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Risk management in the era of environmental disruption

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Climate Risk Summit 12 December 2019

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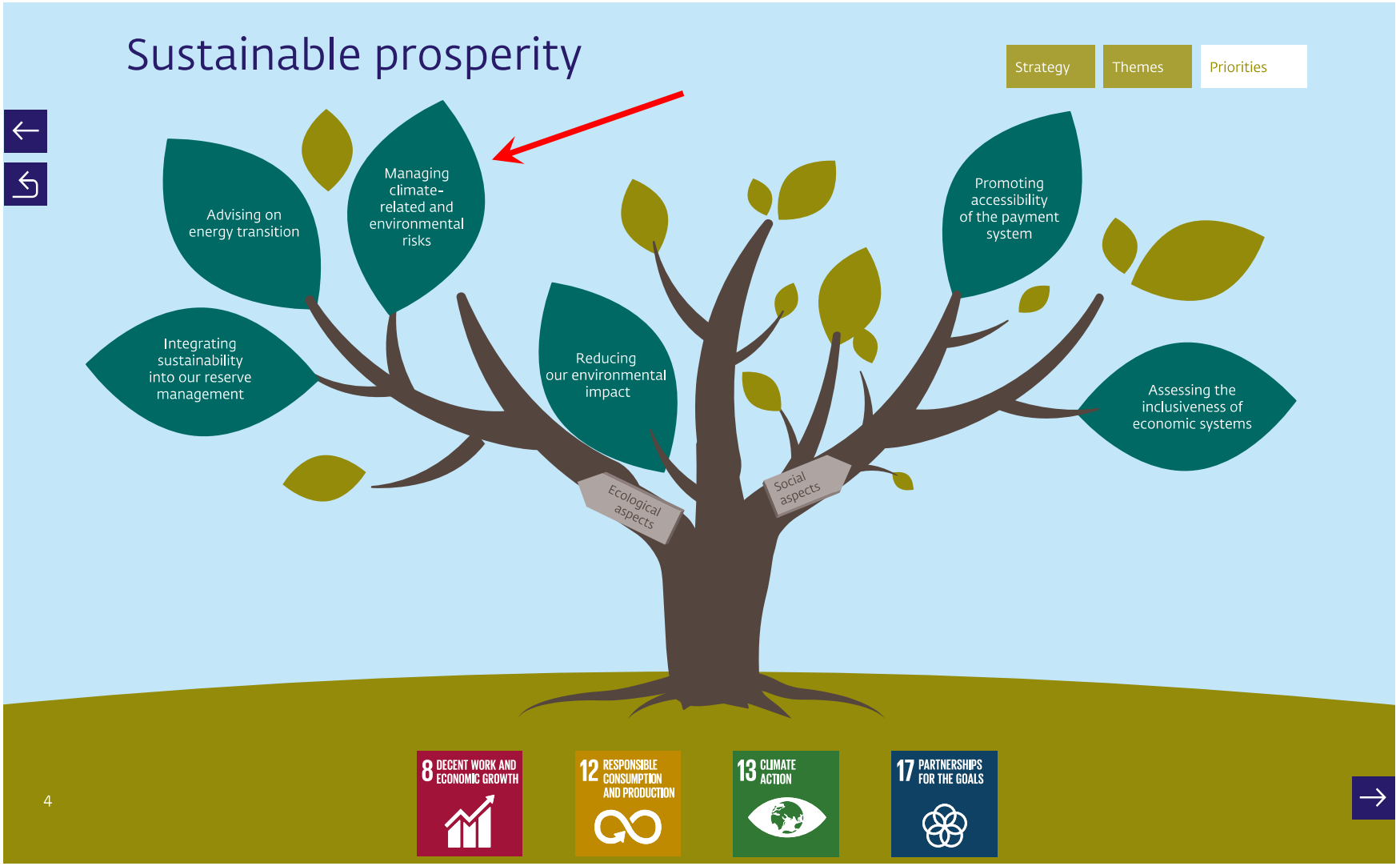
Managing climate risk is part of DNB's corporate policy



