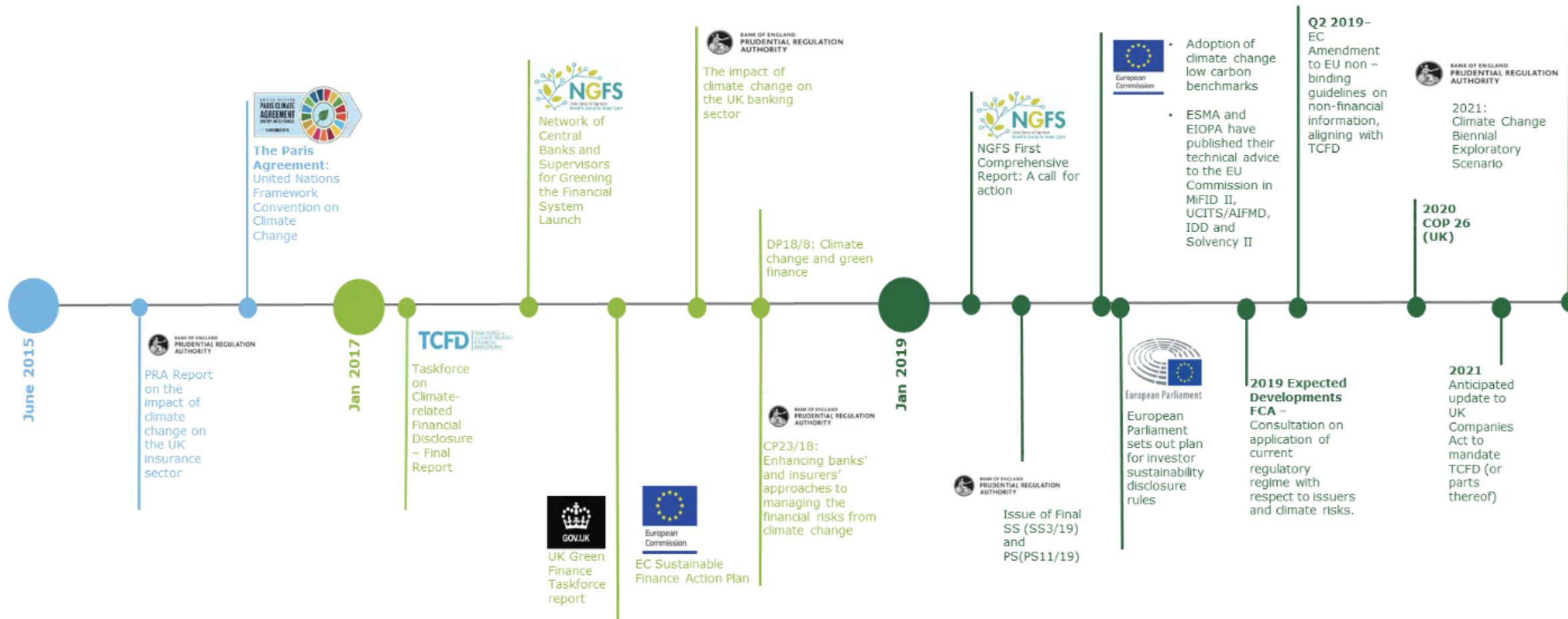
“Once climate change becomes a defining issue for financial stability, it may already be too late”

“The speed at which such re-pricing occurs is uncertain and could be decisive for financial stability”

“Risks to financial stability will be minimised if the transition begins early and follows a predictable path”

“The more we invest with foresight; the less we will regret with hindsight”

# Recent Developments

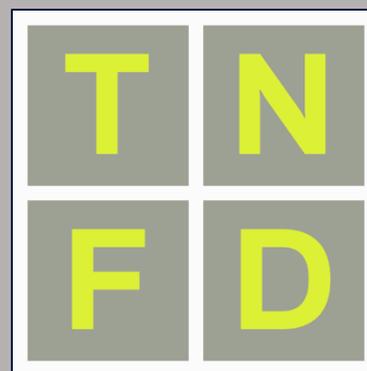


# Trends

Growing momentum linked to mandatory disclosures, policy new technologies and shifting sentiments



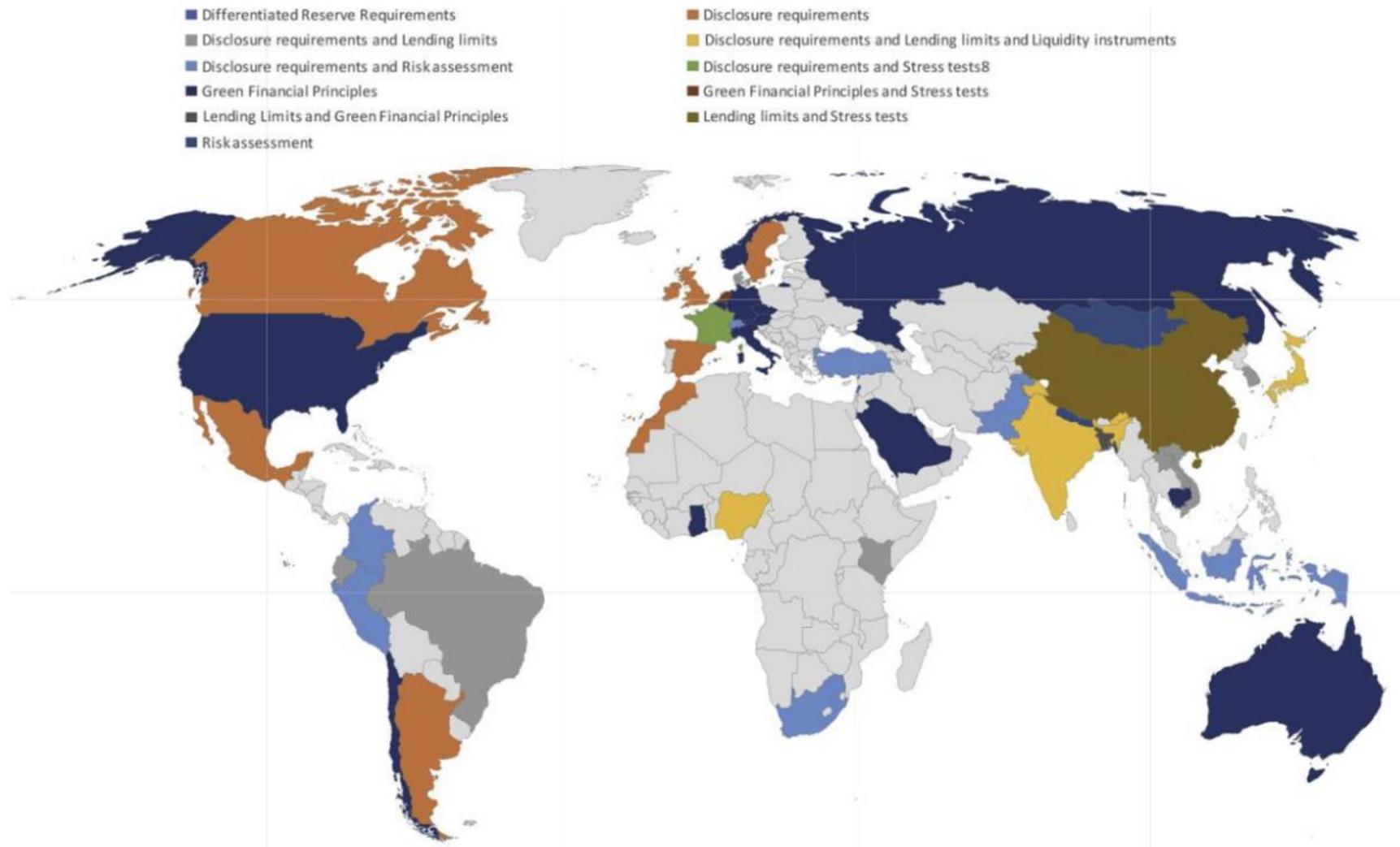
Continued growing focus on the role of nature, linkages to wider SDGs and physical risks



Increasing demand for more and better data, with higher quality and more standardised approaches

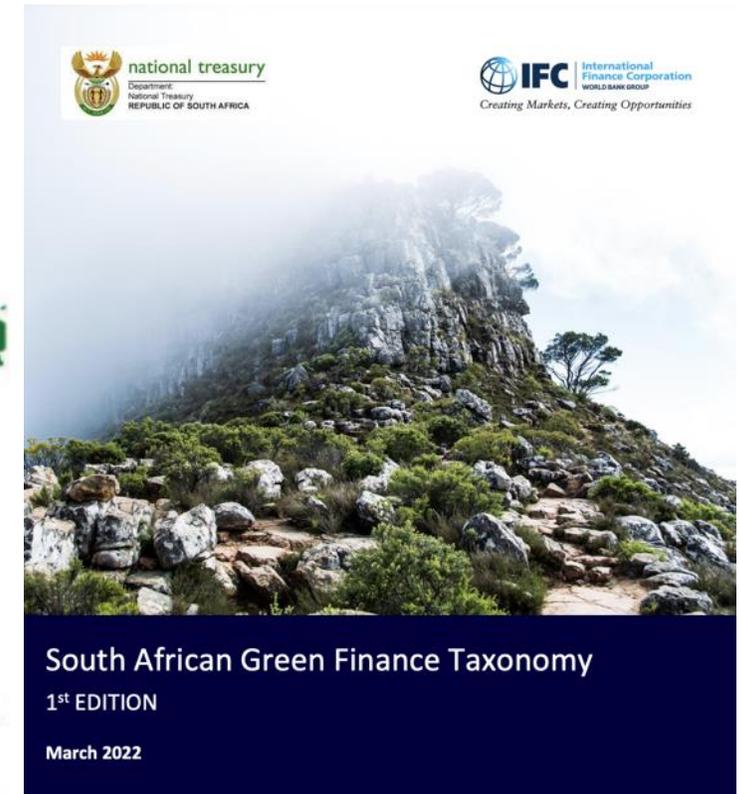
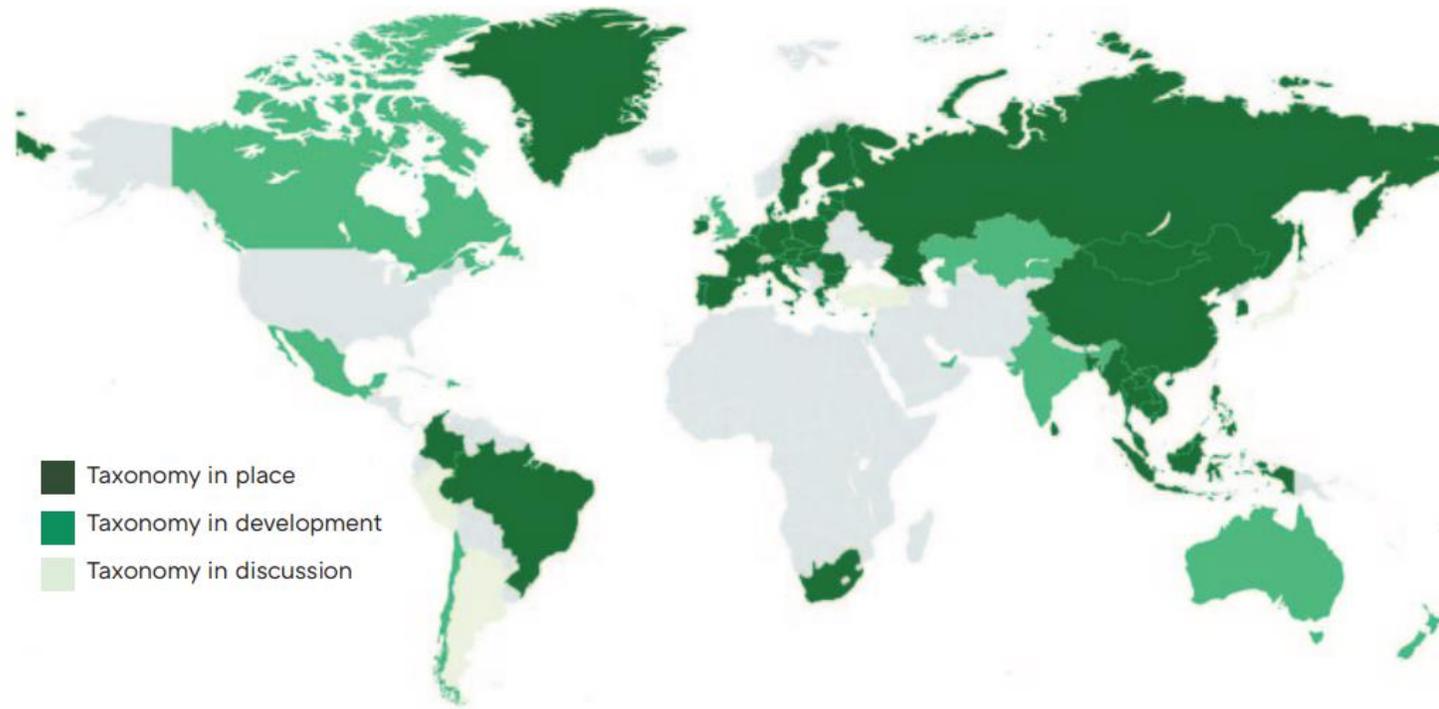


