Climate Risk Seminar

GIFT City, Gandhinagar

19th July 2024

Climate Risk Scenario Analysis and Stress Testing

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1. Overview

IPCC 6th Assessment Report's take on India

The three major climate change hotspots in India are the semi-arid and arid regions, the Himalayan ecosystem and coastal zones.

About half of India's landmass is arid and semi-arid, prone to impacts of rising temperatures.

Coastal megacities & smaller coastal towns including the Andaman and Nicobar Islands are at a greater risk of being flooded.

Global warming has increased the average temperature in the Himalayas causing large scale glacier melting

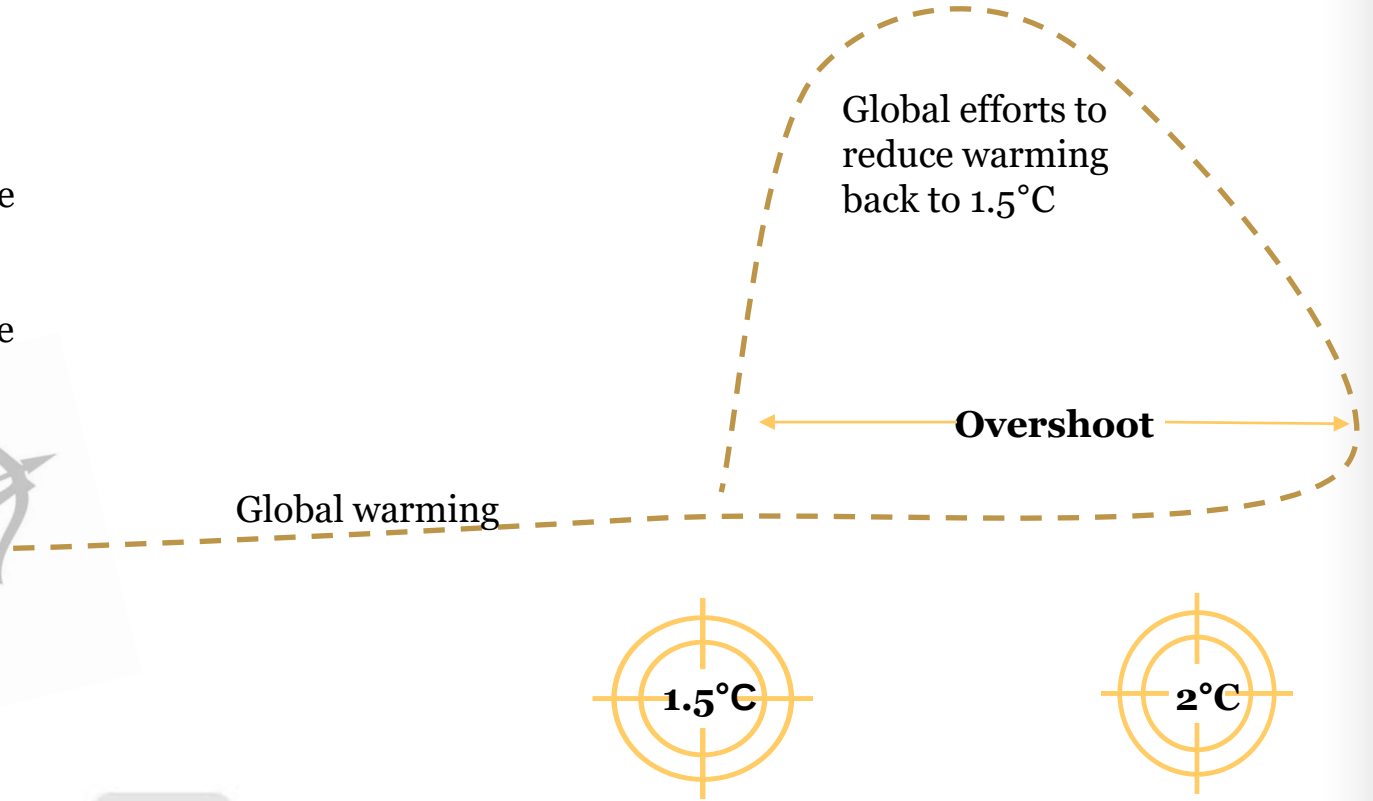
Urbanisation in the Himalayas is reducing the cover of the water bodies thus making water insecurity in hill towns the order of the day

Only worlds with no - or low-temperature overshoots beyond 1.5˚c will prevent substantial burdens falling on current and future generations

The greater any overshoot, the greater the efforts needed to return global average temperature increase to 1.5°C — using 'negative emissions'

But negative emissions at the required scale are still very uncertain.

Measures currently in place globally to limit emissions are projected to result in about 2.7°C warming above pre-industrial levels by the end of the century.