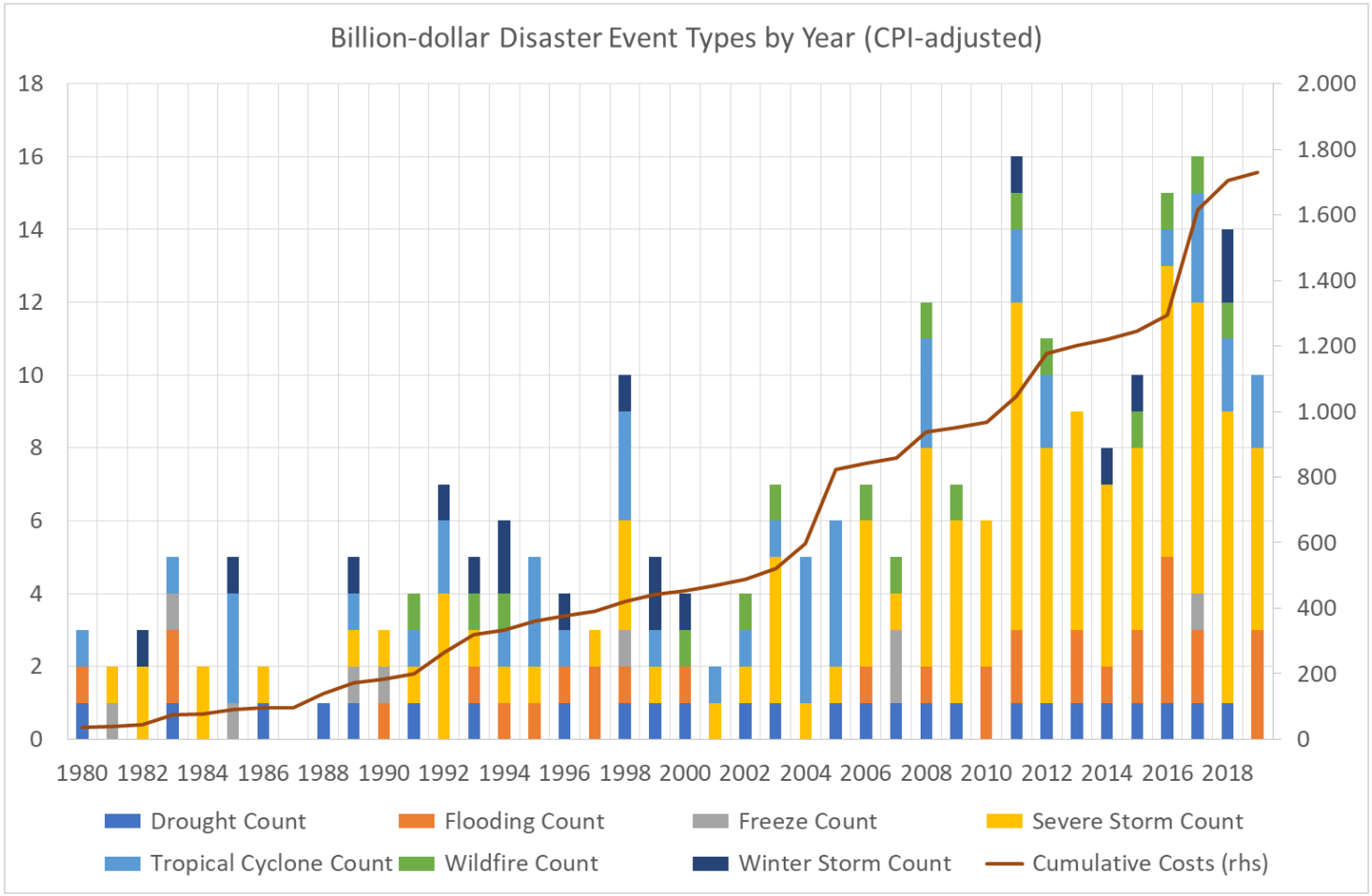
Purpose of this presentation

- Discuss the economics of climate change risk
- Pricing of climate change risk in financial markets
- Integration of climate change risk in risk management

