

# Climate Risk Modelling Scenario Analysis

# Agenda

1. Introduction and Global Regulatory Developments
2. Scenario Analysis for Climate Risk
3. Financial Impacts Examples
4. Summary
5. Q&A

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Introduction and Global  
Regulatory Developments

# Climate Change Introduction

## Climate Change

- A change in global or regional patterns attributed largely to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels. (Oxford Dictionary)
- Potential to significantly impact the safety and soundness of financial institutions resulting in climate change risks.

### Transition Risk

- Permanent shifts driven by changes in policies, technology, carbon pricing and regulations and market behaviour.

### Physical Risk

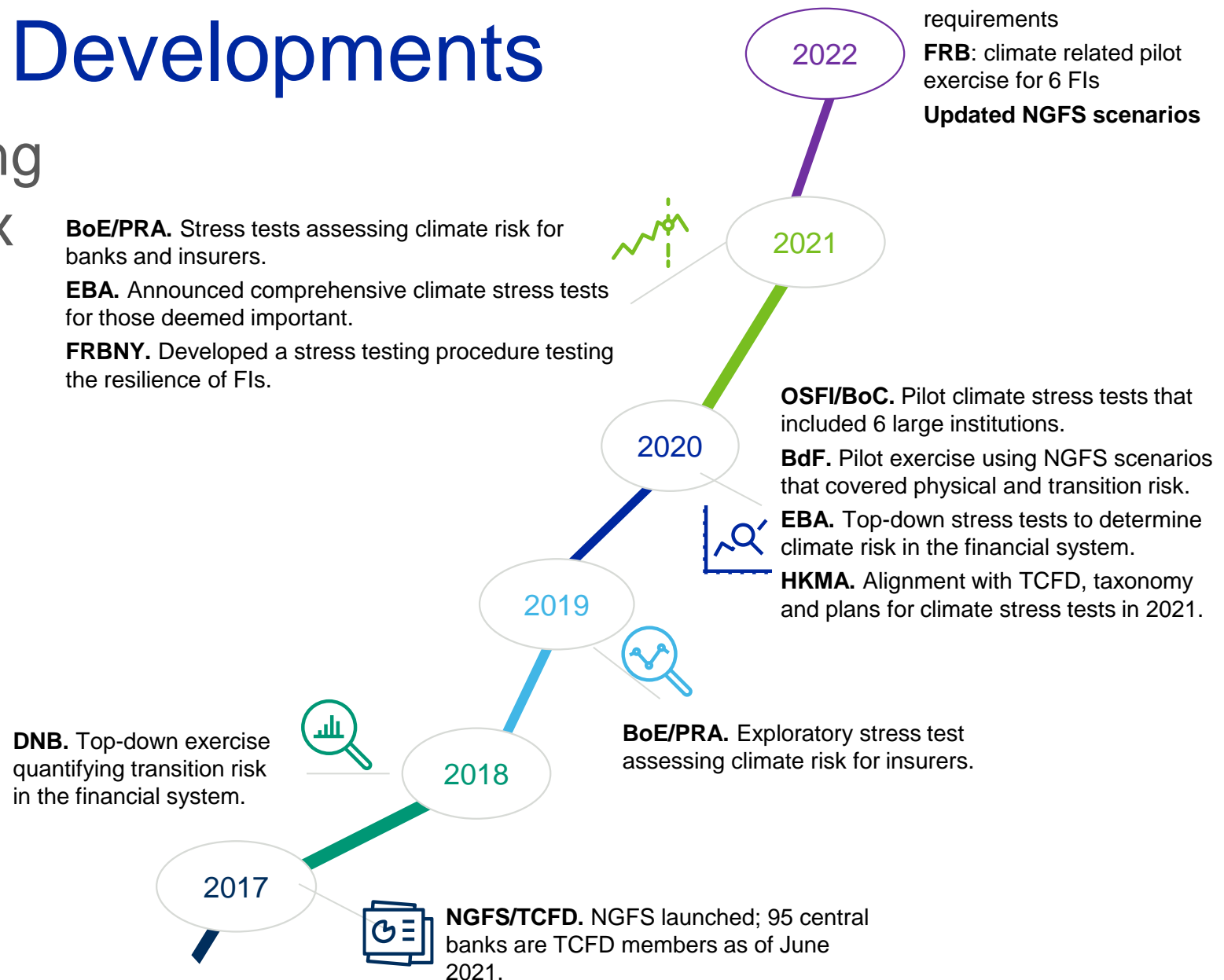
- Acute physical risks – shocks due to increased number of extreme weather events
- Chronic physical risks – long term systemic (not diversifiable) shifts

# Global Regulatory Developments

## Examinations are becoming more popular and complex

Since the Paris Agreement in 2015 regulators around the world have conducted stress tests of increasing sophistication on their financial systems and members.

- » Early tests were regulator-driven and focused on top-down analysis.
- » Initially the exercises focused on physical or transition risk, but now cover both.
- » Regulators have typically used scenarios inspired by the Network for Greening the Financial System (NGFS), tailored for their jurisdiction.
- » Complexity is growing, increasing the burden on banks and insurers.



