Factoring transition risks into regulatory stress-tests:

The case for a standardized framework for climate stress testing and measuring impact tolerance to abrupt late & sudden economic decarbonization

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Presentation Outline

1. Introduction to climate risk
2. Shortfalls of current supervisory stress test in assessing climate risk
3. Suggested new approaches
4. Illustrative empirical results

Climate Risks

Transition risks are risks generated by the policy, technology, market, and regulatory changes likely to accompany the transition to a low carbon economy.

Physical risk derived the costs associated with impact of climate change on the physical environment and physical assets.

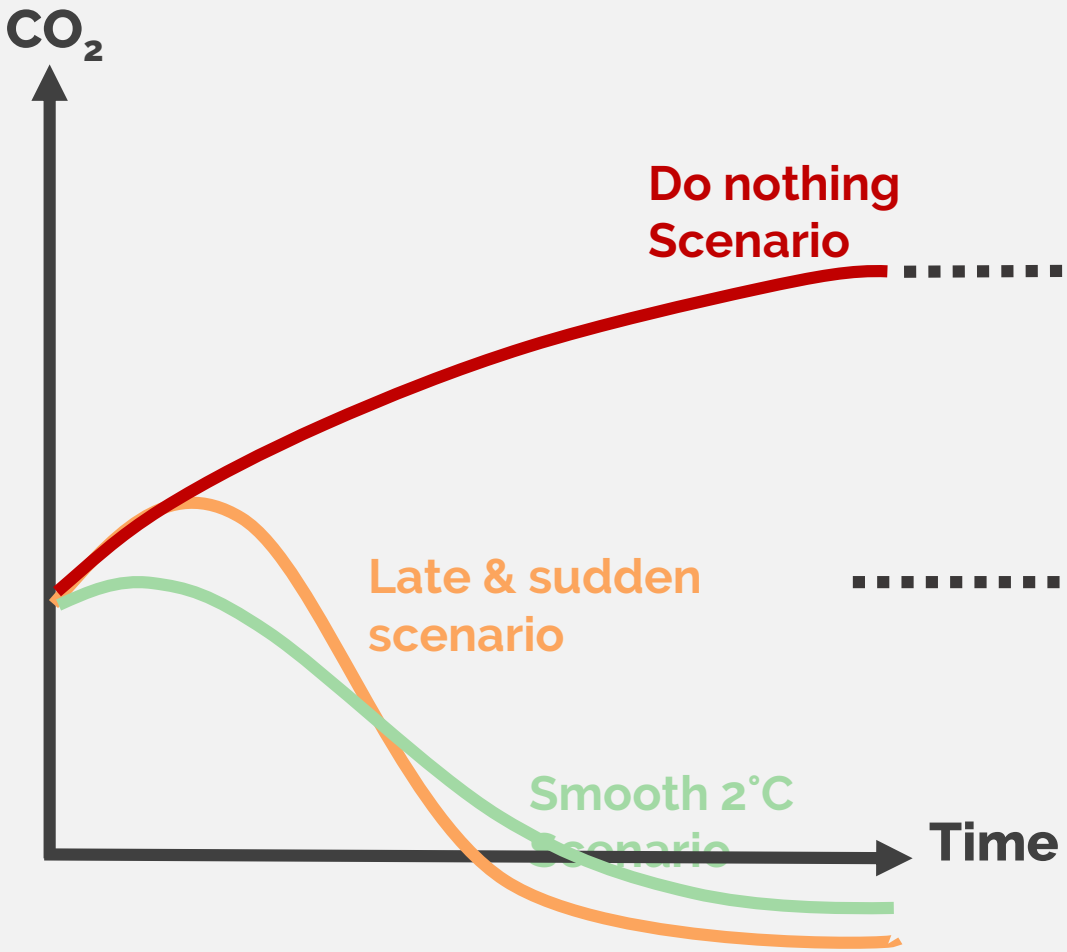
Legal risks derived from cost of litigation due to firms failure to adequality mitigate impacts of climate change, or adapt to climate change, or disclose around material financial risks.