Economics of climate change risk

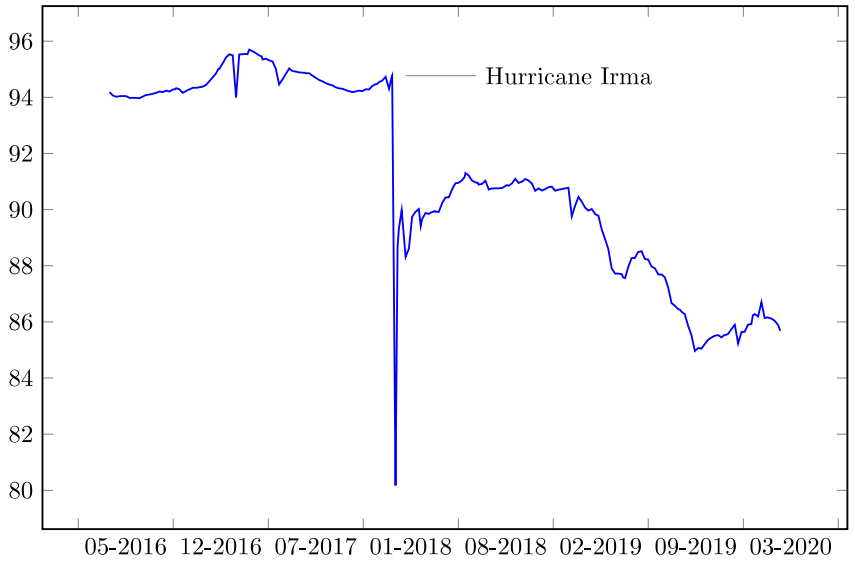
- The valuation and risk management of climate change risk takes place in an **incomplete market** setting (CCR is a non-traded risk factor)
- Climate change risk is of a **systemic nature**. Financial institutions hold a buffer for systemic/non-hedgeable risks (cf. systemic longevity risk)
- Pricing climate change risk appropriately is required for the **optimal allocation of capital** (not pricing risk appropriately can lead to disaster)
- Effective climate change policy creates **stranded assets** while policy failure implicates **asset destruction**

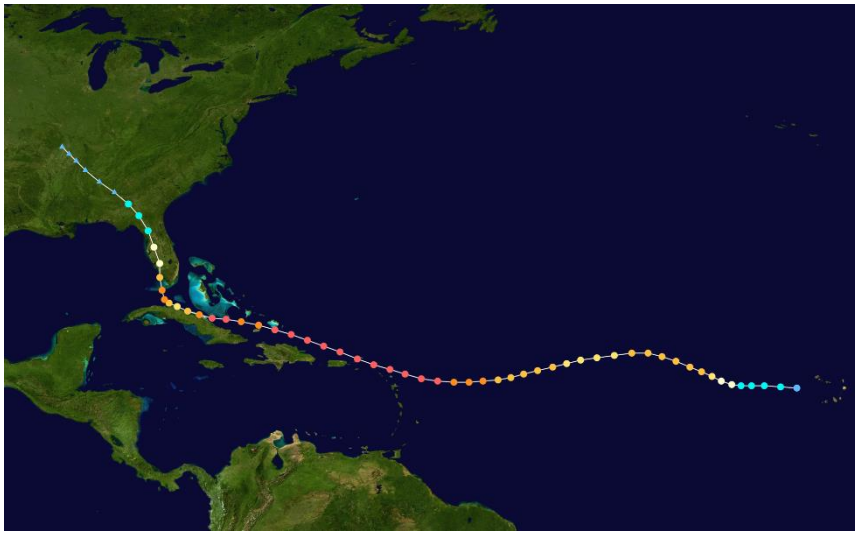
The number of billion-dollar disasters increases ominously



Source: NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2019). https://www.ncdc.noaa.gov/billions/