BoC – Bank of Canada  
 BoE – Bank of England  
 BdF – Banque de France  
 DNB – De Nederlandsche Bank  
 EBA – European Banking Authority

HKMA – Hong Kong Monetary Authority  
 NGFS – Network for Greening the Financial System  
 OSFI – Office of the Superintendent of Financial Institutions  
 FRBNY – Federal Reserve Bank of New York  
 TCFD – Taskforce for Climate-Related Financial Disclosures

# Impacts of the Climate Change on the Balance Sheet

## Assets

### Top-down Scenario Analysis

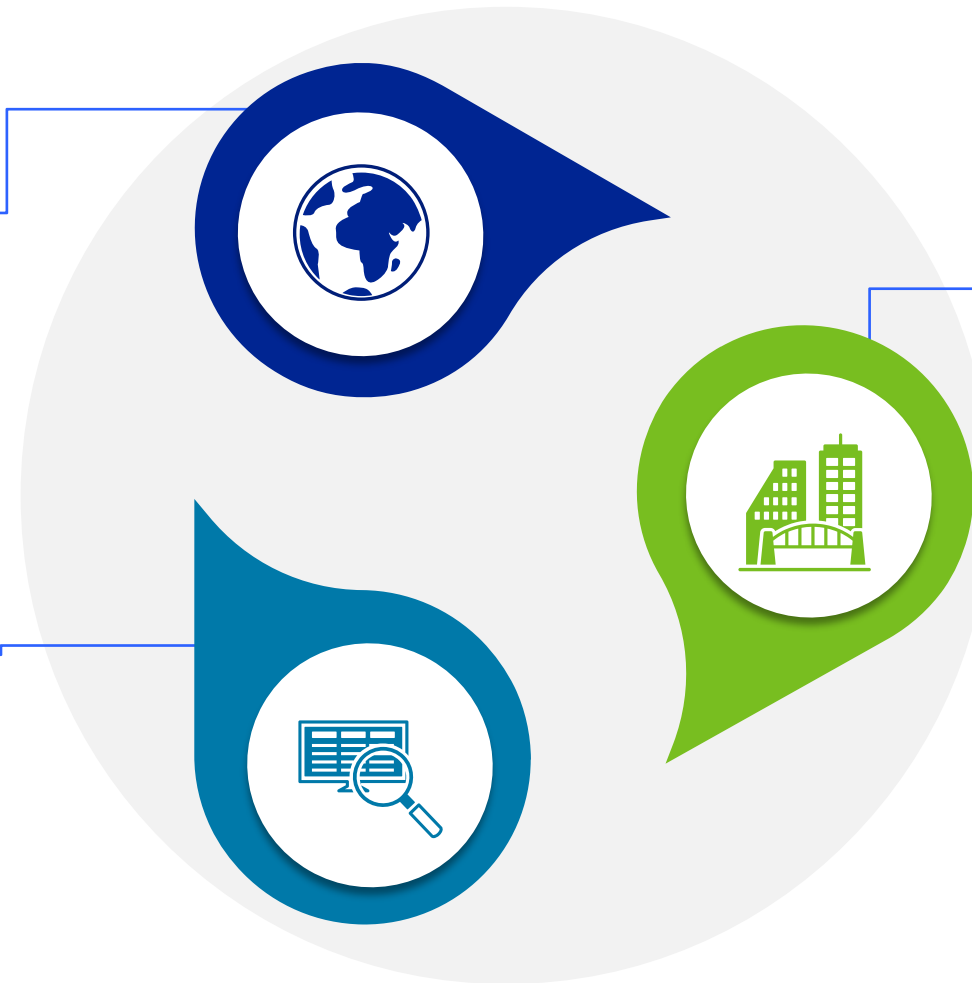
Climate scenarios translated into macroeconomic variables for your asset liability management models

- ✓ Meet regulatory requirements
- ✓ Quantify financial impact

### Bottom-up Climate Credit Risk

Climate-adjusted probability of default for each security in your portfolio for granular climate risk quantification

- ✓ Meet regulatory requirements
- ✓ Quantify credit risk impact



## Liabilities

### Climate Scenario Physical Risk Modelling

Climate conditioned Nat Cat models for individual perils based on Representative Concentration Pathways at a range of time horizons