Scenario for limiting global warming to 1.5° temperature rise

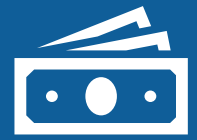
The future will look different no matter what – just how different is our choice. Because decision we take today determine the world we get to live in tomorrow.

'Limiting global warming to 1.5°C requires rapid, far-reaching and unprecedented changes in all aspects of society'

Global net zero CO_2 emissions by 2050 (carbon neutrality)

CO_2 emissions need to decline 40-60% from 2010 levels by 2030

Renewables supplying 70-85% of global electricity by 2050



Required clean energy system investment of around $2.4 trillion every year until 2035

Source: IPCC

There is no single ‘1.5°c warmer world’, but some paths diverge more from the world as we know it today

Late, uncoordinated action

Despite past pledges, global support for the Paris Agreement wanes. Major actions are eventually taken, including massive investments in renewable energy, but these efforts are uncoordinated and limited. Almost all of Earth’s ecosystems experience irreversible impacts. Progress on the Sustainable Development Goals (SDGs) is largely undone, poverty rates reach new highs and life expectancy decreases.

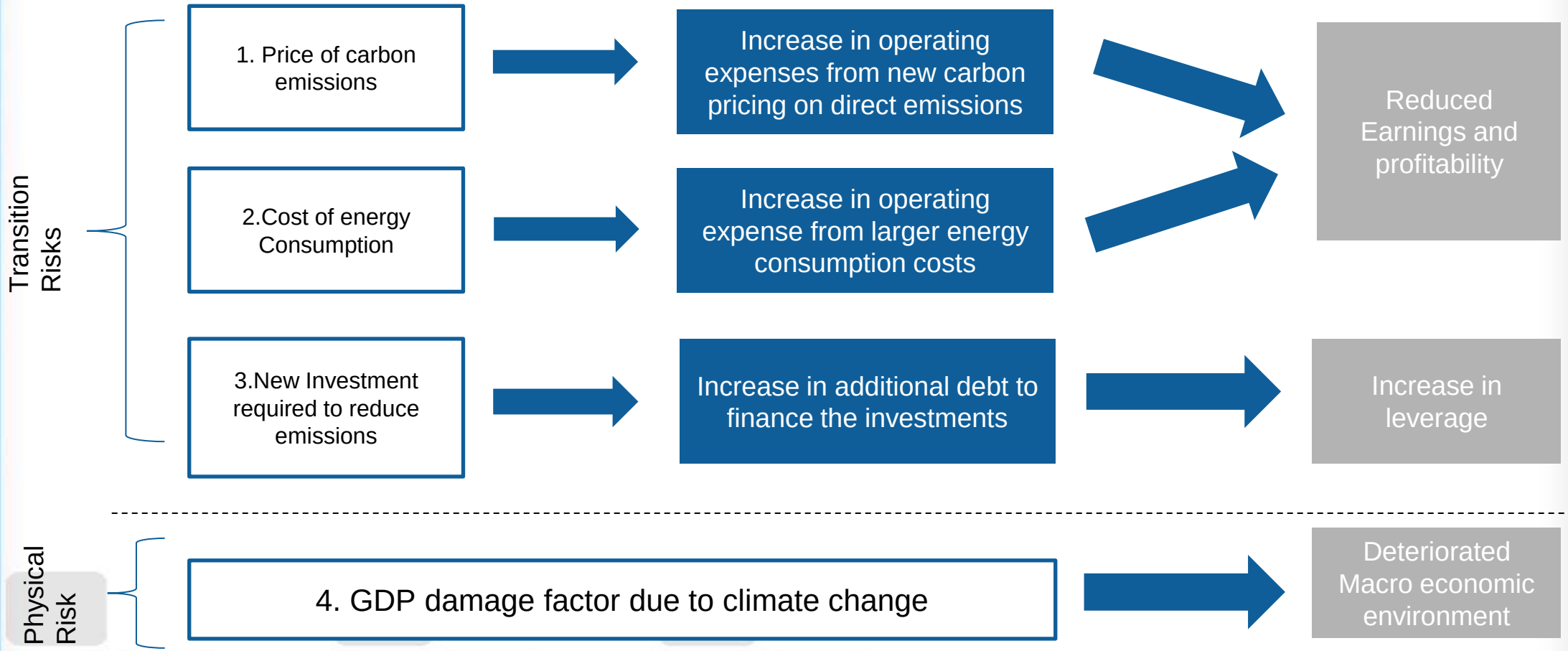
Delayed, decisive action

Delayed action leads to the need to employ intensive Bioenergy with Carbon Capture and Storage (BECCS), but no effort is made to minimize the land and water footprint of BECCS production. Food production is prioritized over the protection of ecosystems, causing widespread problems.