# Prudential Measures



# Adoption of green taxonomies globally

Figure 1: **International taxonomy landscape**



IN PARTNERSHIP WITH

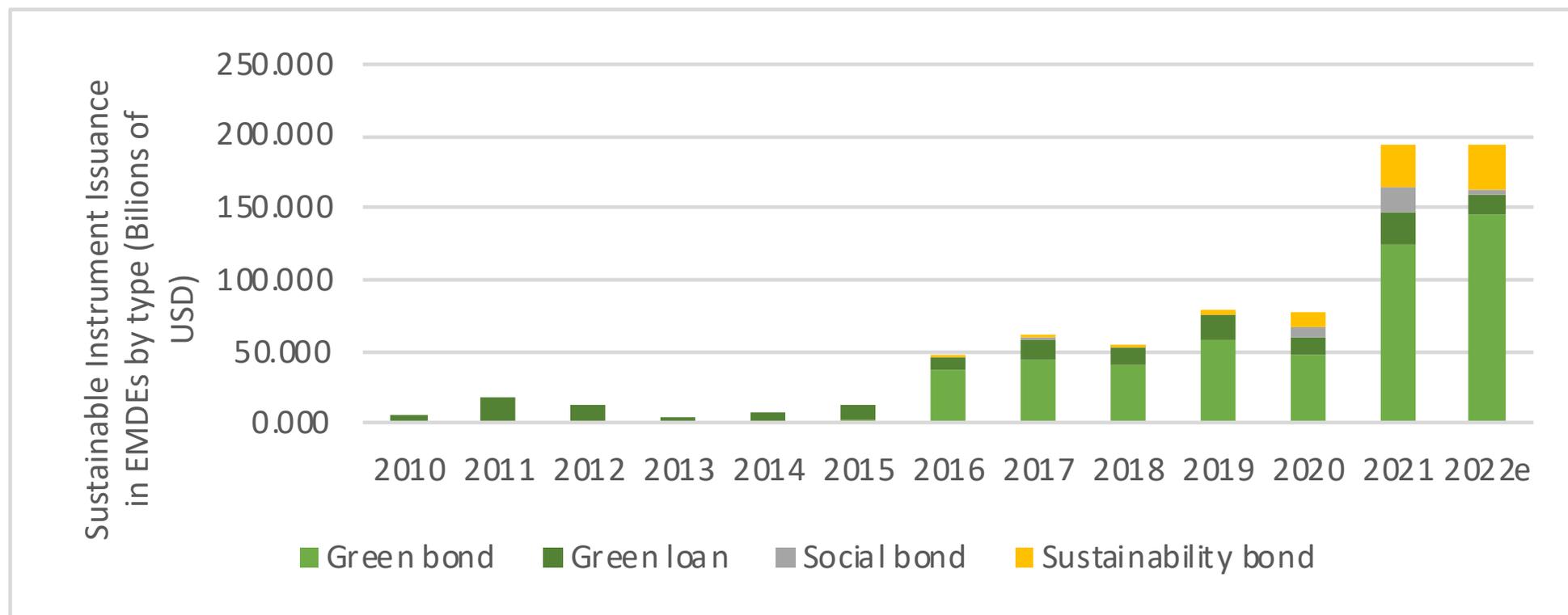


TECHNICAL PARTNERS



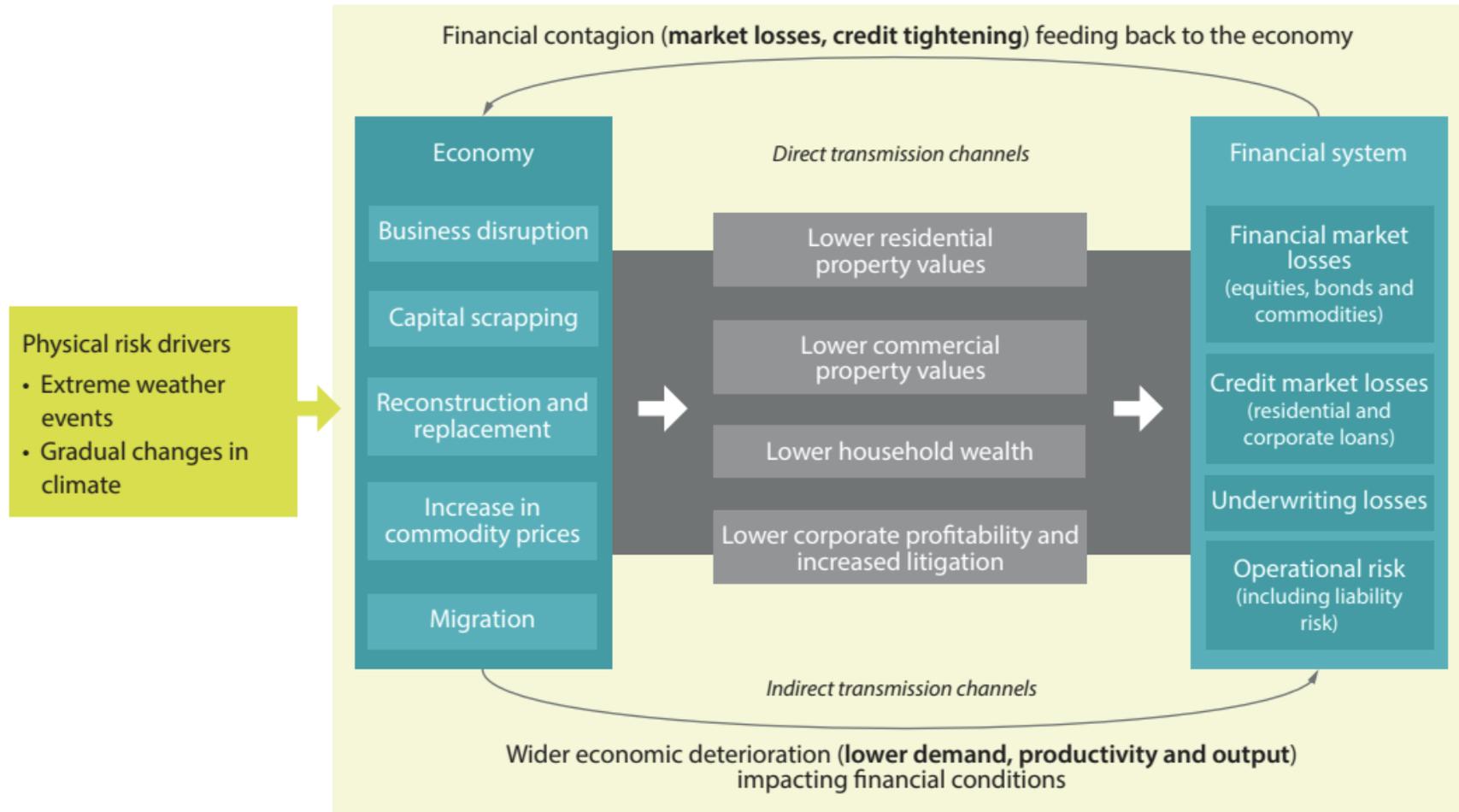
# Opportunities for new sources of financing

## Sustainable debt issuance in EMDEs



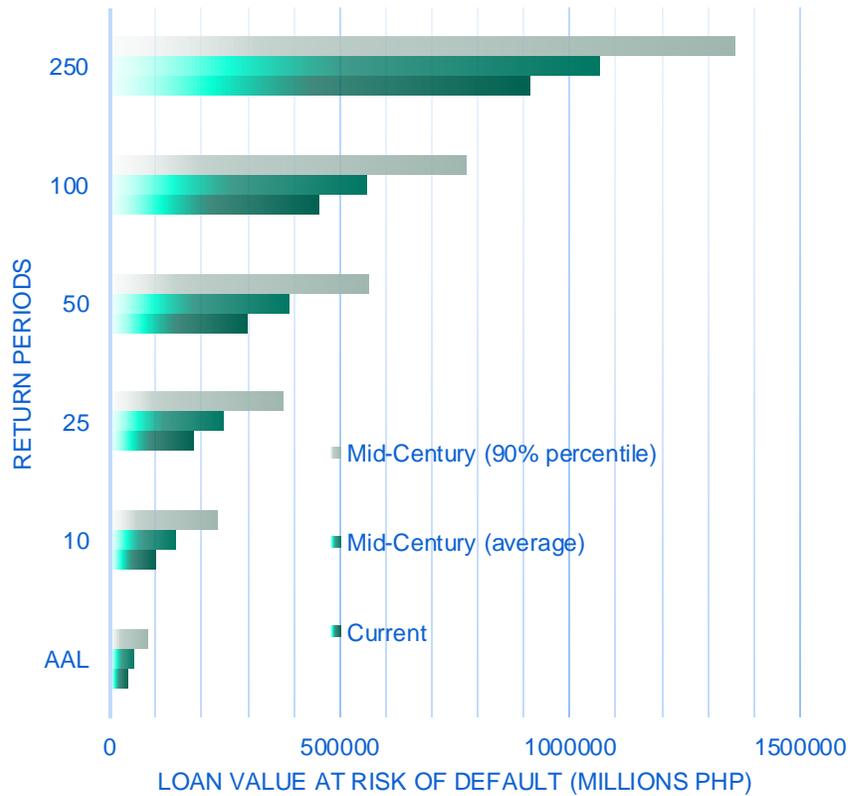
Source: data from IMF 2022 Chapter 2.