- ✓ Support pricing decisions
- ✓ Inform capital allocation

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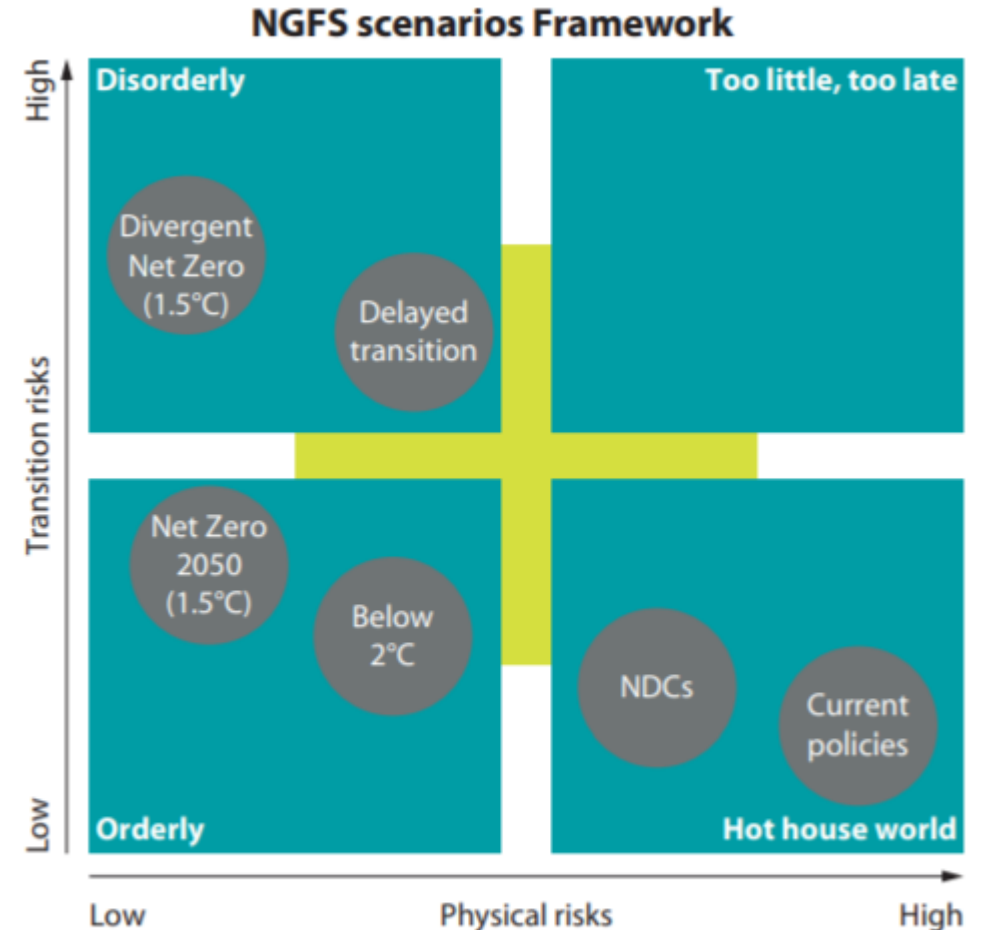
## Scenario Analysis for Climate Risk

# Climate Change Scenario Analysis

Similar to existing Stress and Scenario Testing which is commonplace across the insurance industry to quantify an entity's risk.

Climate Scenario Analysis models a plausible future state of the world to assess the impact of climate-related risk on business operations.

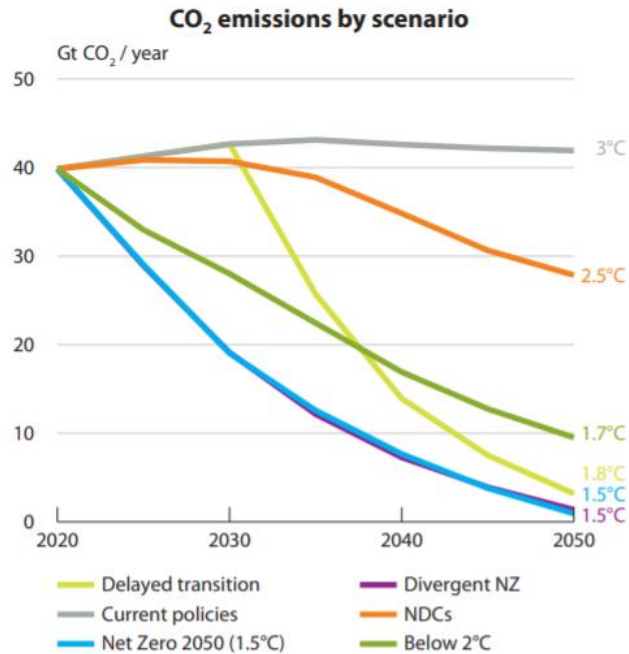
Network for Greening of Financial System Scenarios are emerging as a market standard - from the outset these were designed to be used specifically by financial institutions.