Early, effective action

Strong adherence to the goals of the Paris Agreement by an almost unanimous global community leads to coordinated and rapid decarbonization. While some climate hazards become more frequent, timely adaptation measures reduce risks. Early global climate action, designed to minimize the land footprint, helps global warming halt at around 1.5°C.

Scenario Analysis Analytical Framework



Global Reference Scenarios

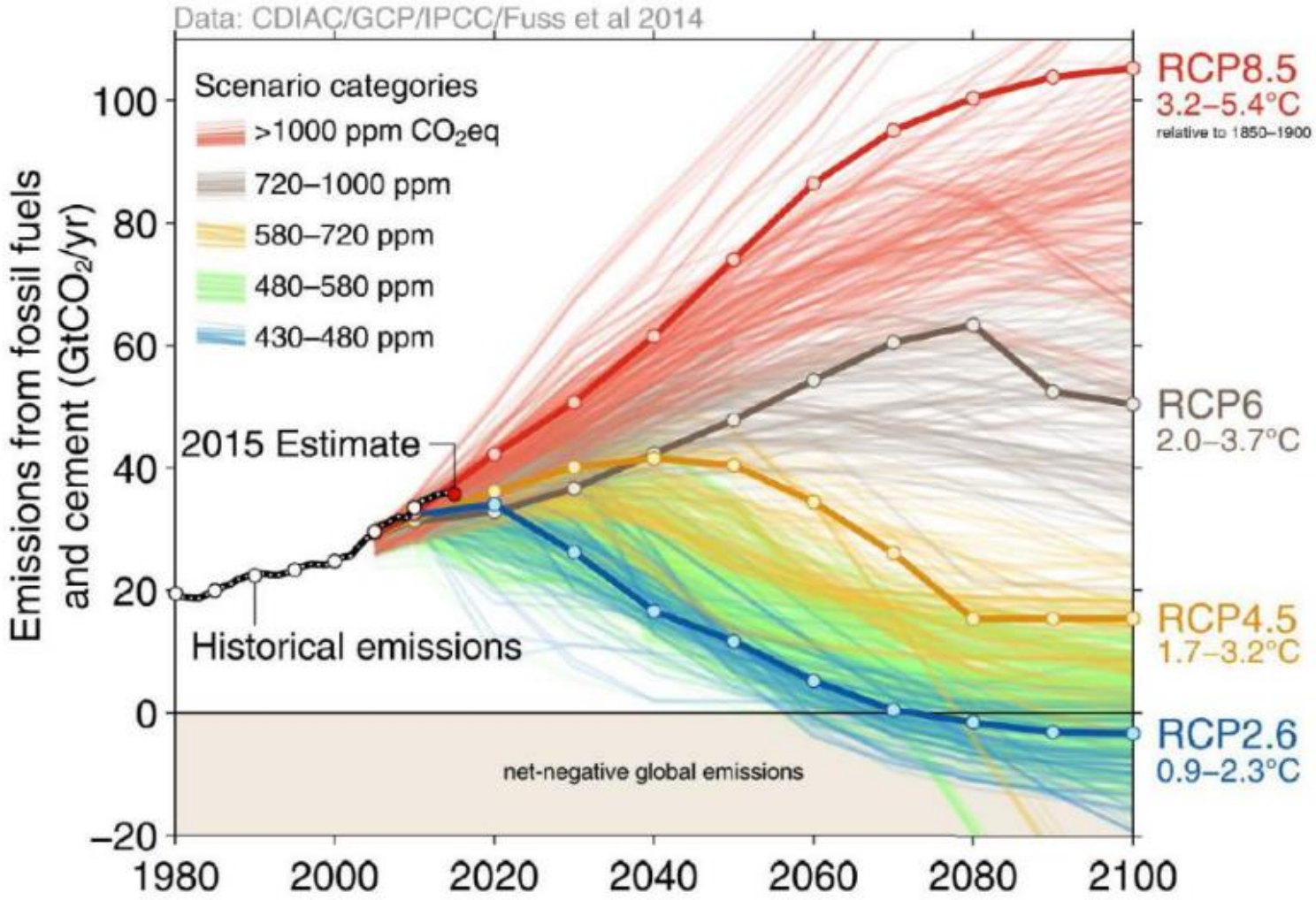
Pathway Name	Corresponding Rise in Global Average Temperature by 2100	Emissions Trend to 2100	Comments
RCP 1.9	~1.5°C	very strongly declining	
RCP 2.6	~2.0°C	strongly declining	"Paris aligned"
RCP 4.5	~2.4°C	slowly declining	
RCP 6.0	~2.8°C	stabilizing	"Current policies"
RCP 8.5	~4.3°C	rising	"Business as usual"

The RCPs did not originally include a socioeconomic "narrative". Shared Socioeconomic pathways(SSPs) have been developed subsequently to be used in conjunction with the RCPs.