# Physical Risks



# Example: Philippines FSAP

## Micro-level financial risk analysis



## 'Traditional' stress test

FIGURE B2.4.1. Impact of Typhoon on Bank Capital – Normal Time

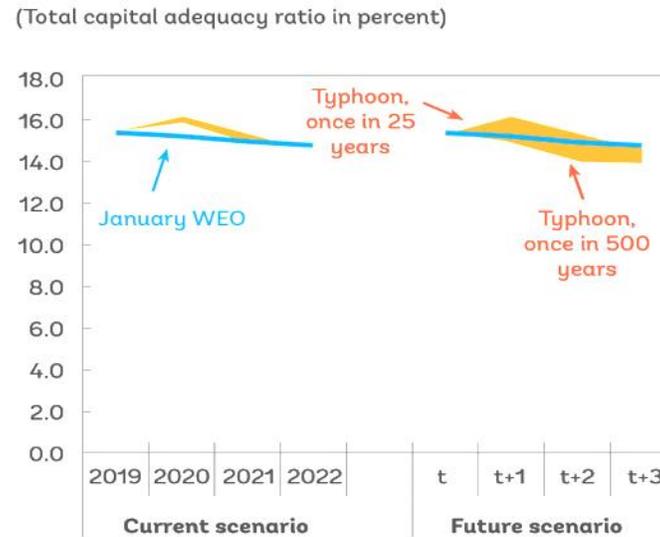
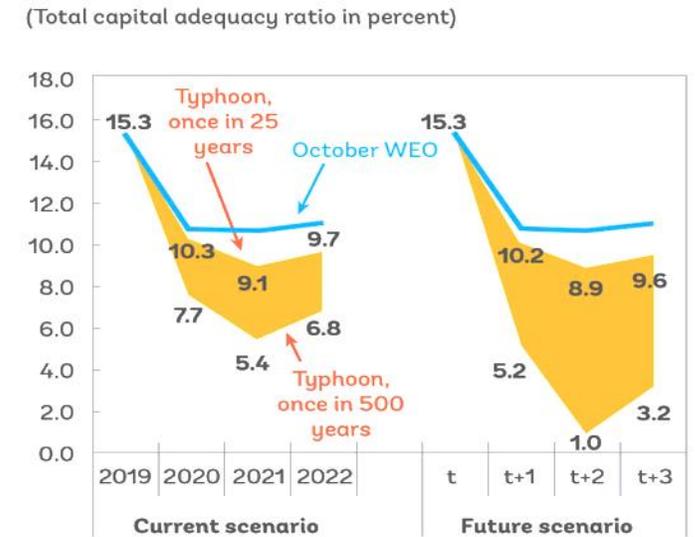


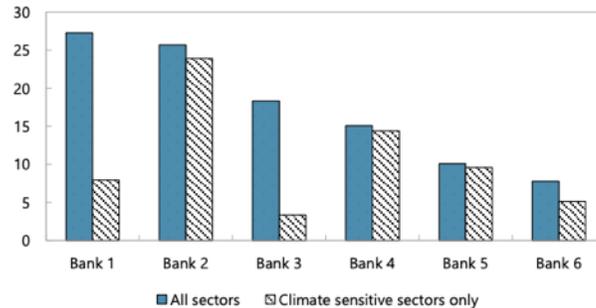
FIGURE B2.4.2. Impact of Typhoons and Pandemic on Bank Capital



# 2022 South Africa FSAP Climate Risk Analysis: Drought

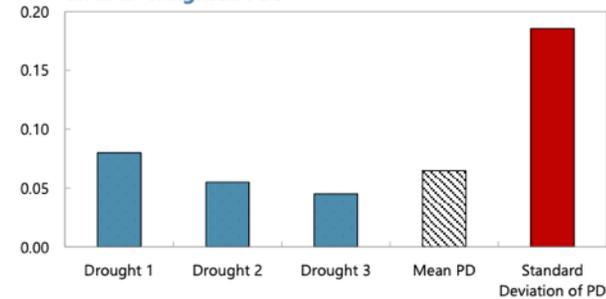
Exposures to water scarce provinces are notable ...

**Exposures to Water Scarce Provinces**  
(Percent of Credit Exposures)



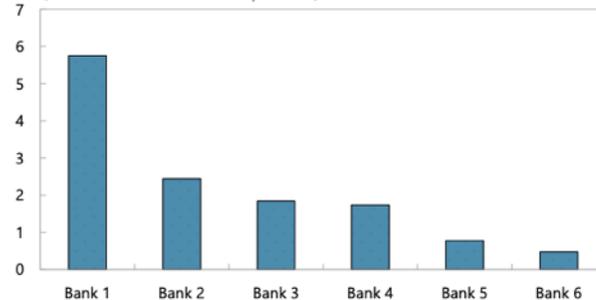
... and the credit risk impacts of physical risk are, to some extent, already reflected in estimated default probabilities.

**Estimated Impact of Droughts on EAD-Weighted PDs**



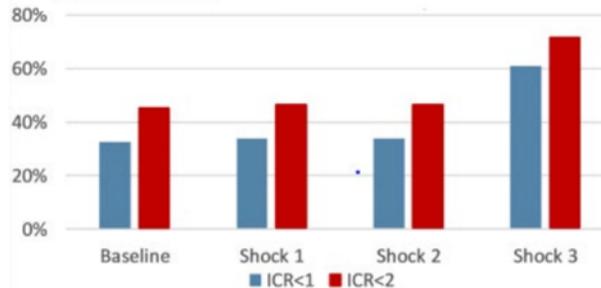
Exposures to the coal-producing region are relatively small, but there is some heterogeneity.

**Exposures to Mpumalanga**  
(Percent of Total Credit Exposures)



A sudden and large rise in the price of carbon could increase the share of corporate debt at risk as margins are compressed

**Corporate Debt-at-Risk**  
(Percent of total debt)



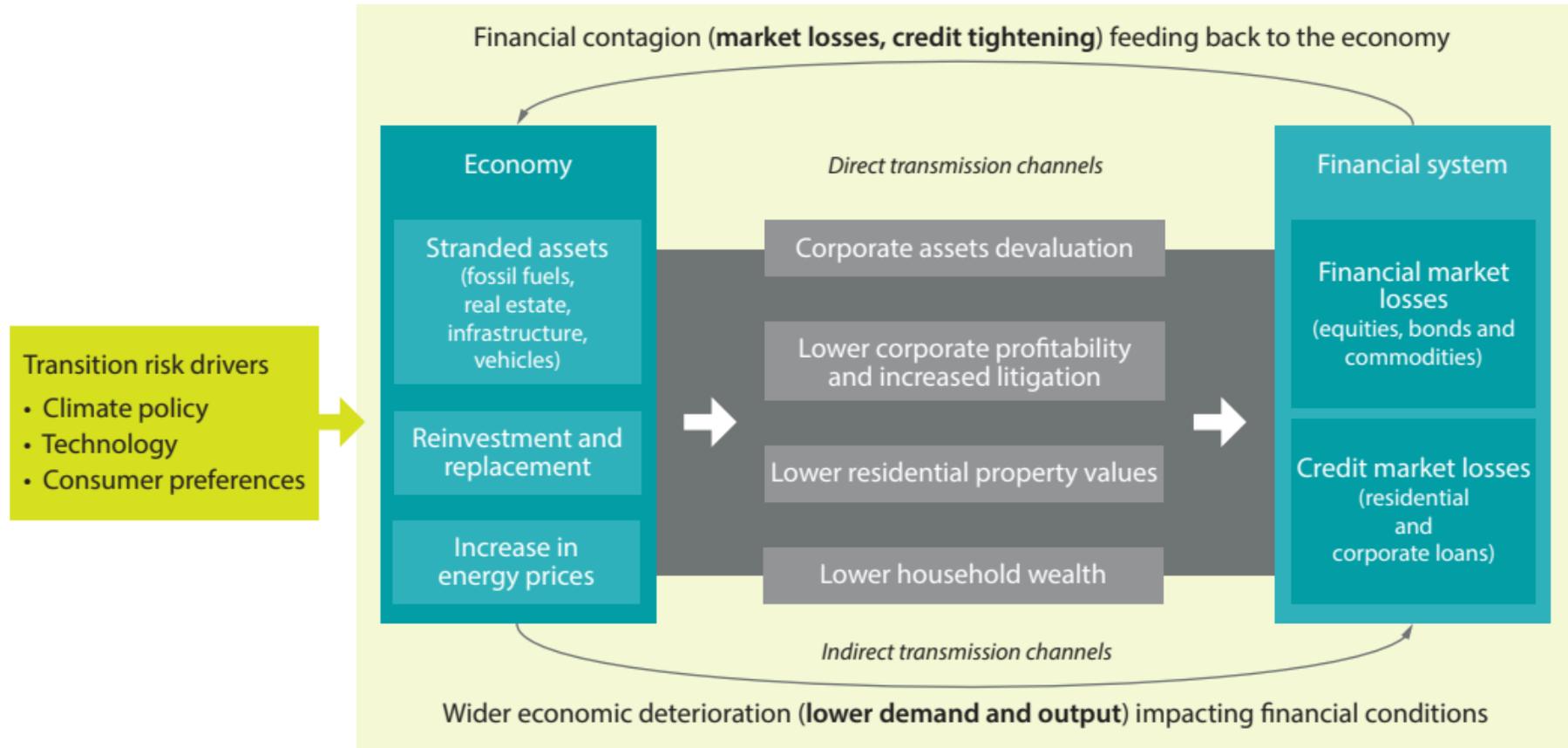
“Analysis of stress testing of climate risks points to non-negligible implications for the financial sector”

“The country’s arid climate, geographical position and high dependence on fossil fuel production and consumption renders it vulnerable to both physical and transition risks”

Sources: SARB, South African banks, and IMF staff calculations.