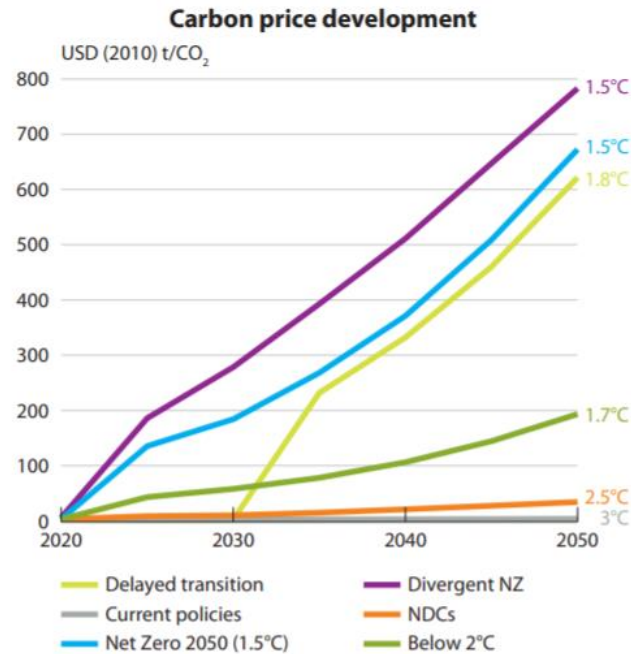
Positioning of scenarios is approximate, based on an assessment of physical and transition risks out to 2100.



# Looking inside the NGFS Scenarios



Source: IIASA NGFS Climate Scenarios Database, REMIND model.  
End of century warming outcomes shown.



Source: IIASA NGFS Climate Scenarios Database, REMIND model.  
Carbon prices are weighted global averages. End of century warming outcomes shown.

Provide CO<sub>2</sub> Emissions as well as Carbon Price Development by running each policy narrative through Integrated Assessment Models

...But don't provide details on how to translate the CO<sub>2</sub> Emissions and Carbon Price Development onto asset returns.

# Translating NGFS Scenarios into Financial Stresses



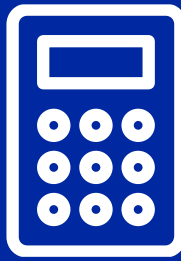
## Select Climate Scenarios

NGFS/IPCC aligned climate scenarios for 1.5°C, 2°C or hot house scenarios with early or late policy action



## Translate Macroeconomic Impact

Policy costs, via carbon taxes, and physical damages drive changes in GDP and consumption growth



## Calculate Financial Returns

Convert macroeconomic impact into key financial variables



## Set Calibration Targets

Decompose real returns to set expected paths for short rate, long rate, credit spreads and asset risk premia