Shared Socioeconomic pathway (SSPs)	Description
SSP1	Significant focus on sustainability
SSP2	Business as usual
SSP3	Regional rivalry between countries
SSP4	High degree of inequality
SSP5	Fossil fuel developments

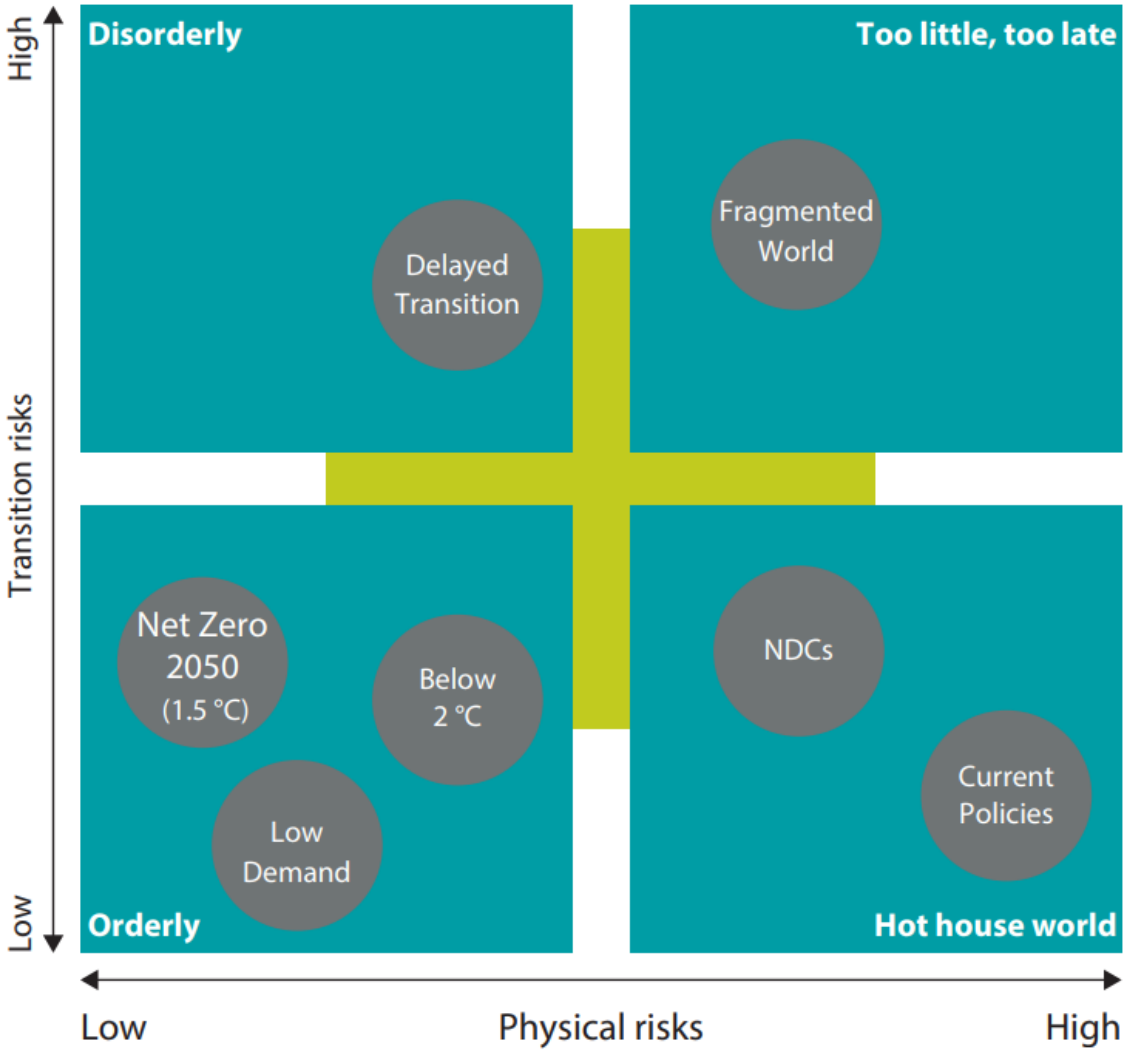
SSPs provide plausible scenarios in areas such as population, economic growth, education, level of globalization, level of urbanization, and the rate of technological development.