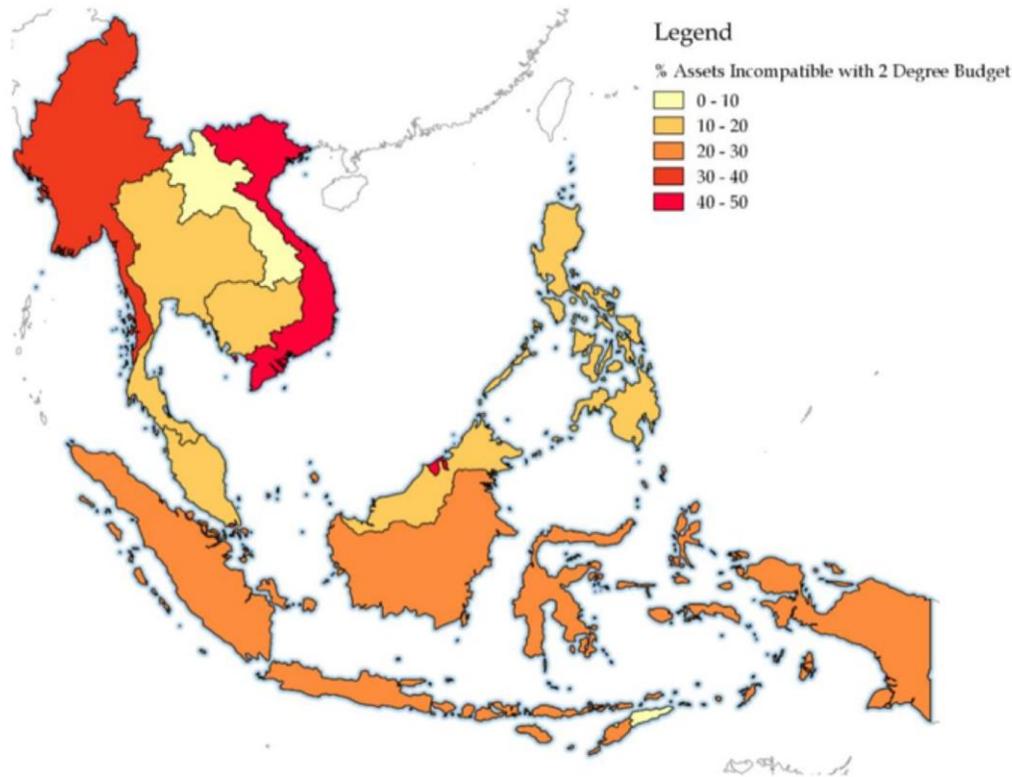


# Transition Risks



# Stranded Capital and Stranded Assets

This figure plots a heat map based on the percentage of current and planned fossil fuel generation assets that are incompatible with a 2°C global carbon budget in Southeast Asia.



**Estimated global value of stranded assets - \$2 – 18 trillion** (IEA and IRENA 2017)

**Stranded Capital:** Capital invested in a project, at risk from the transition. Driven by cost of equipment, labour and other inputs needed for the project.

**Stranded Value:** Market valuation of a firm or project, at risk from the transition. Driven by expected future profits from projects

Chart 1 Capital re-allocation in the energy sector consistent with the IEA's 2°C pathway

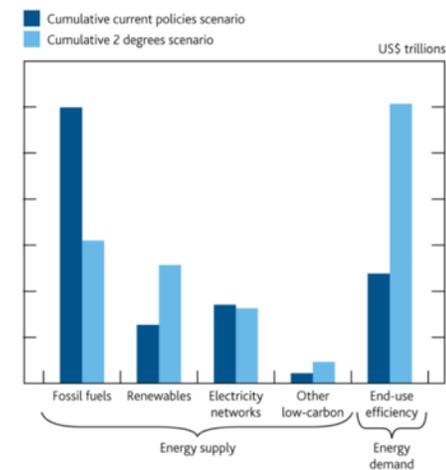
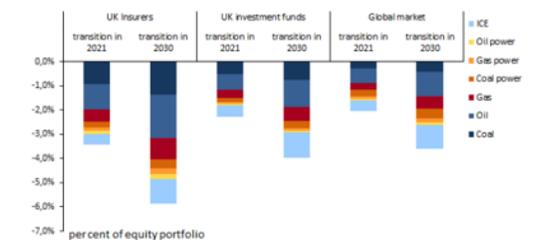


Chart 2 Equity valuation losses in high-carbon technology exposures in the case of a climate Minsky moment, including fossil fuel price shock, in 2030





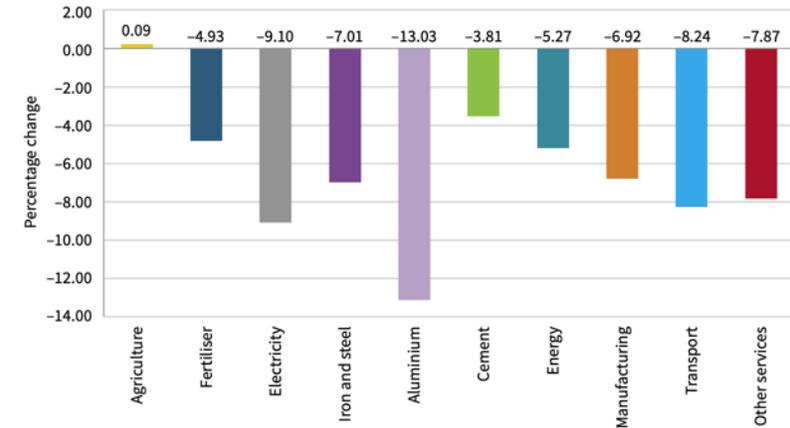
# Impacts of CBAMs

**Table 5: Impact of the CBAM on Africa's exports, by sector, carbon price at €40 per tonne and €87 per tonne (% change)**

	CBAM with carbon price of €40	CBAM with carbon price of €87
Agriculture	3.43	1.09
Fertiliser	-2.13	-3.91
Electricity	-6.49	-9.22
Iron and steel	-5.71	-8.12
Aluminium	-9.6	-11.57
Cement	-2.01	-3.14
Energy	1.45	0.06
Manufacturing	-4.23	-5.97
Transportation	-5.78	-7.06
Other services	-6.87	-7.39
Public administration	-5.96	-8.01
Overall	-3.99	-5.75

Source: CGE analysis results

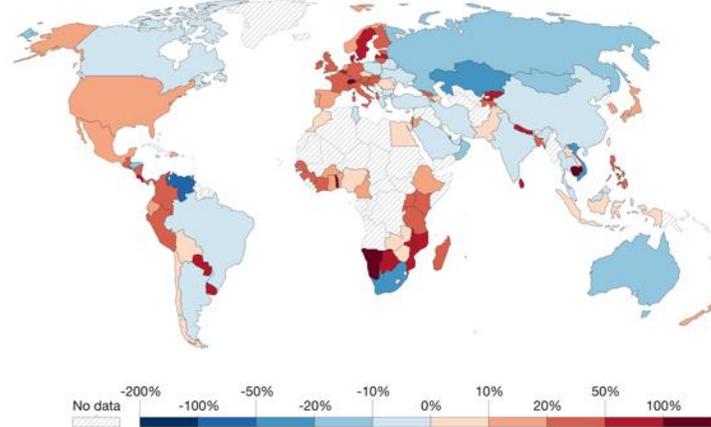
**Figure 7: Scenario 3: Impact of the CBAM on Africa's exports, by sector (% change)**



Source: CGE analysis results

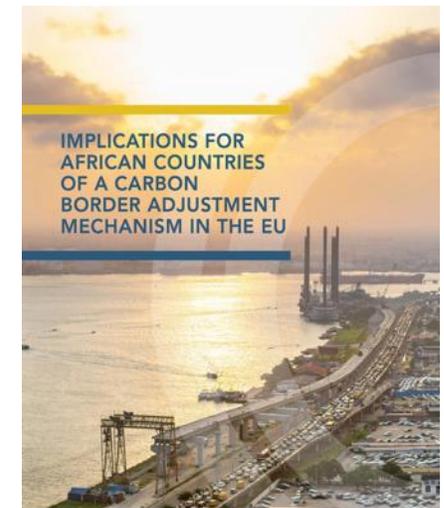
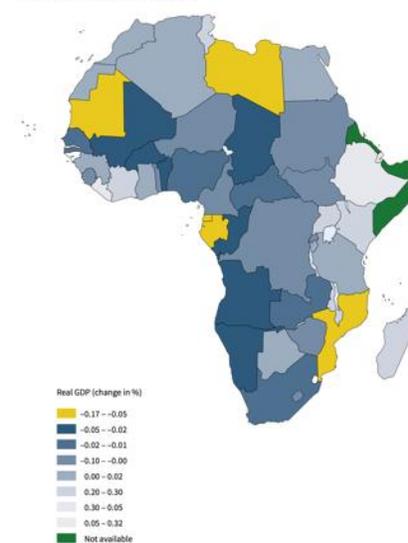
## CO<sub>2</sub> emissions embedded in trade, 2020

This is measured as emissions exported or imported as a percentage of domestic production emissions. Positive values (red) represent net importers of CO<sub>2</sub>. Negative values (blue) represent net exporters of CO<sub>2</sub>.



Source: Our World in Data based on the Global Carbon Project (2023)  
OurWorldInData.org/co2-and-greenhouse-gas-emissions • CC BY

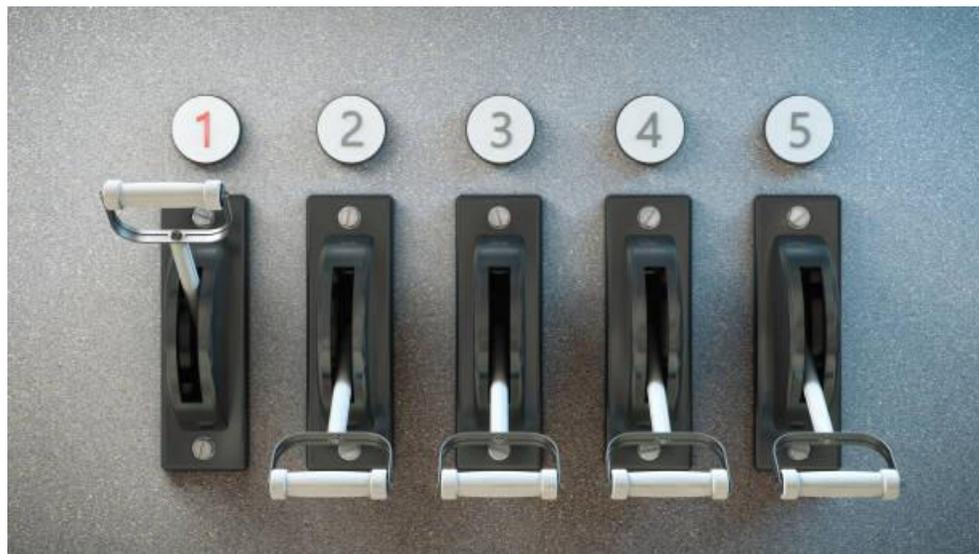
**Figure 18: Change in real GDP, limited coverage**



# **Part 3: Adaptation – Ministry of Finance Perspective**

## How can governments manage risks to themselves?

## What is the role of public finance in catalyzing wider resilience?



*"How do we make actors within the financial system work in ways that are aligned with societal sustainability outcomes?"*