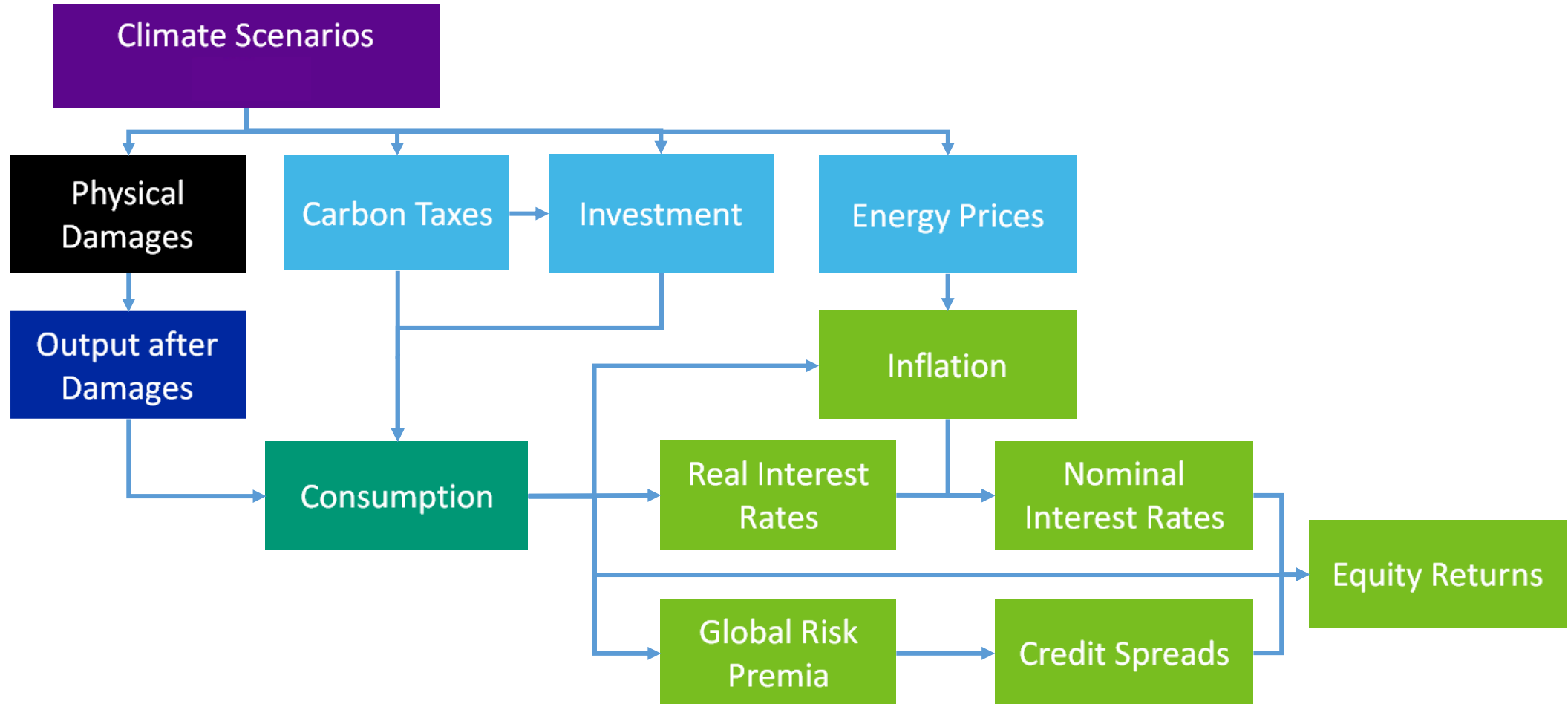
## Generate Scenario Sets

Calibrate and run Scenario Generator to produce deterministic or stochastic scenario sets

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## Financial Impacts Examples