Article 173

TCFD TASK FORCE ON CLIMATE-RELATED FINANCIAL DISCLOSURES

EU HIGH-LEVEL EXPERT GROUP ON SUSTAINABLE FINANCE

Different transition pathways will have different consequences for financial markets



High physical risk

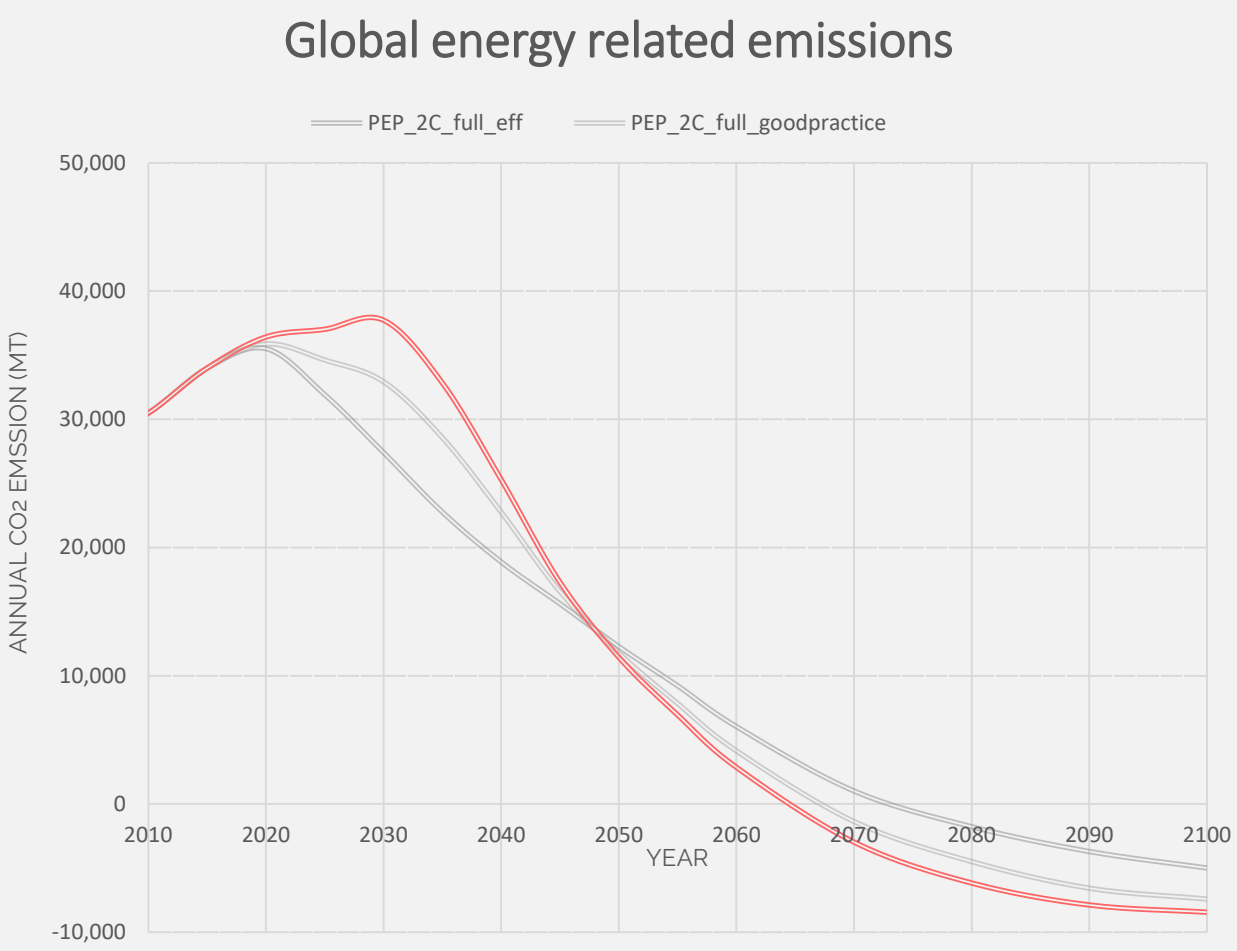
High transition cost & potential market stability risk