Updated emission scenarios – RCPs (pre--2021) vs RCP-SSP combination



(Sabine Fuss et al, 2014)

NGFS scenario pathways

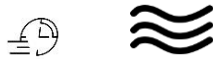
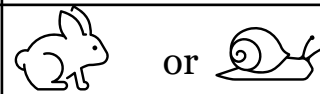
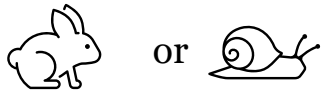


The NGFS scenarios explore a set of seven scenarios which are consistent with the NGFS framework

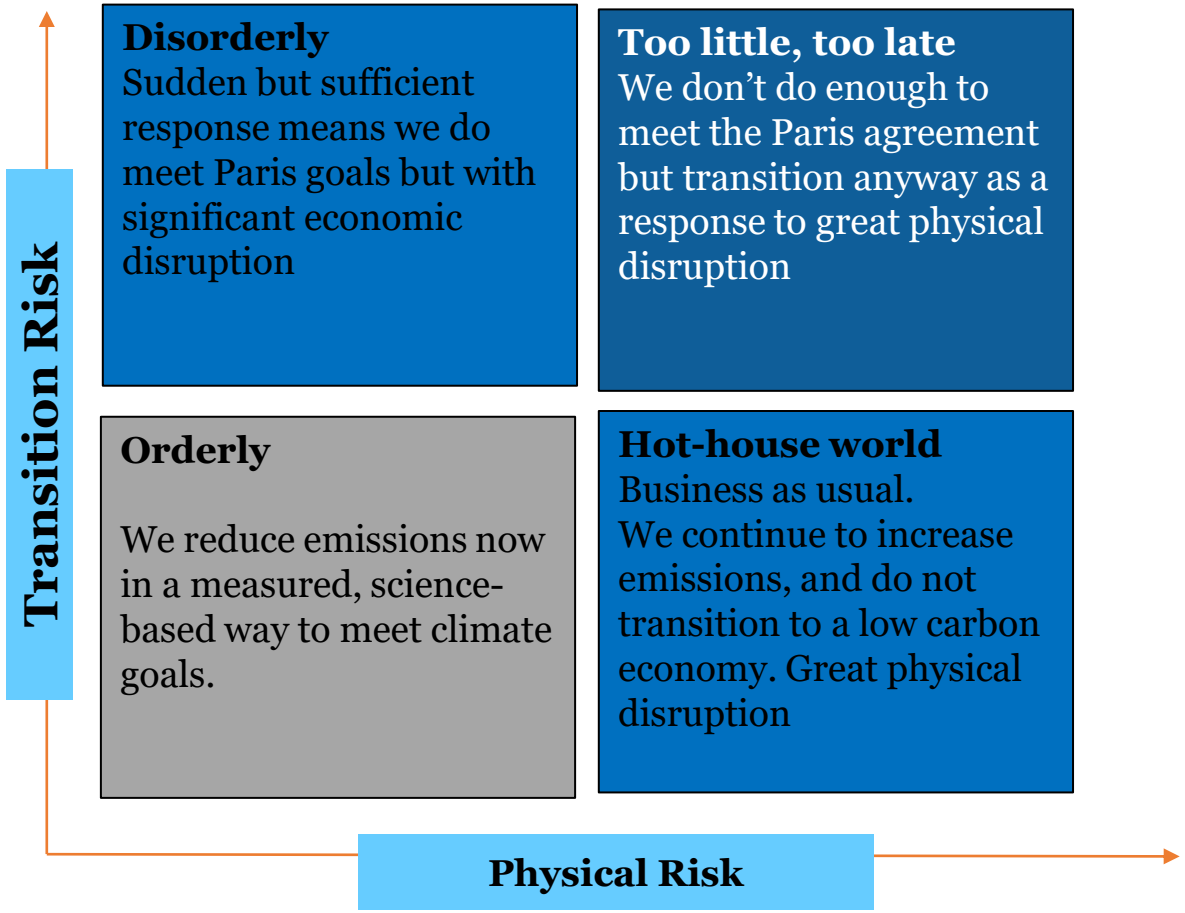
Each NGFS scenario explores a different set of assumptions for how climate policy, emissions, temperatures and physical risk impacts evolve

Differences in assumptions across scenarios lead to different temperature pathways, carbon emissions reductions, and carbon price developments that allow to reach them.