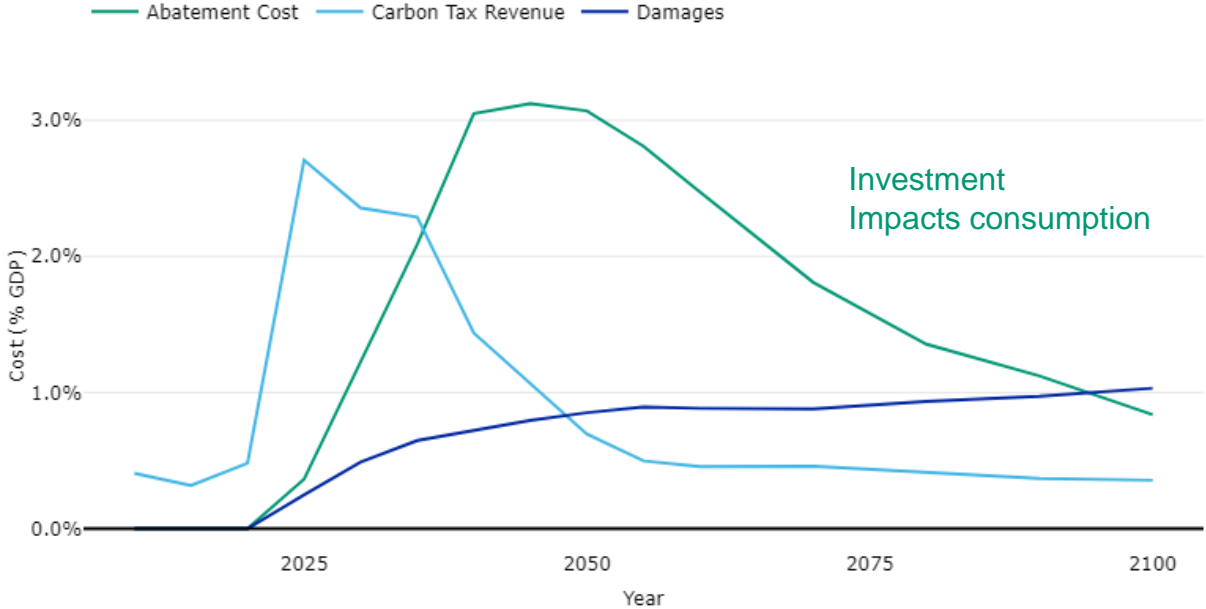
# Scenario Analysis Framework



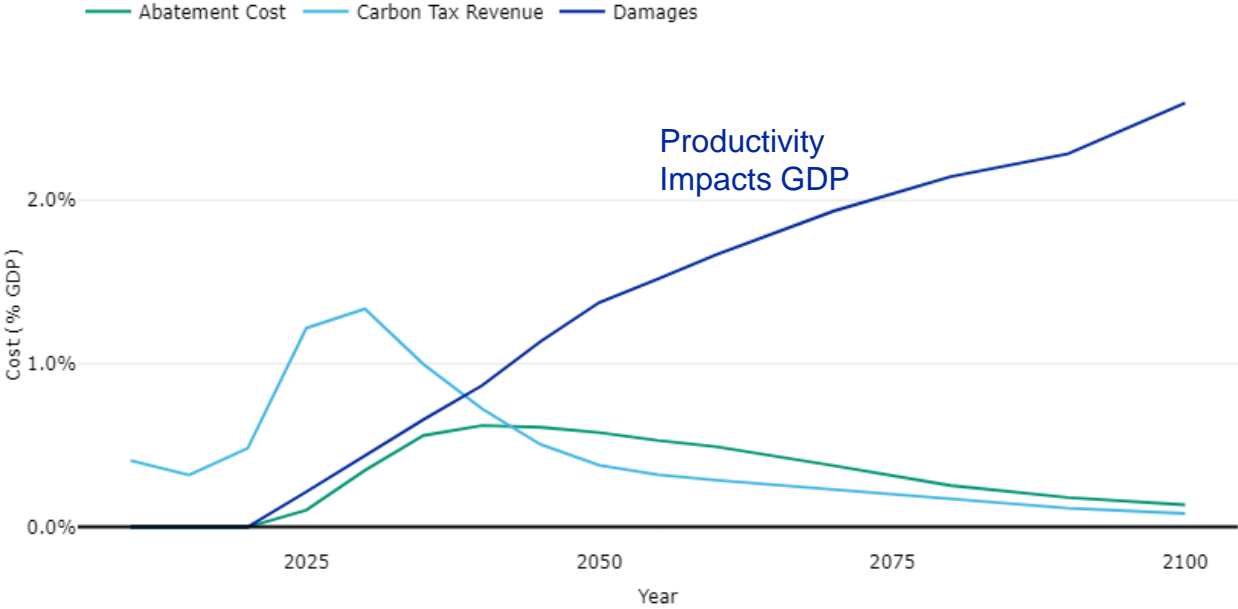
# Three waves of Costs

Costs vary across regions and scenarios

## Orderly Transition – Net Zero 2050



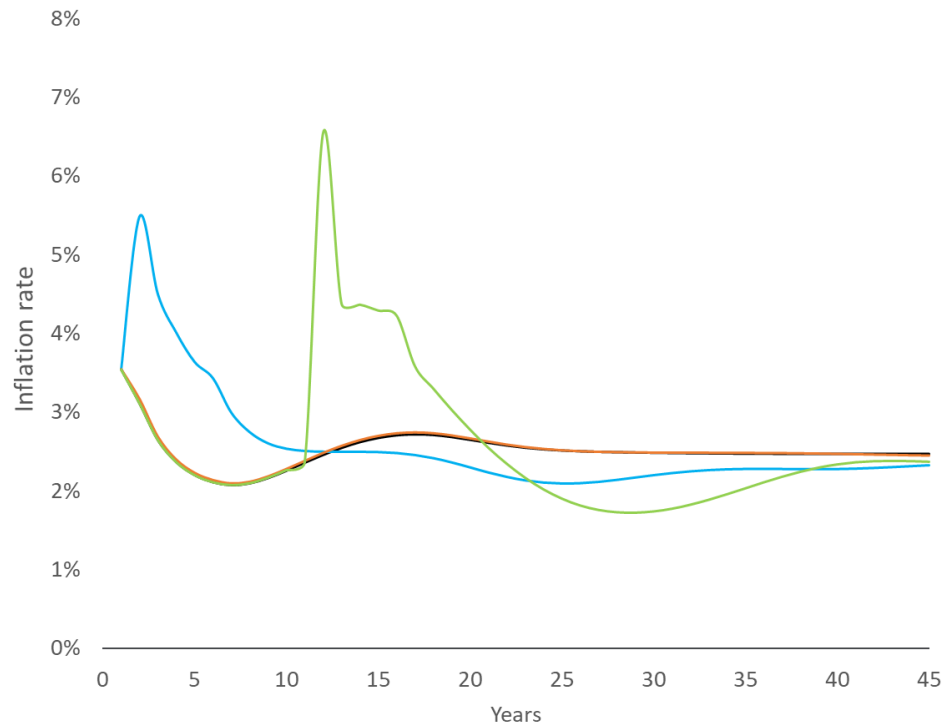
## Hot House Scenario – Nationally Determined Contributions



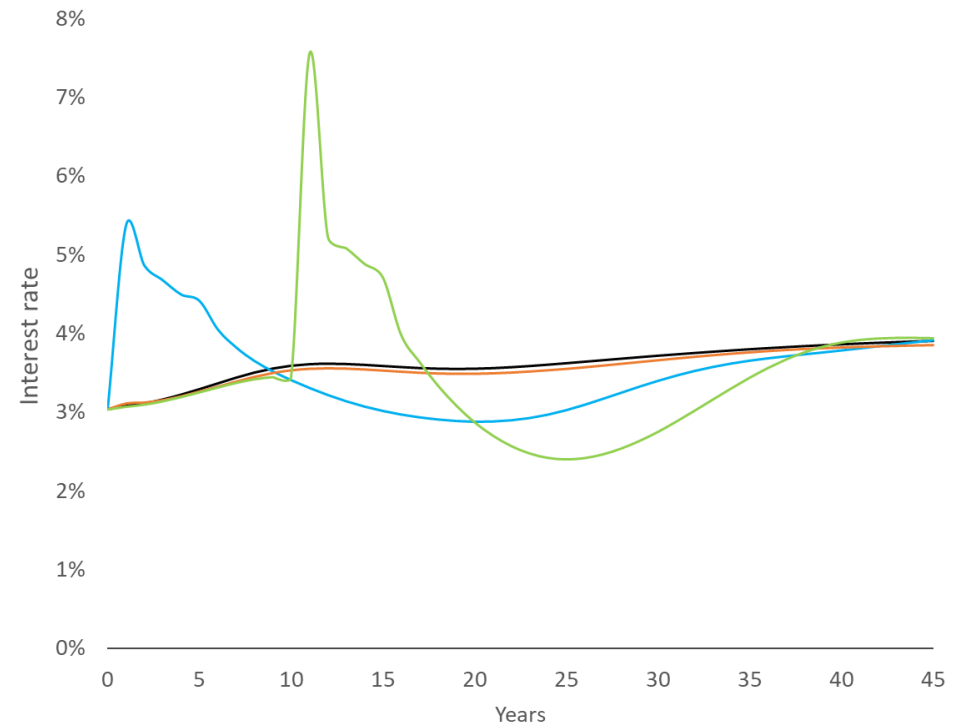
# Projecting financial variables

Scenario analysis converts the emissions and carbon price impacts into impact on financial market variables.