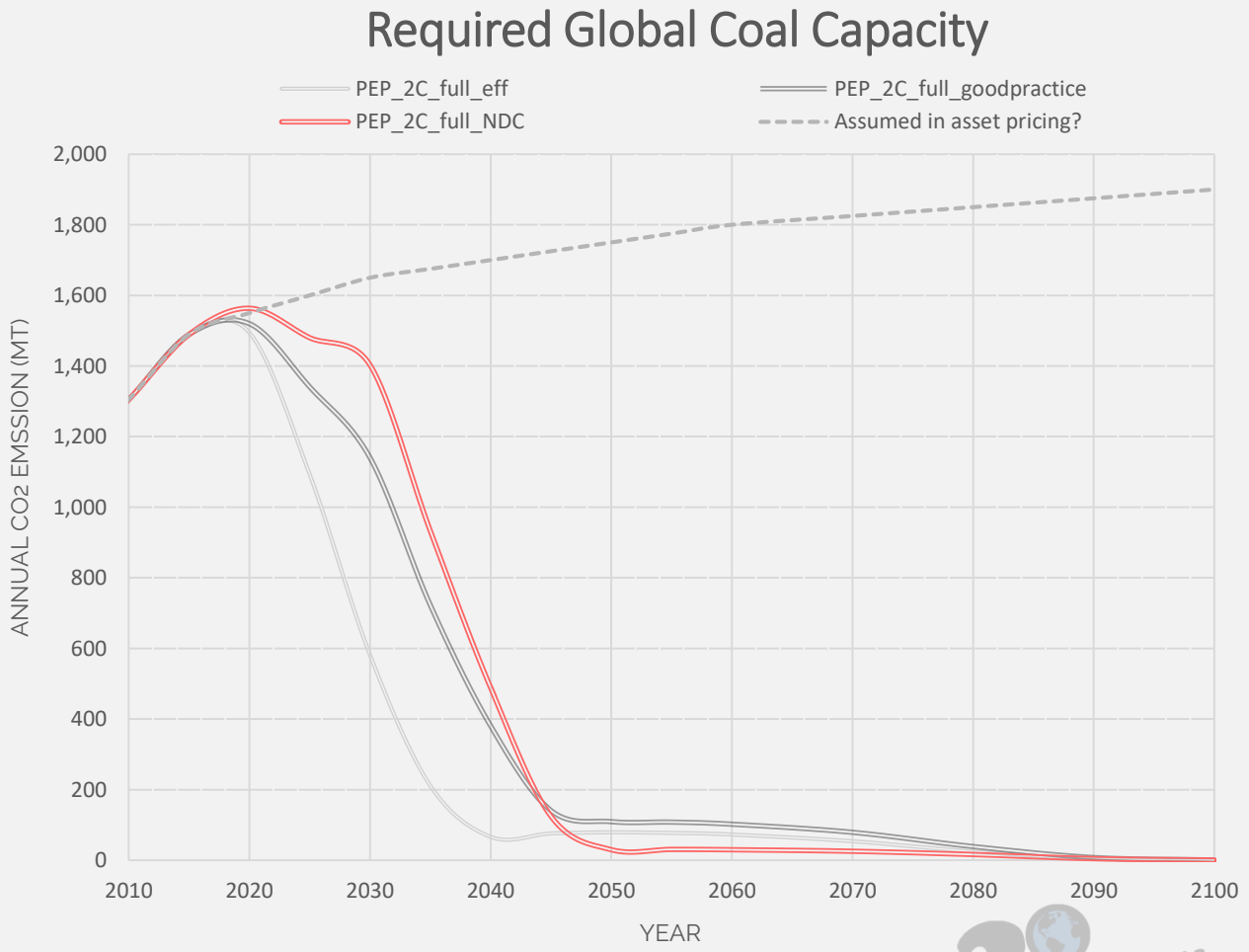
Shortfalls of current supervisory stress test in assessing climate risk