# Adaptation and Fiscal Resilience

Example of Thailand

## Sovereign ratings

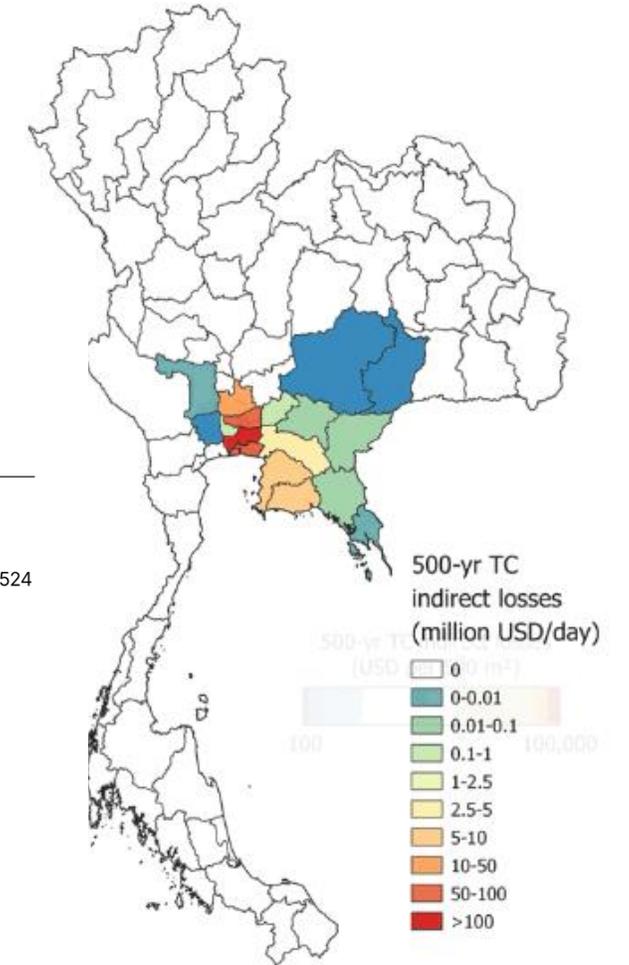


Floods

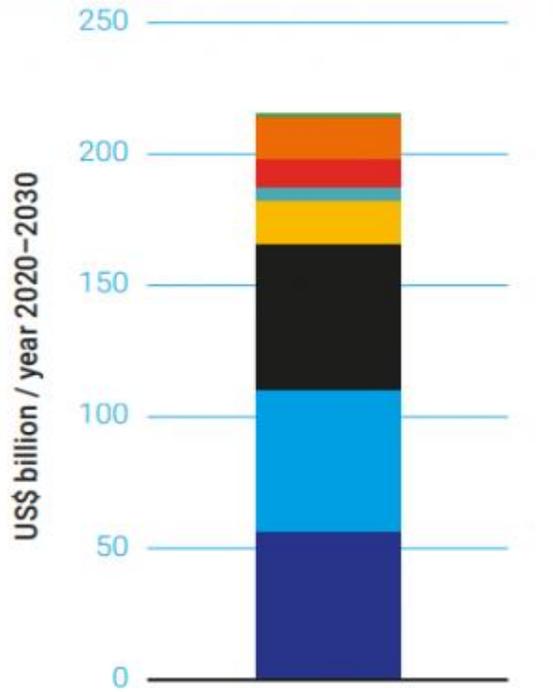


Tropical Cyclones

Scenarios	Downgrade (notches)	Increase in probability of default	Increased cost of debt (\$bn)
<b>Scenario 01:</b> Today	1.344	1.082	0.482
<b>Scenario 02:</b> Future	3.166	4.935	1.524
<b>Scenario 03:</b> Future + adaptations	1.582	1.408	0.59
<b>Scenario 01:</b> Today	1.085	0.781	0.373
<b>Scenario 02:</b> Future	1.319	1.051	0.471
<b>Scenario 03:</b> Future + adaptations	0.86	0.558	0.284

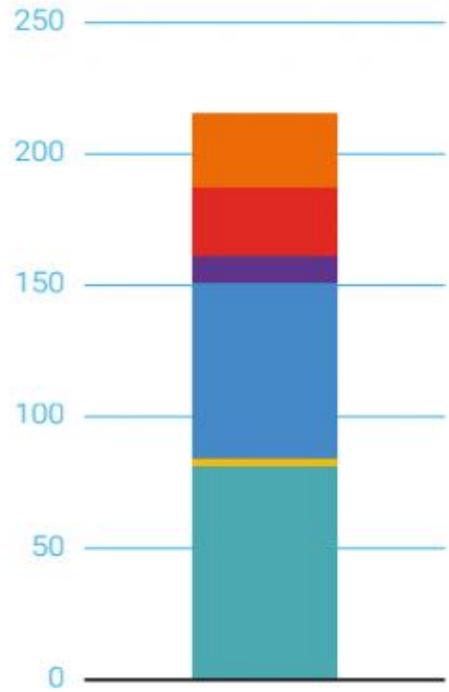


A.



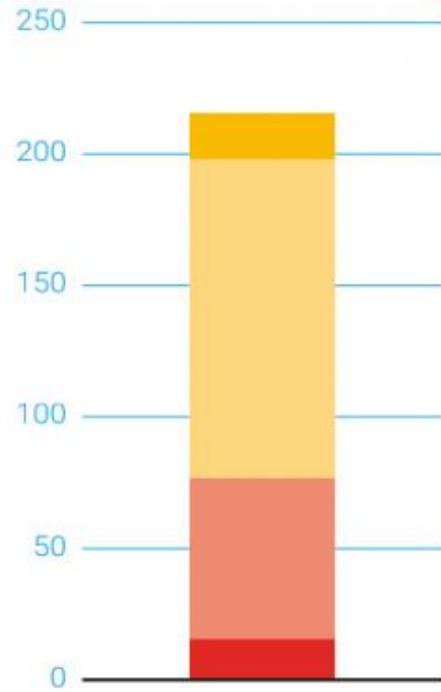
- Terrestrial biodiversity
- Early warning and social protection
- Health
- Fisheries and marine
- Agriculture
- Infrastructure
- River floods
- Coastal

B.



- Sub-Saharan Africa
- South Asia
- Middle East and North Africa
- Latin America and the Caribbean
- Europe and Central Asia
- East Asia and Pacific

C.

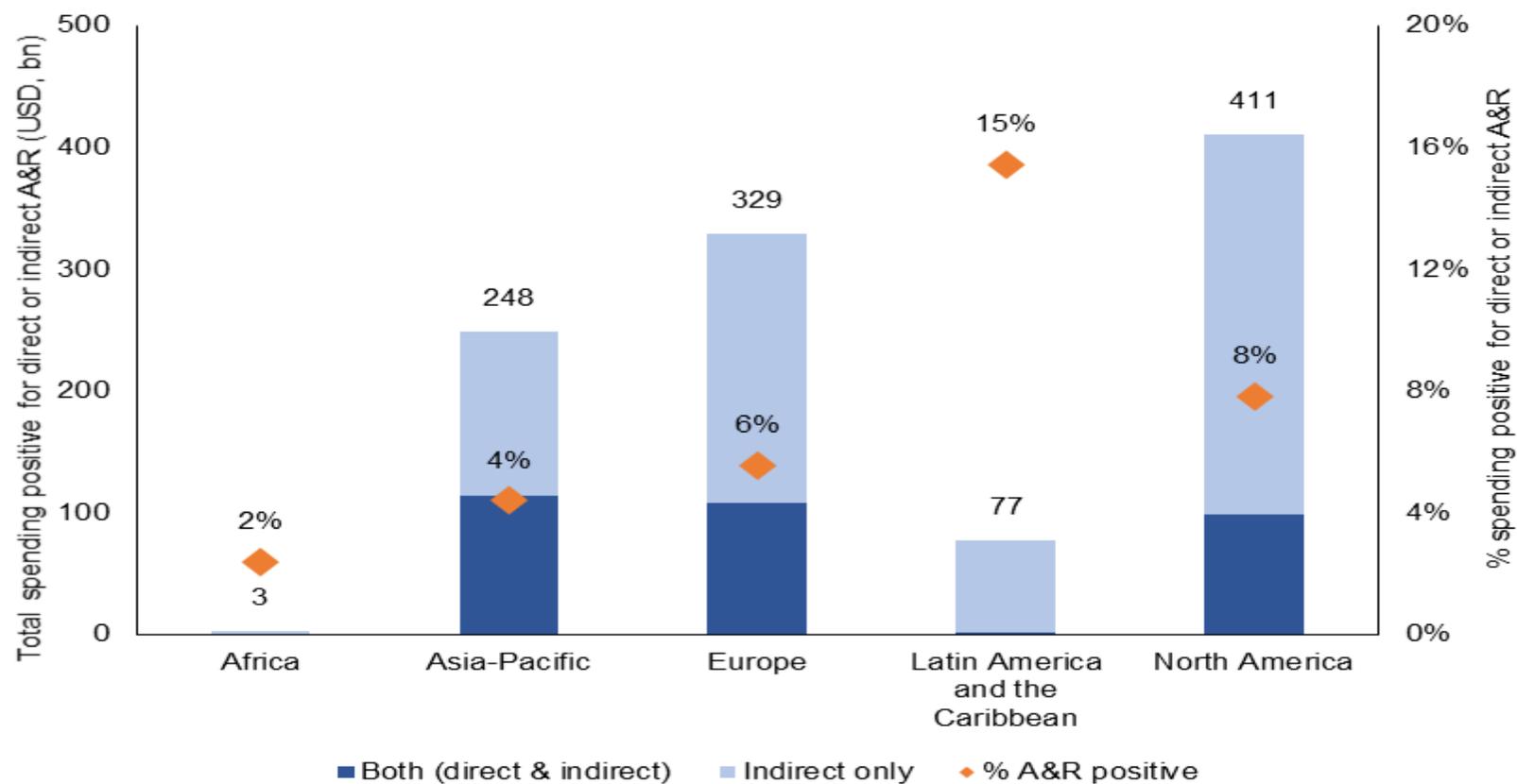


- High-income countries
- Upper-middle-income countries
- Lower-middle-income countries
- Low-income countries



**Current global adaptation finance gap is \$194-366 billion per year**

## COVID-19 Rescue and Recovery Spending Aligned with Adaptation and Resilience



Source: Sadler et al. (forthcoming)

# Overcoming Barriers to Private Adaptation

Misalignment of social and commercial returns: beneficiaries of investments different from those who pay; how to capture the positive externality created by investing in resilience?