Cat bond prices react steeply on extreme climate events

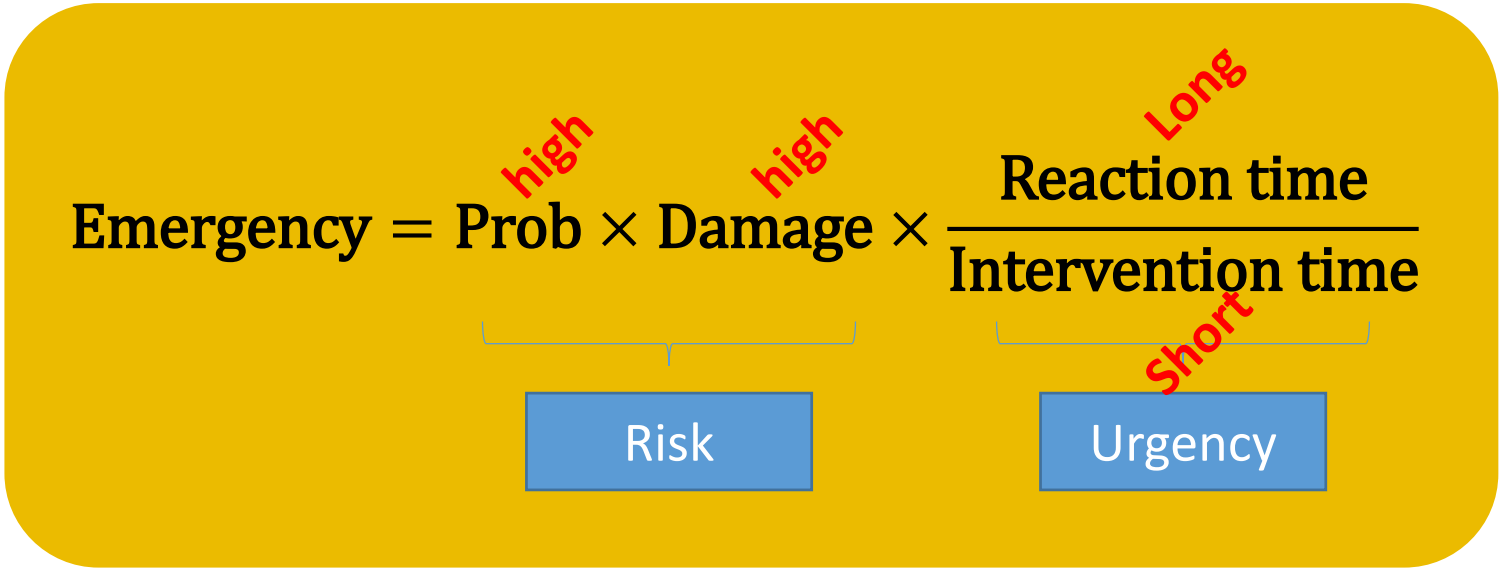




Source: Swiss Re Global Cat Bond Performance Index: This index tracks the aggregate performance of all USD, EUR, and JPY denominated cat bonds, Bloomberg ticker SRGLPRC