## Projection of US Inflation



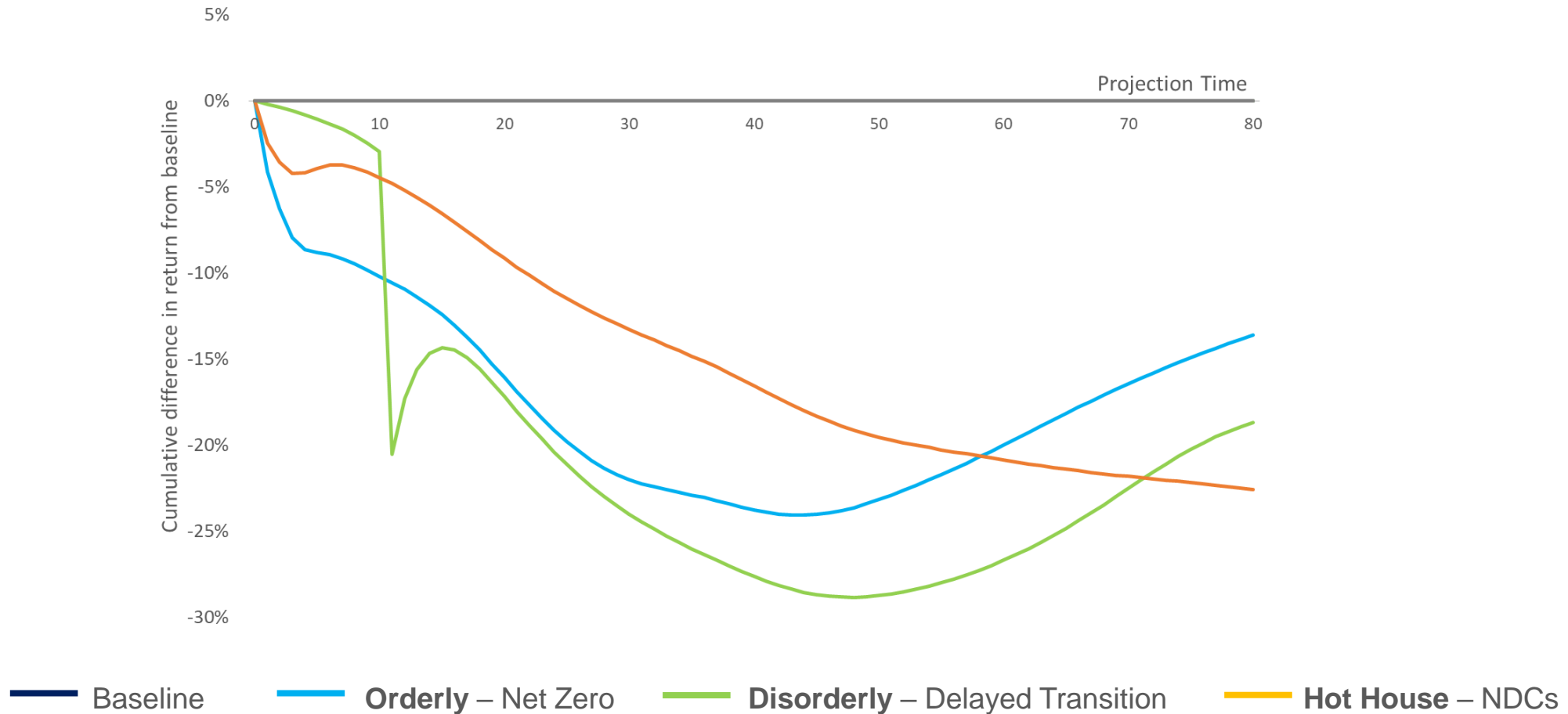
## Projection of USD 10Y Treasury rate



— Baseline    — Orderly – Net Zero    — Disorderly – Delayed Transition    — Hot House – NDCs