Highest physical risk assets will require most investment

Physical risk is underpriced (capital)

Lack of clear adaptation goals

Upfront costs versus long-run benefits

Lack of data, knowledge, awareness

Smaller project size, high risk

Opex vs capex

Regulatory constraints (or lack of regulation)



Public Intervention

Metrics and Targets

Information, Data, Tools, Advisory, Technical Assistance

Financial and real economy regulation, economic incentives and market creation

Public finance (guarantees, first loss, equity, lending, concessional finance, project preparation, DD, intermediation, aggregation)

Standards for financial instruments (resilience-linked bonds)

# Examples: EBRD & EIB

## FIRST DEDICATED CLIMATE RESILIENCE BOND: US \$700m in 2019

BNP Paribas, Goldman Sachs, and Skandinaviska Enskilda Banken AB acted as joint bookrunners, which saw demand from approximately 40 investors in 15 countries in 2019. The proceeds from the five-year bond are used to finance the Bank's existing and new climate resilience projects. These will typically fall under one of three categories:

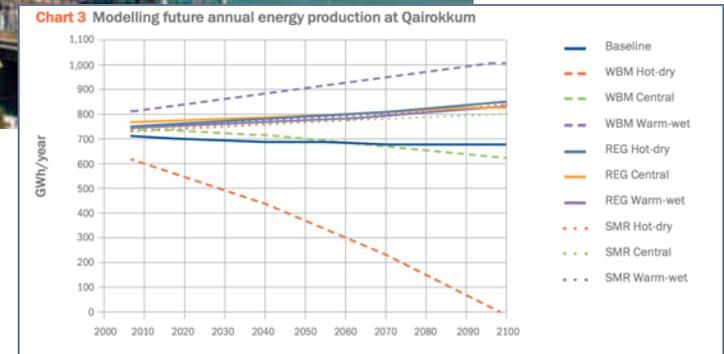
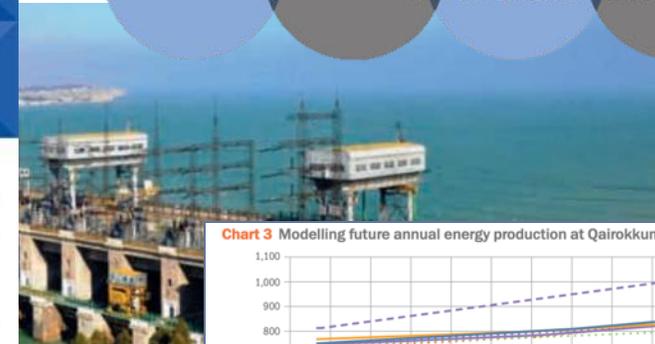
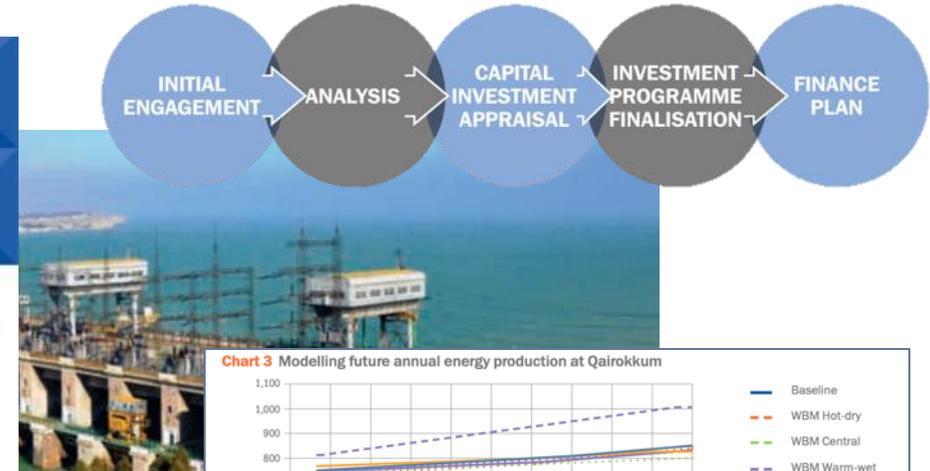
- Climate resilient infrastructure (e.g. water, energy, transport, communications and urban infrastructure)
- Climate-resilient business and commercial operations; or
- Climate-resilient agriculture and ecological systems.

Projects earmarked for the Use of Proceeds are selected and managed in alignment with the **Climate Resilience Principles** of Climate Bonds Initiative

## QAIROKKUM HYDROPOWER:



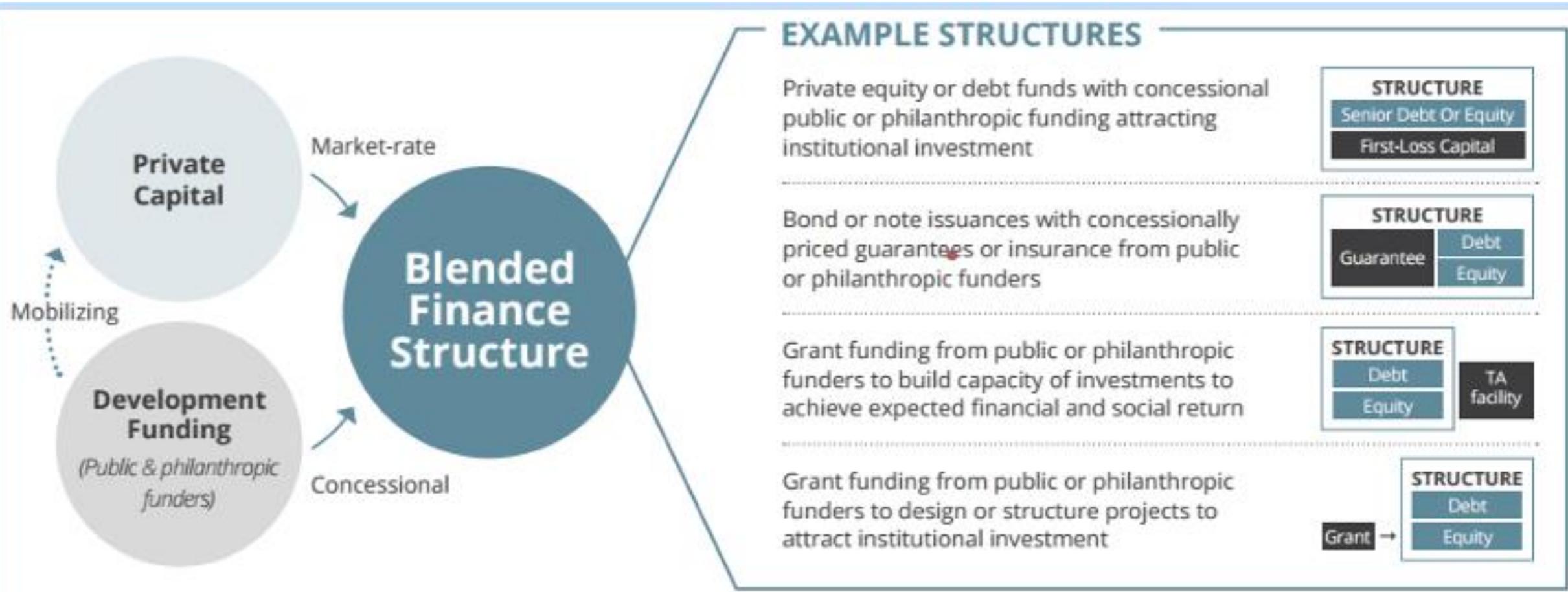
**The EIB Climate Adaptation Plan**  
Supporting the EU Adaptation Strategy to build resilience to climate change



**Technical Assistance:** Analysing future scenarios and embedding climate change into investment design (PPCR funded)

**Blended Finance Investment structure** The EBRD provided US\$ 50 million (15 years). The PPCR contribution was US\$ 21 million (40 years), consisting of a US\$ 10 million loan and a US\$ 11 million grant.