NGFS scenario pathways

Scenarios	Name	Policy Ambition	Policy Reaction	Technology Change speed
Orderly scenarios assume climate policies are introduced early and become gradually more stringent. Both physical and transition risks are relatively subdued.	Net Zero 2050	1.5°C		
	Below 2°C	1.7°C		
	Low Demand	1.4°C		
Disorderly scenarios explore higher transition risk due to policies being delayed or divergent across countries and sectors. Carbon prices are typically higher for a given temperature outcome.	Divergent Net Zero	1.5°C		
	Delayed Transition	1.8°C		
Hot House World Scenarios assume partial climate policy implementation in certain areas, with global efforts insufficient to halt significant global warming, leading to severe physical risks such as irreversible sea-level rise.	Nationally Determined Contributions	2.4°C		
	Current Policies	2.9°C+	NA	
Too little too late assumes a delayed and divergent climate policy response among countries globally, leading to high physical and transition risks. Countries with net zero targets achieve them only partially	Fragmented world	2.3°C		

Interaction between Physical and Transition risks- A conceptual Trade-off



Taken from Network for Greening the Financial System (NGFS) report, 2019 'Climate as a source of financial risk'

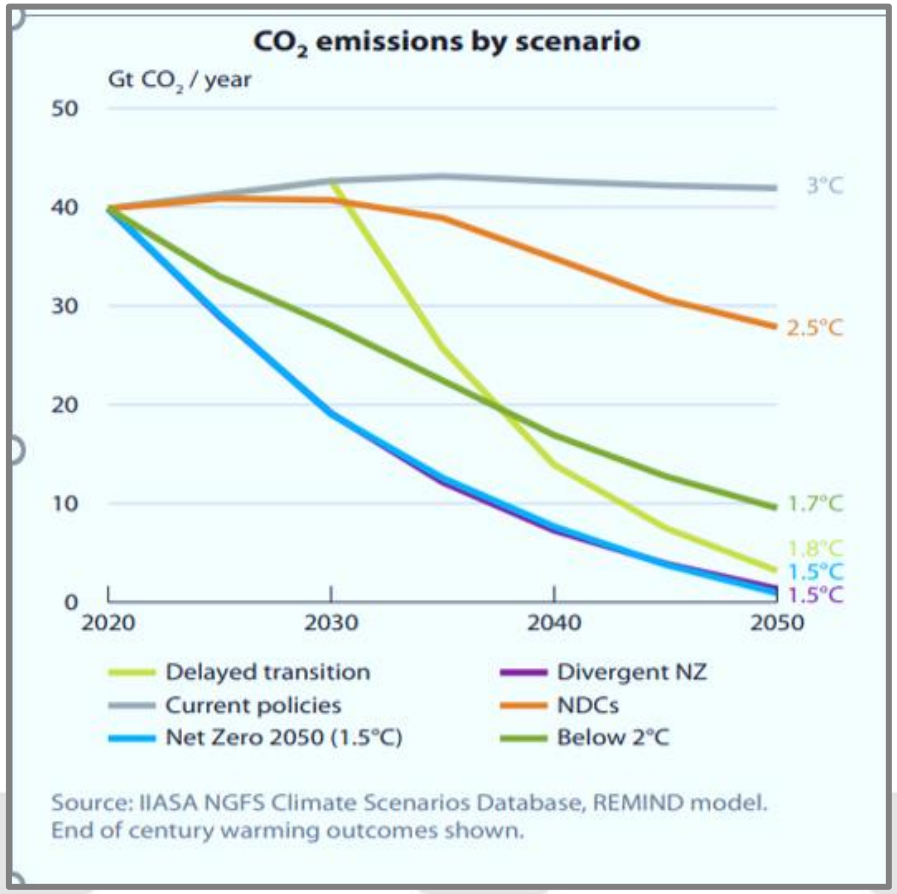
2

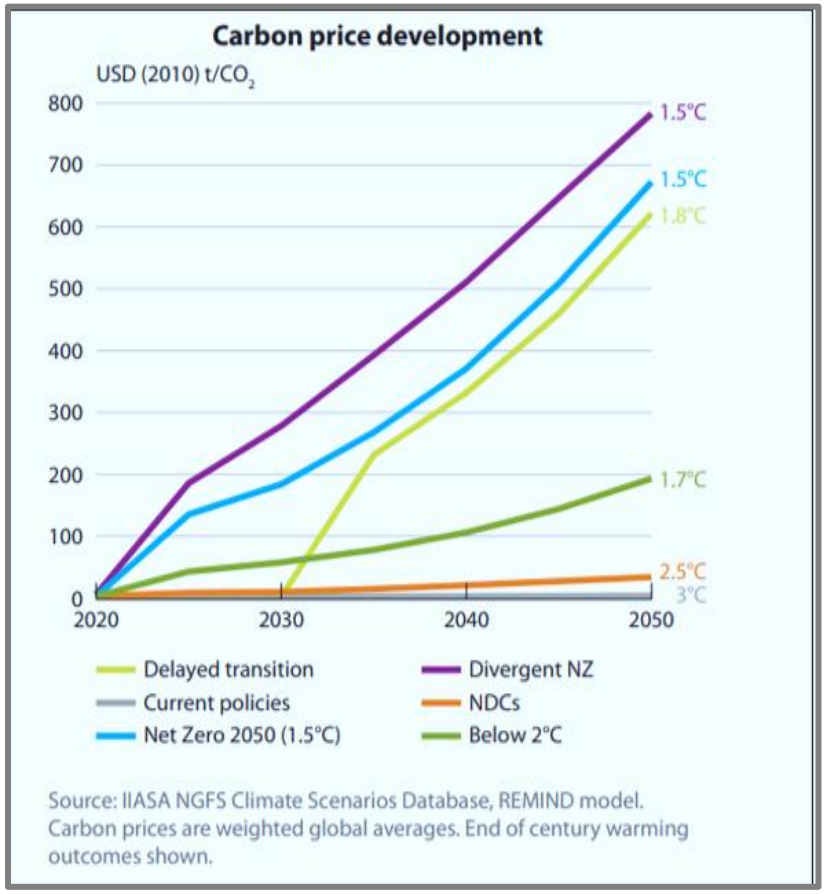
Second paradox: success is failure
A delayed move towards a low-carbon economy could materially damage financial stability. A wholesale reassessment of prospects could destabilize markets, spark a pro-cyclical crystallization of losses and lead to a persistent tightening of financial conditions: a climate 'Minsky moment'.