# Projecting equity returns

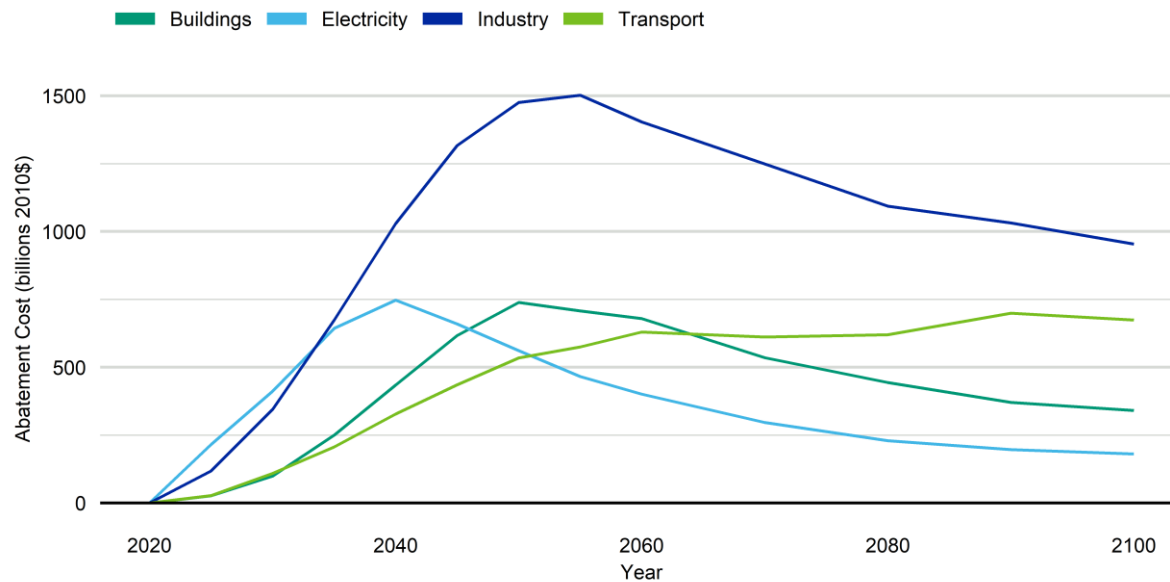
## Cumulative Impact on Expected Equity return, expressed relative to baseline



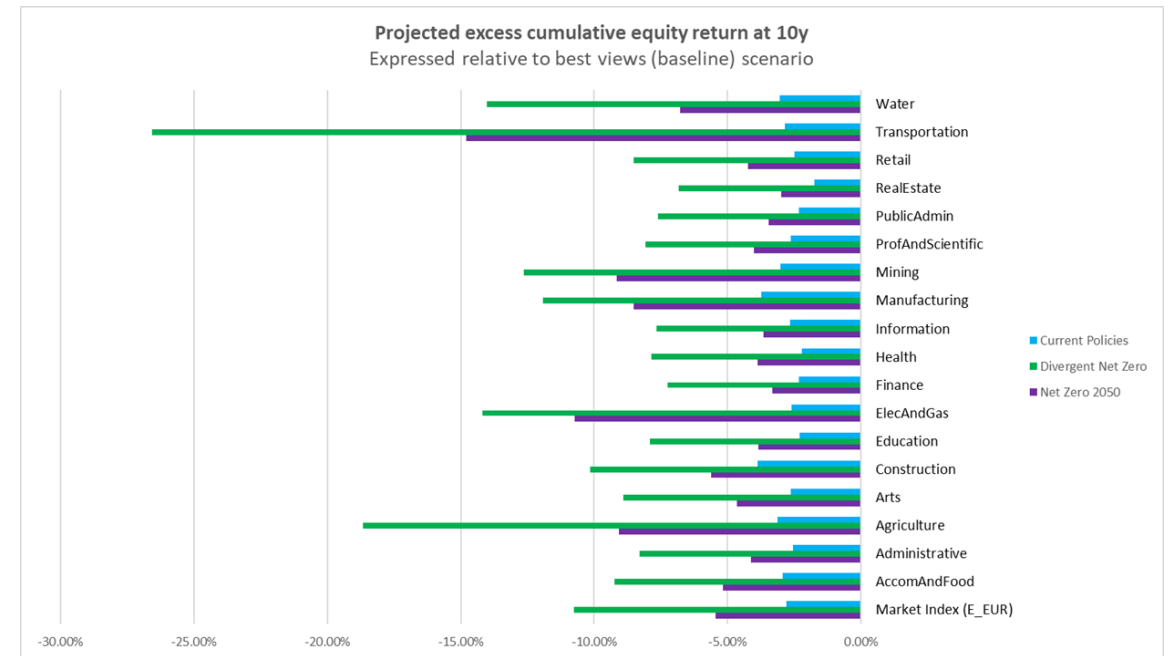
# Sector Costs

Output from the Integrated Assessment Model (IAM) provides emissions data split into different sectors. Marginal abatement cost curve can be applied to sectors, as well the whole economy.

Sector Abatement Costs



Impact on Equities by sector (relative to baseline)





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Summary

# Key takeaways

- » Scenario analysis is a key technique for climate risk modelling.
- » Although regulatory requirements don't currently require capital to be held against climate risk, it is the best practice for insurers to consider climate risk in their ORSA.
- » Needs mindset to switch to long-term, not just the next 5 years.
- » Translating climate change impacts into financial impacts is non-trivial and requires careful methodological decisions.



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Q&A

# Thank you!

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