- The change in sectorial production from non-financial firms (or value) would be non-linear, and the magnitude will accumulate with inaction
- There will be strong differentiation in the evaluation of financial assets issued by different non-financial firms in sectors undergoing the transition
- The change in sectorial production and/or revenues would not be cyclic
- The change in demand would likely be too sudden to allow market forces act to induce cost minimized deployment of future supply and it is uncertain how this would be reflected in terms of market sentiment.

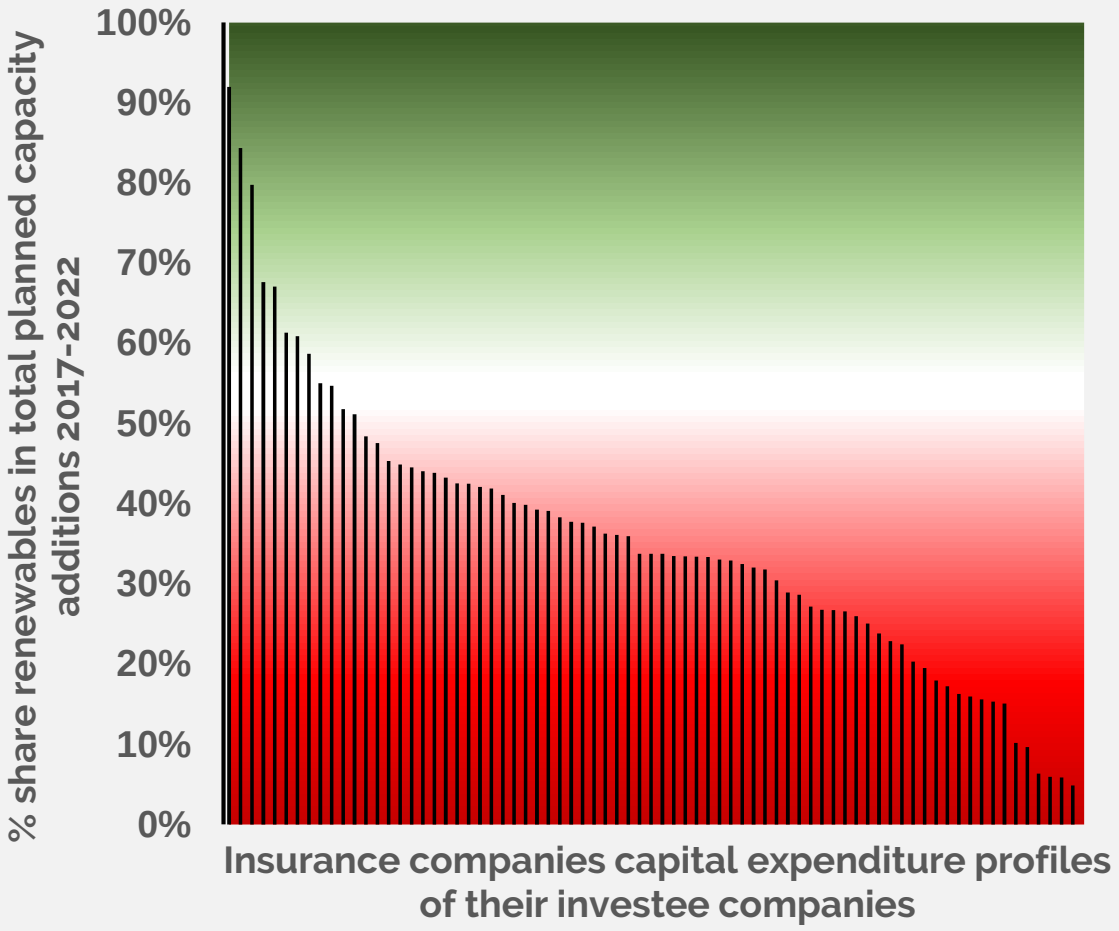
Accumulated transition risks

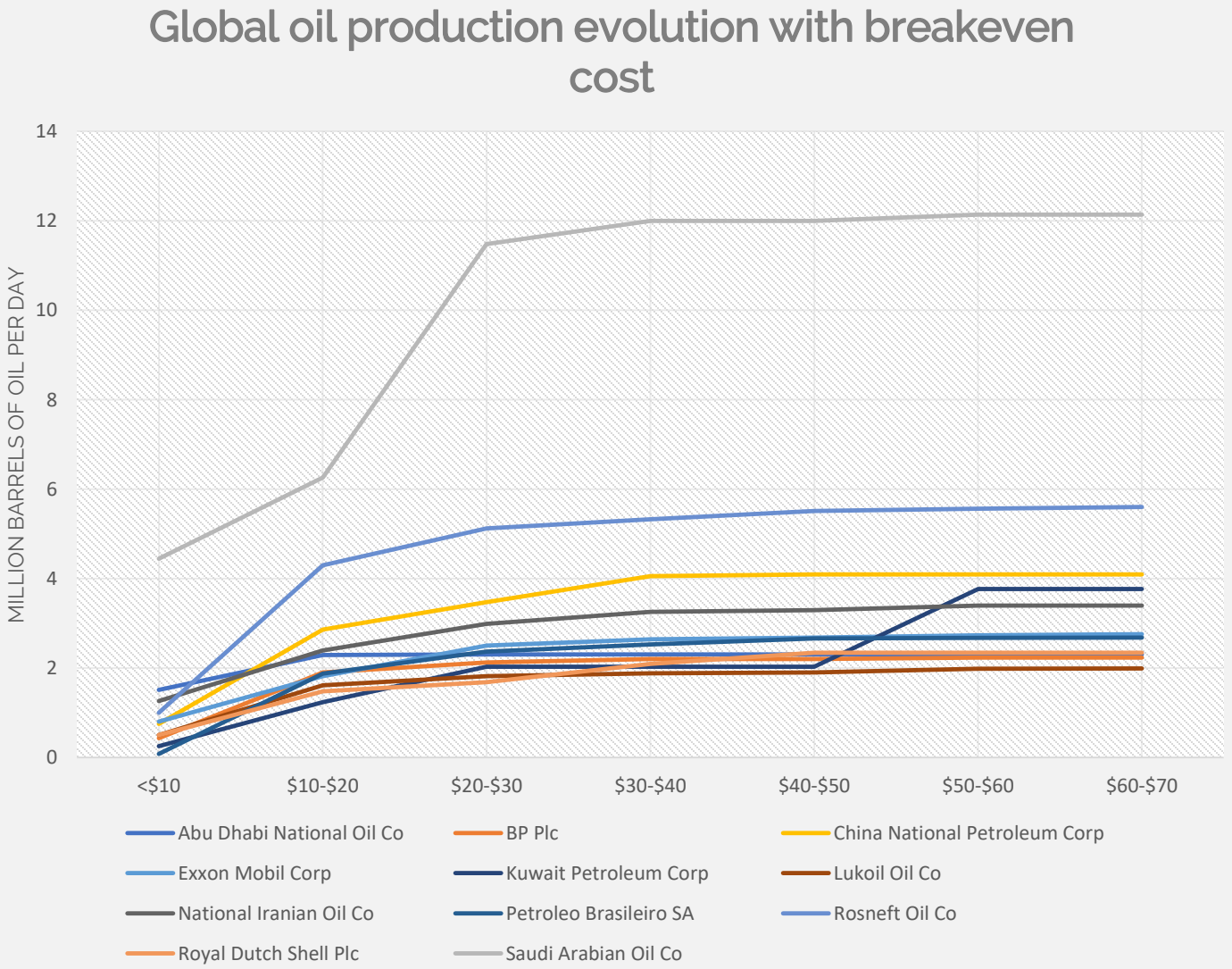
- The change in sectorial production from non-financial firms (or value) would be non-linear, and the magnitude will accumulate with inaction