1

First paradox: the future will be past
Climate change is a tragedy of the horizon, which will impose major costs on future generations that the current generation has no direct incentive to fix. Once climate change becomes a clear and present danger to financial stability, it may already be too late to stabilize the atmosphere.

Each scenario explores a different set of assumptions for how climate policy, emissions, and temperatures evolve(1/2)

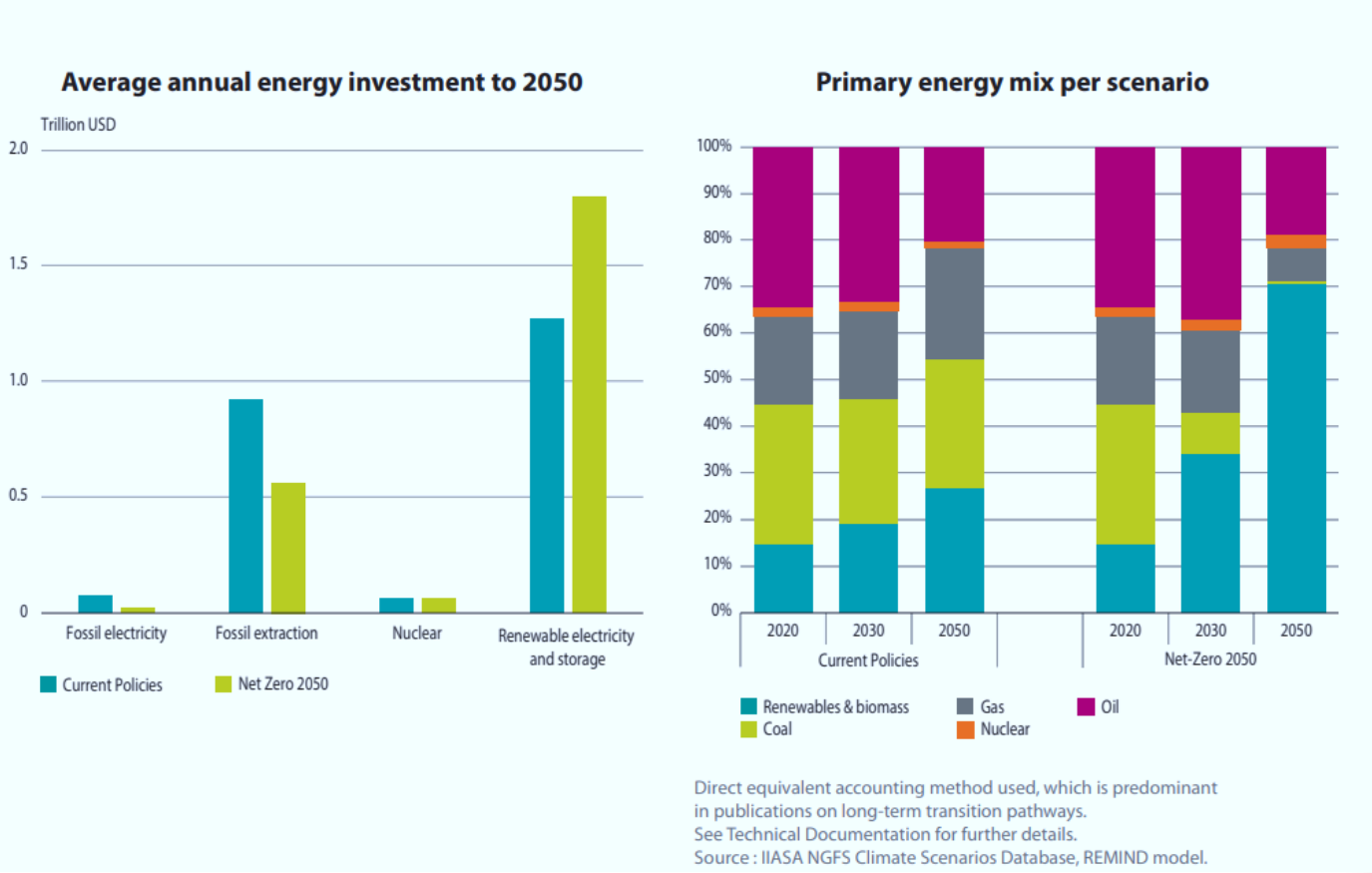




Energy Mix(2/2)

- Significant investment flows would need to be directed towards green energy in the coming decades to achieve net zero (left chart)

- By 2050, renewables and biomass would deliver 70% of global primary energy needs in the Net Zero 2050 scenario (right chart). This is a marked contrast to the Current Policies scenario where fossil fuels continue to be the dominant source of primary energy, even after accounting for current technology trends.



Climate Risk Stress Testing

Climate change is increasingly becoming a focus of supervision and requires integration into stress testing methods.

European Systemic Risk Board

"To quantify the significance of these risks, policymakers could seek enhanced disclosure of the carbon intensity of non-financial firms. The associated **burdens on financial firms** could then be **stress tested** under the negative scenario of a **late and sudden transition.**"

European Central Bank (ECB)

"Institutions with material climate and environmental risks are expected to assess the adequacy of their stress tests and **include** them **in their baseline and adverse scenarios.**"

European Banking Authority (EBA)