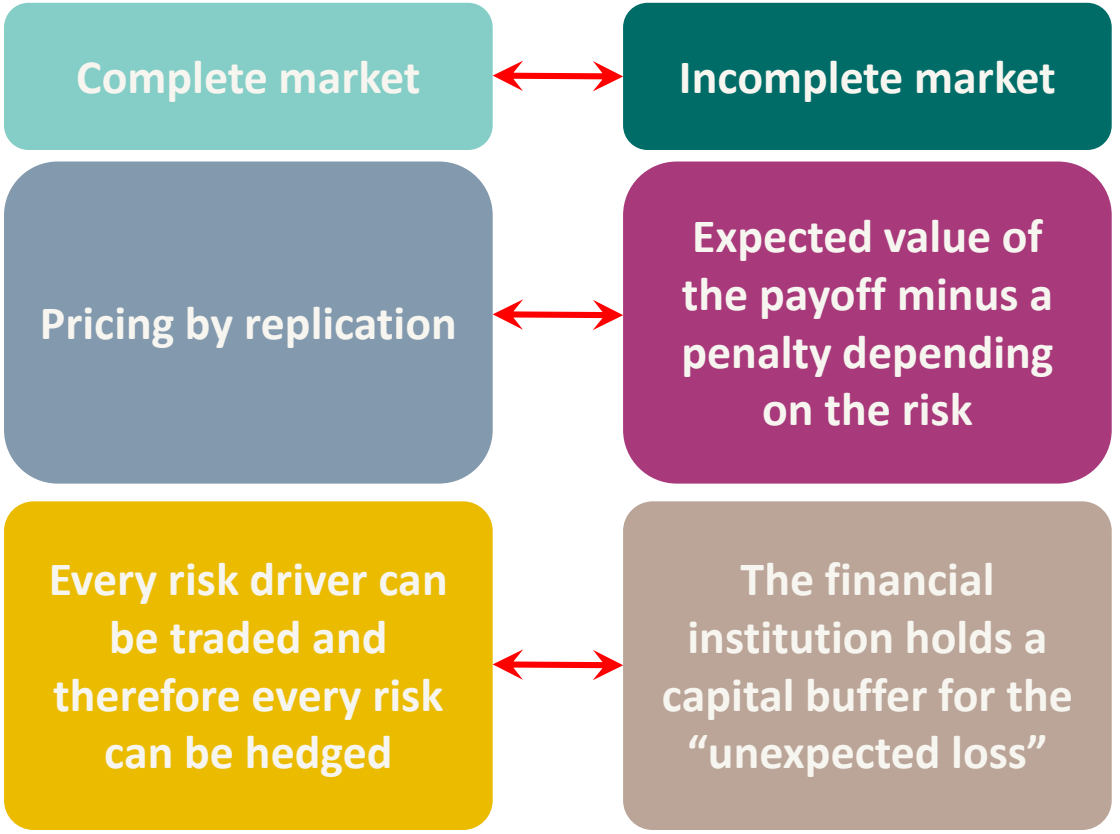
Both the risk and urgency of climate change are critical

- The **probability** of climate tipping and the **damage** it will cause are high
- The **reaction time** to achieve net zero emissions is measured in decades
- The **intervention time** left to prevent climate tipping goes to zero



Source: Lenton, T.M. et al. (2019), Climate tipping points — too risky to bet against, Nature

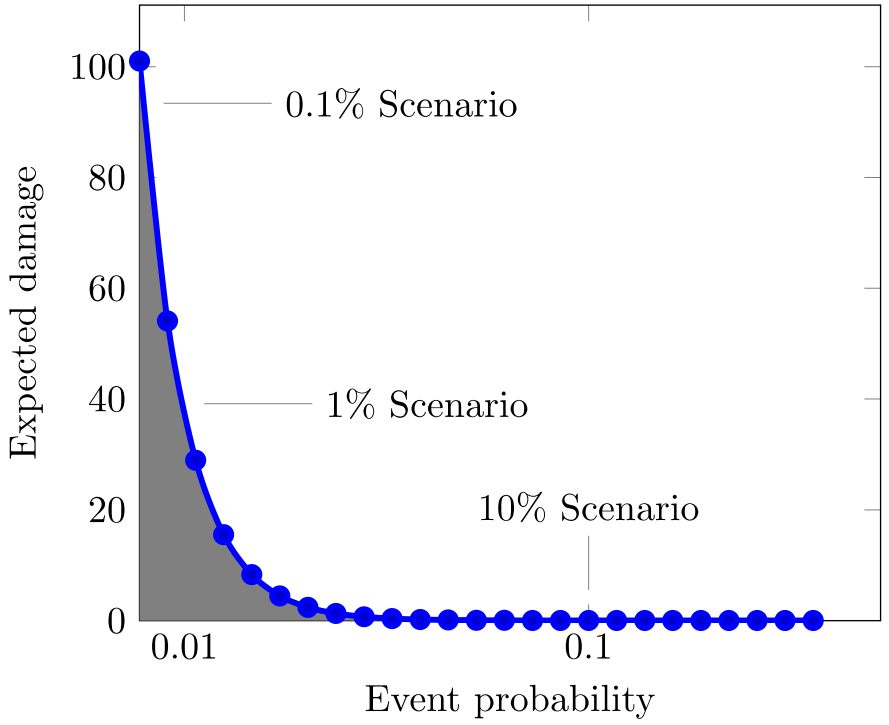
Pricing in an incomplete market setting



Source: Pelsser, A. (2011), Pricing in incomplete markets

The risk premium for climate change risk should reflect

- Fundamental **uncertainty** about the size and impact of climate change risks
- A high level of **societal risk aversion** (cf. the equity risk premium puzzle)
- The impact of **convexity** effects (discounting risks over a long-term)



Do financial markets price climate change risk?