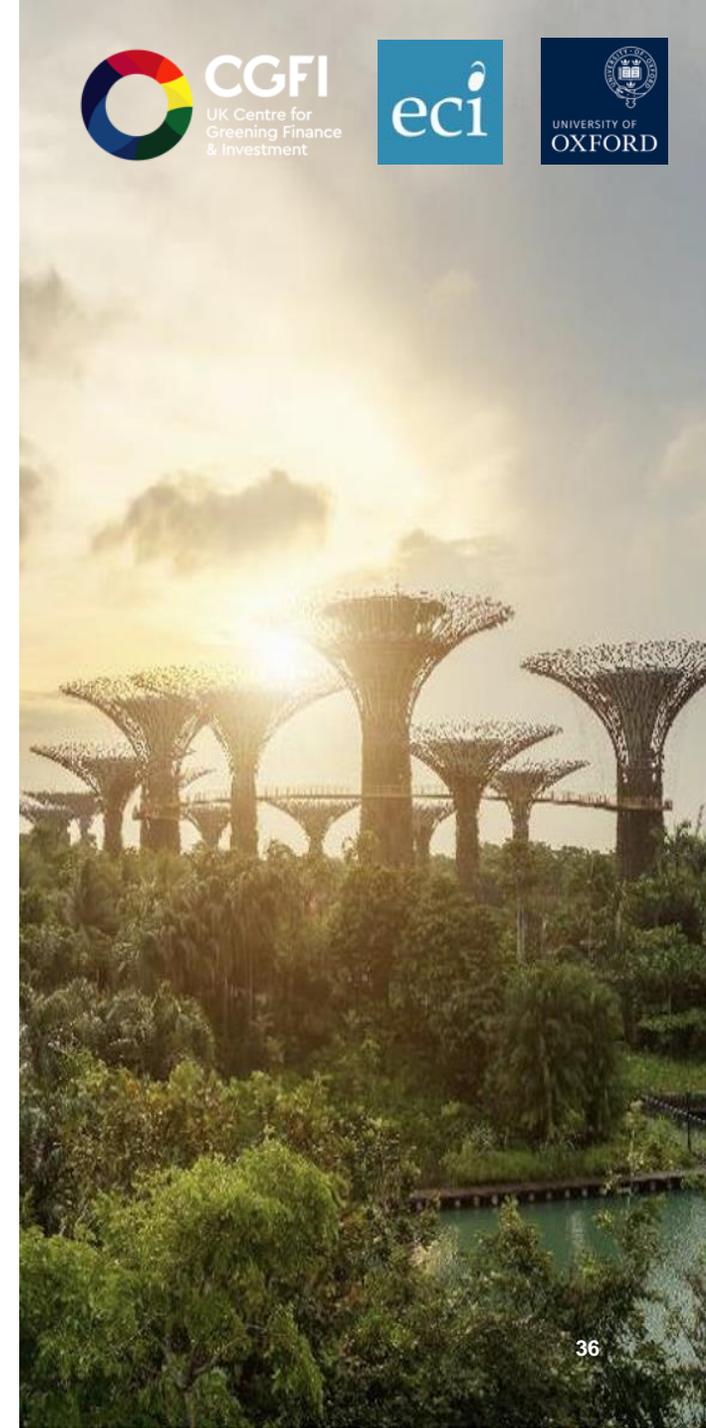
# Blended Finance for Adaptation



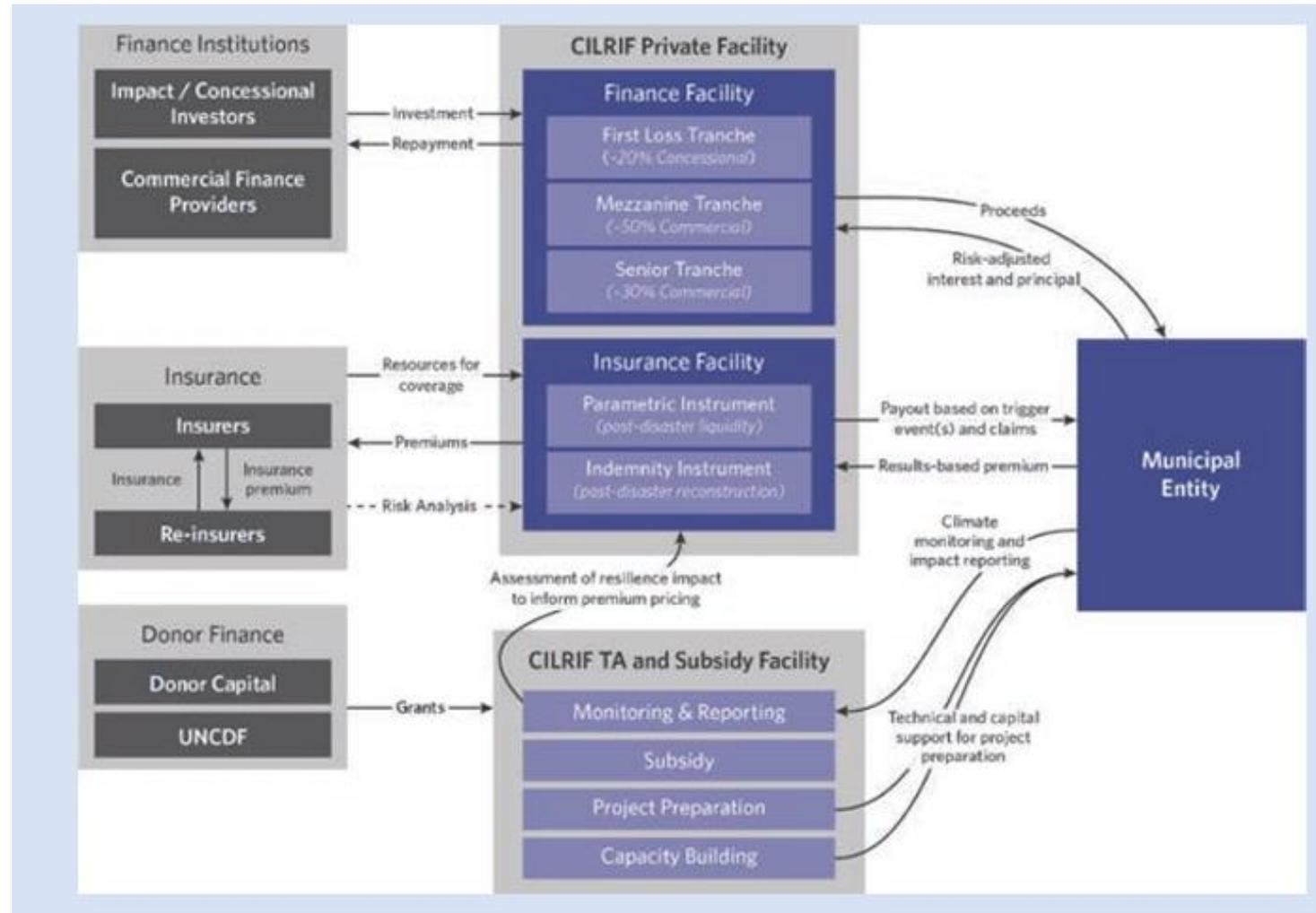
# Critical importance of insurance markets



Source: BCG analysis, AXCO, Global Data.



# Insurance to Unlock Investment



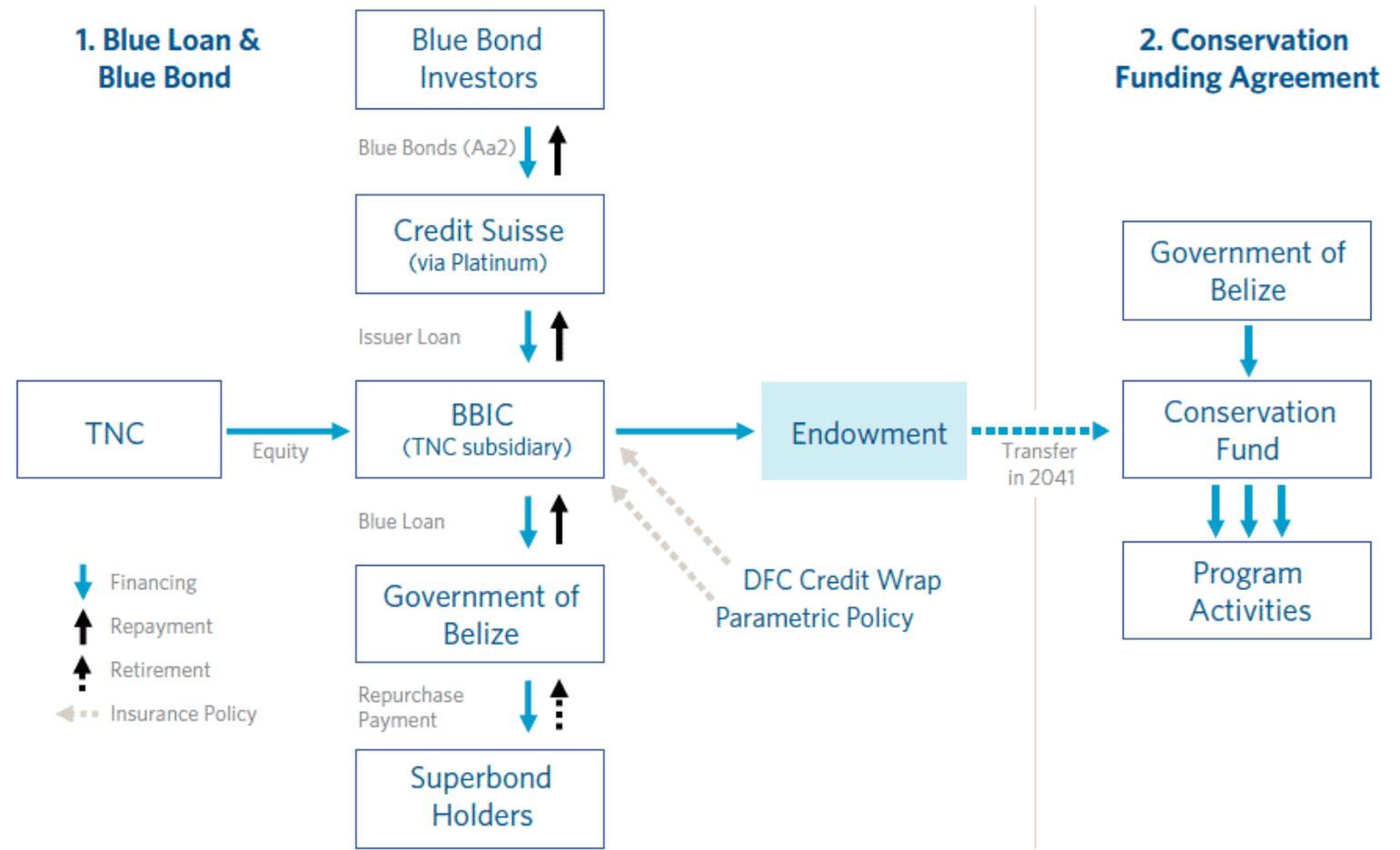
# Sovereign Financing: Debt for Nature



Last updated on November 29th, 2022 at 04:36 am



## Belize Blue Loan/Blue Bond & Conservation Funding Agreement Structure



The background image is a wide-angle shot of the Gardens by the Bay in Singapore. In the center, the Supertrees are silhouetted against a bright, hazy sky where the sun is low on the horizon. To the left, the curved, glass-and-steel structure of the Flower Dome is visible. In the foreground, there is a dense, lush green forest with a wooden walkway and a body of water with a fountain on the right side.

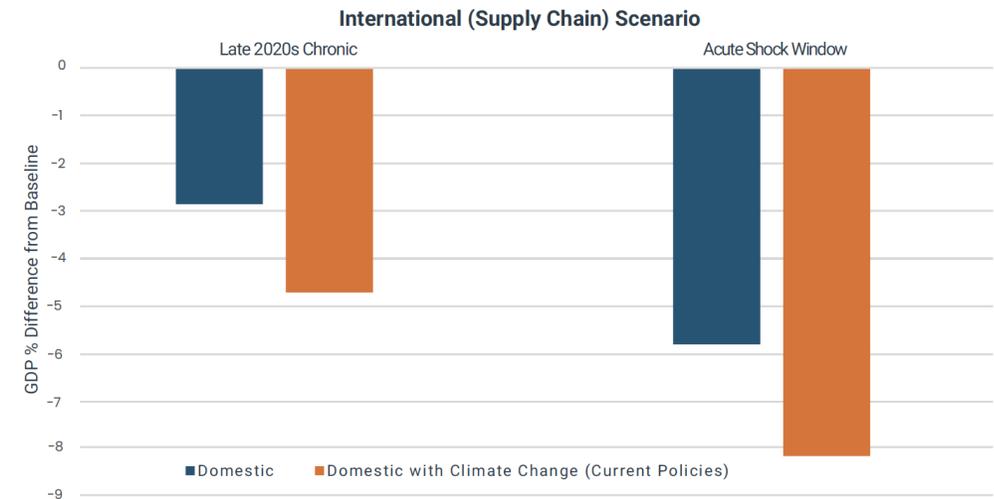
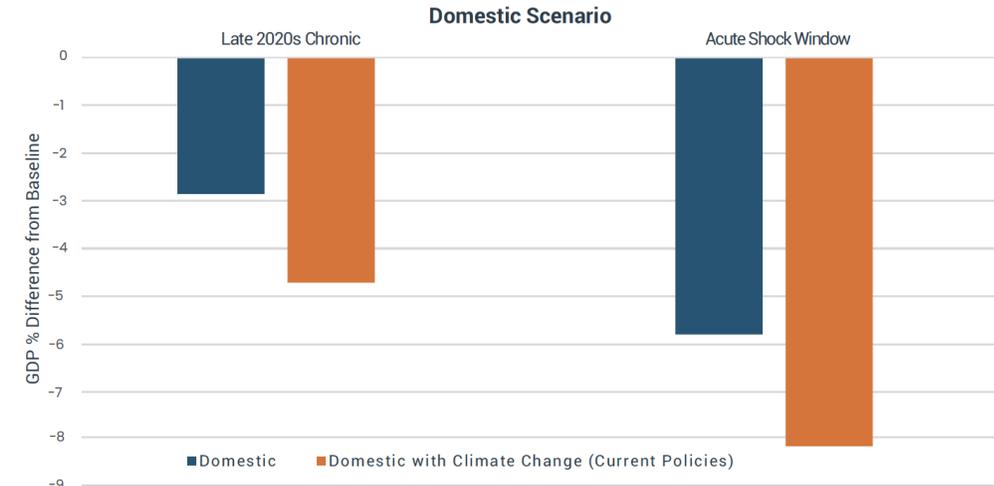
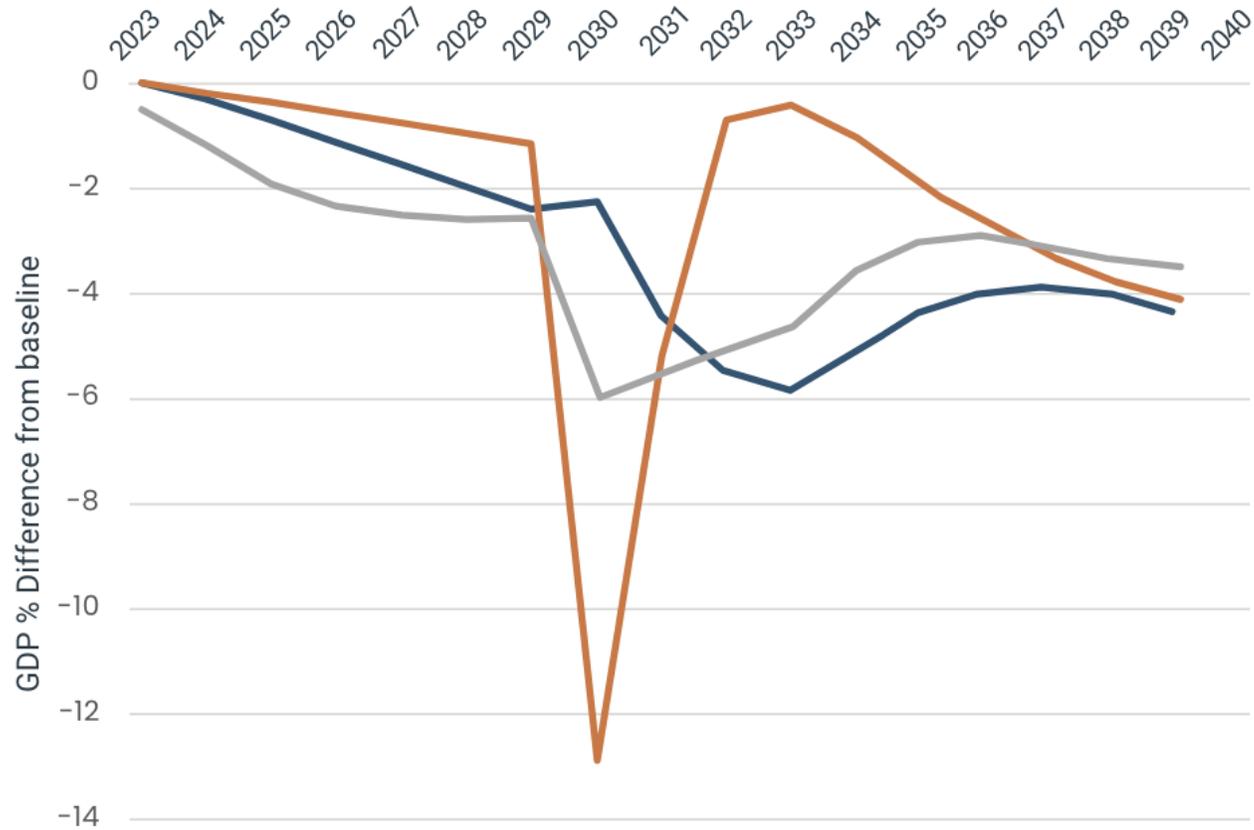
# Part 4: New Dimensions