"(…) currently, the objective of a climate risk stress test should be to assess climate-related risks and obtain information on the resilience of institutions' own business model and investment strategies, with less focus on the impact on capital. (…) Institutions could use reference scenarios from international organisations (e.g., **NGFS**) as a starting point."

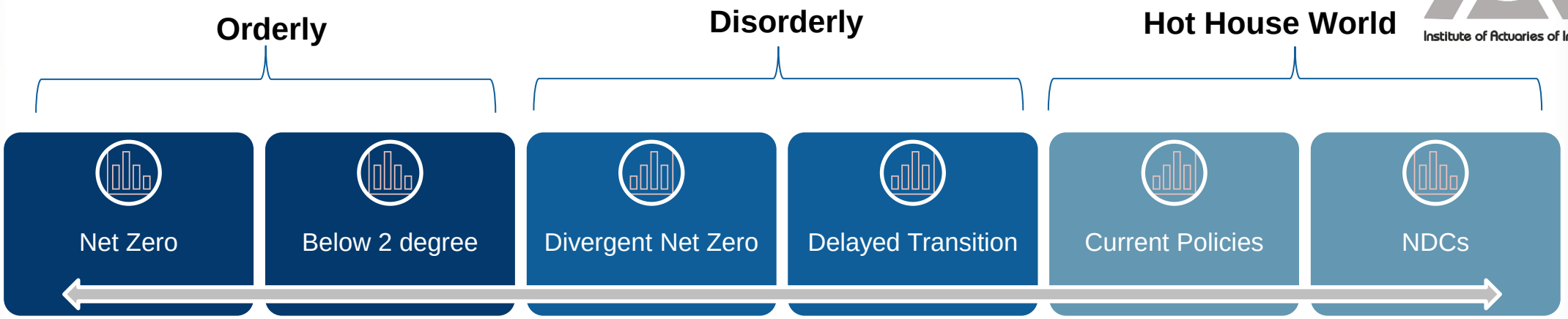
Federal Financial Supervisory Authority (BaFin)

"Stress tests may include **specific sensitivity and scenario analyses to** examine the **firm's ability to withstand** adverse events or scenarios caused by **physical and transitory risks.** Given the characteristics of sustainability risks […] it is therefore advisable that stress tests also **consider scenarios reflecting plausible future developments** and make greater use of **long-term scenario analyses.**"

Key challenges

- **Methods** for climate risk stress testing are at an **early stage**.
- The **analysis over several decades** requires a fundamental modelling approach due to the longer time period over which the risks materialise.
- Modelling of **dynamic interactions** and use of multiple scenarios
- Challenge in assessing how companies can **adapt** their **business models over the** course of the **scenario**
- **Limited empirical and granular data** to measure actual climate risk exposure
- Significant problems with comparability and **data quality**

Climate Risk Stress Testing



Impact on credit rating

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Impact on RWA

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Impact on provisions/capital

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Probability weighted outcome

Thank You