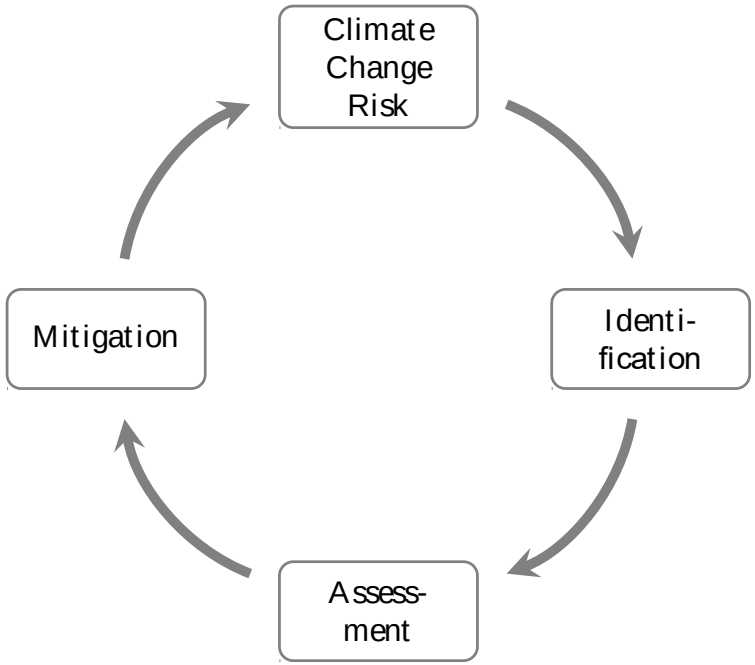
- Climate change has a long-term impact on the economy
- It leads to lower economic growth, higher volatility and more tail risks
- Bansal *et al.* (2019) study infinite-maturity securities to find that
  - A one standard deviation increase in the temperature trend leads to about 3% decline in equity valuations
  - The temperature beta of equity returns (i.e., exposure of equity returns to temperature risks), on average, is negative
  - Society is willing to give up about 1.4% of world GDP to eliminate all global industrial emissions produced in one year

CCR in risk management requires a paradigm shift

	Traditional paradigm	New paradigm
Causes of climate change	Exogenous Solar activity	Endogenous Learning process
Horizon	Short-term	Long-term
Analytical perspective	Historical data	Forward looking
Risk process	Continuous	Poisson process
Identification	Data driven	Expert driven Dissenting voices
Tooling	Models Stress tests	Pre-mortems Reverse stress tests
Risk control	Diversification Risk transfer	Contingency planning Capital

High level principles to integrate CCR in risk management

- A robust and structured integration of CCR in a risk management function builds upon some high-level principles



Area 1: Identifying climate change risk

- *Identification principle 1.* The risk management function takes a long-term perspective in identifying climate change risk
- *Identification principle 2.* The identification of CCR requires both a fact driven and an expert driven approach
- *Identification principle 3.* Climate change risk is a factor that influences both financial and non-financial metrics

Area 2: Assessing climate change risk

- *Assessment principle 1.* The exposure to climate change risk is assessed in a structured way

- *Assessment principle 2.* The impact of CCR is quantified by looking at losses under different scenarios (stress testing)

- *Assessment principle 3.* The risk management function reports on a regular basis about CCR exposures to the highest decision-making body

Area 3: Mitigating climate change risk

- *Mitigation principle 1.* The mitigation of climate change risk arguably needs to be 'on the safe side' (prudence concept)
- *Mitigation principle 2.* Mitigating measures are implemented in a predictable and gradual way to avoid abrupt shocks
- *Mitigation principle 3.* The risk management function should take CCR into account when determining capital, restrictions, limits and haircuts

Key messages

Both the risk and urgency of climate change are critical

Pricing of CCR should reflect a high level of societal risk aversion

Integrating CCR in risk management requires a paradigm shift

It is a **core competence** of risk managers to deal with the complexity and uncertainty of CCR

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