	Nature's contribution to people	50-year global trend	Directional trend across regions	Selected indicator
REGULATION OF ENVIRONMENTAL PROCESSES	 1 Habitat creation and maintenance	↓ ↓ ↓	○ ○ ○	<ul style="list-style-type: none"> <li>• Extent of suitable habitat</li> <li>• Biodiversity intactness</li> </ul>
	 2 Pollination and dispersal of seeds and other propagules	↓ ↓ ↓	○ ○ ○	<ul style="list-style-type: none"> <li>• Pollinator diversity</li> <li>• Extent of natural habitat in agricultural areas</li> </ul>
	 3 Regulation of air quality	↘	↕	<ul style="list-style-type: none"> <li>• Retention and prevented emissions of air pollutants by ecosystems</li> </ul>
	 4 Regulation of climate	↘	↕	<ul style="list-style-type: none"> <li>• Prevented emissions and uptake of greenhouse gases by ecosystems</li> </ul>
	 5 Regulation of ocean acidification	→	↕	<ul style="list-style-type: none"> <li>• Capacity to sequester carbon by marine and terrestrial environments</li> </ul>
	 6 Regulation of freshwater quantity, location and timing	↘	↕	<ul style="list-style-type: none"> <li>• Ecosystem impact on air-surface-ground water partitioning</li> </ul>
	 7 Regulation of freshwater and coastal water quality	↘	○	<ul style="list-style-type: none"> <li>• Extent of ecosystems that filter or add constituent components to water</li> </ul>
	 8 Formation, protection and decontamination of soils and sediments	↘	↕	<ul style="list-style-type: none"> <li>• Soil organic carbon</li> </ul>
	 9 Regulation of hazards and extreme events	↘	↕	<ul style="list-style-type: none"> <li>• Ability of ecosystems to absorb and buffer hazards</li> </ul>
	 10 Regulation of detrimental organisms and biological processes	↓ ↓ ↓	○ ○ ○	<ul style="list-style-type: none"> <li>• Extent of natural habitat in agricultural areas</li> <li>• Diversity of competent hosts of vector-borne diseases</li> </ul>
MATERIALS AND ASSISTANCE	 11 Energy	↘ ↗	↕	<ul style="list-style-type: none"> <li>• Extent of agricultural land—potential land for bioenergy production</li> <li>• Extent of forested land</li> </ul>
	 12 Food and feed	↓ ↗	↕	<ul style="list-style-type: none"> <li>• Extent of agricultural land—potential land for food and feed production</li> <li>• Abundance of marine fish stocks</li> </ul>
	 13 Materials and assistance	↘ ↗	↕	<ul style="list-style-type: none"> <li>• Extent of agricultural land—potential land for material production</li> <li>• Extent of forested land</li> </ul>
	 14 Medicinal, biochemical and genetic resources	↓ ↘	○ ○ ○	<ul style="list-style-type: none"> <li>• Fraction of species locally known and used medicinally</li> <li>• Phylogenetic diversity</li> </ul>

The 2019 Global Assessment Report of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) concluded that fourteen of the eighteen ecosystem services ('categories of Nature's contribution of people') that were assessed had declined since the 1970s, while outputs of food and other products had risen

Drivers include land-use change, pollution, extraction and climate change

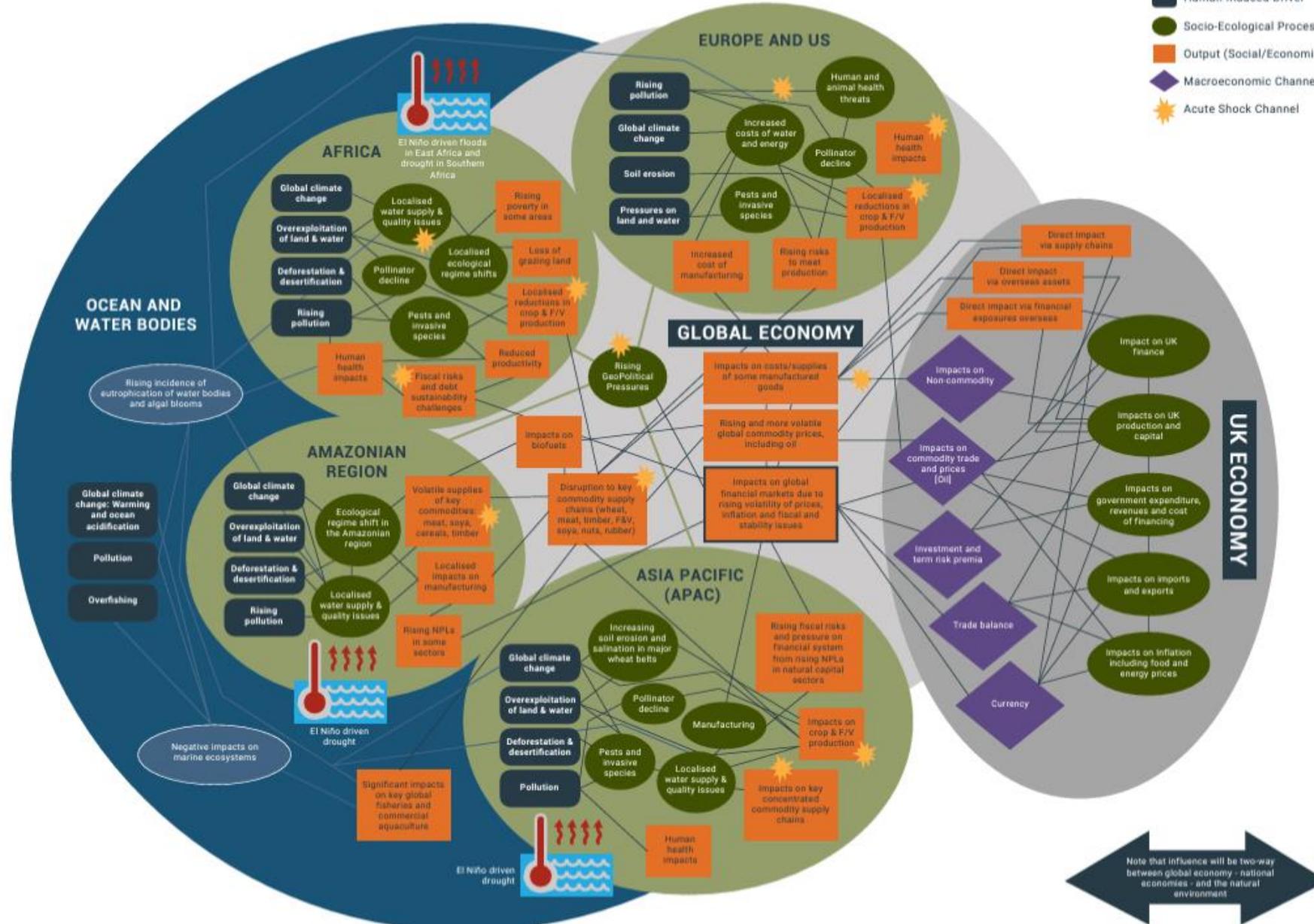
# Nature-Related Risks are Macro-Critical



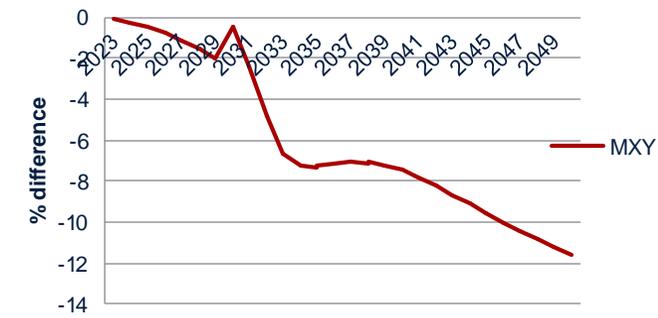
# INTERNATIONAL SCENARIO

## LEGEND

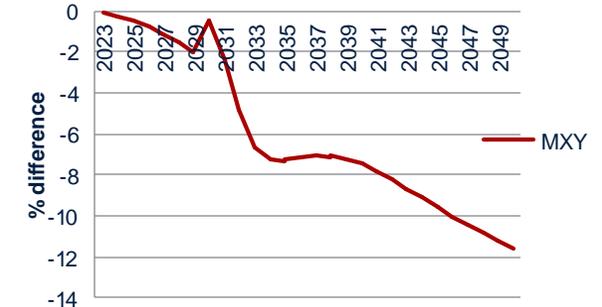
- Human-Induced Driver
- Socio-Ecological Process
- Output (Social/Economic)
- ◆ Macroeconomic Channel
- ★ Acute Shock Channel



Gross Domestic Product (GDP), 2013 prices; MXN Bn



Gross Domestic Product (GDP), 2013 prices; MXN Bn



The background of the slide is an aerial photograph of a city at dusk. A prominent skyscraper, illuminated with red and blue lights, stands out against the darkening sky. The city is surrounded by water, and a large, circular green space is visible in the foreground. The overall scene is a mix of urban architecture and natural elements.

# Summary