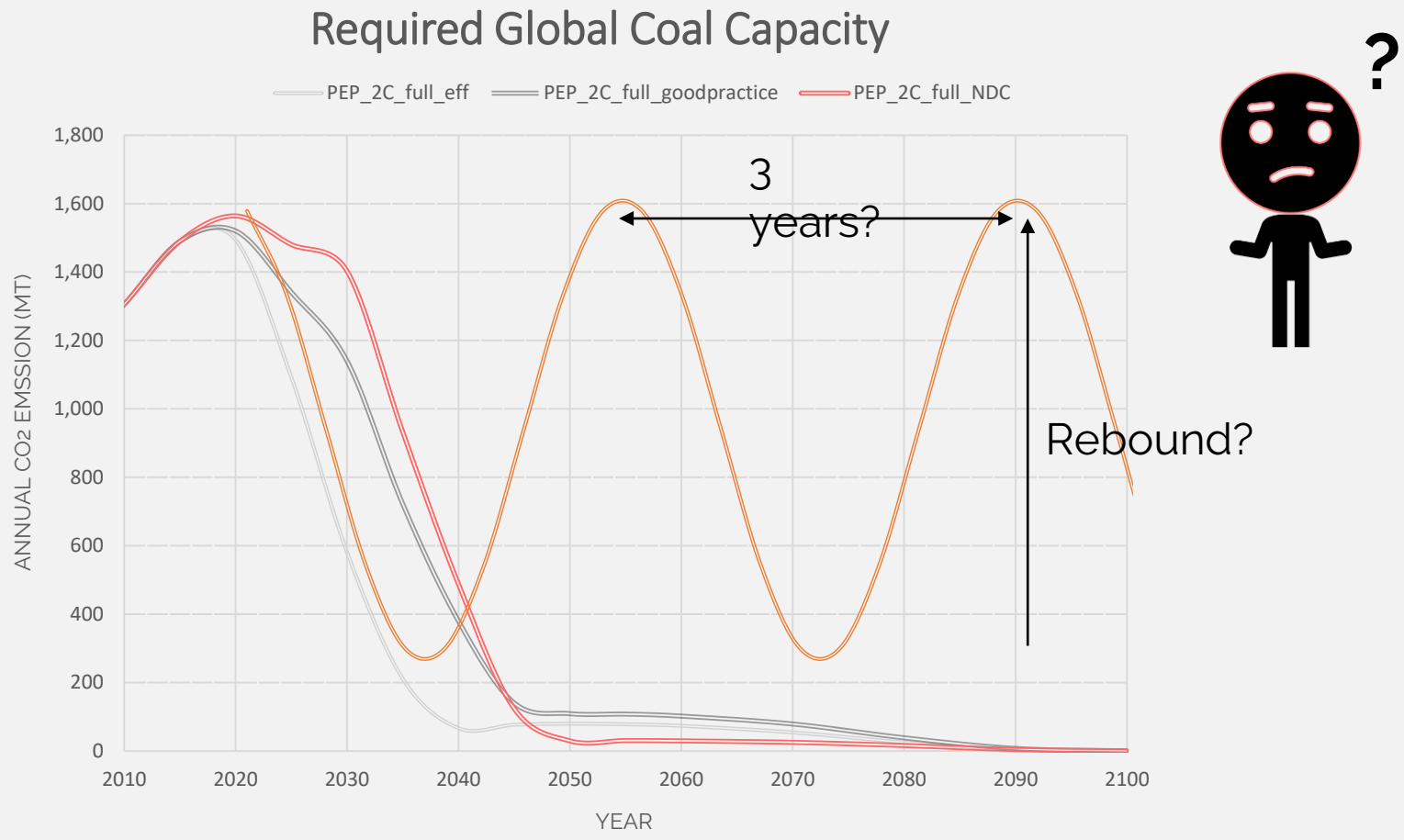


Differentiation among non-financial firms

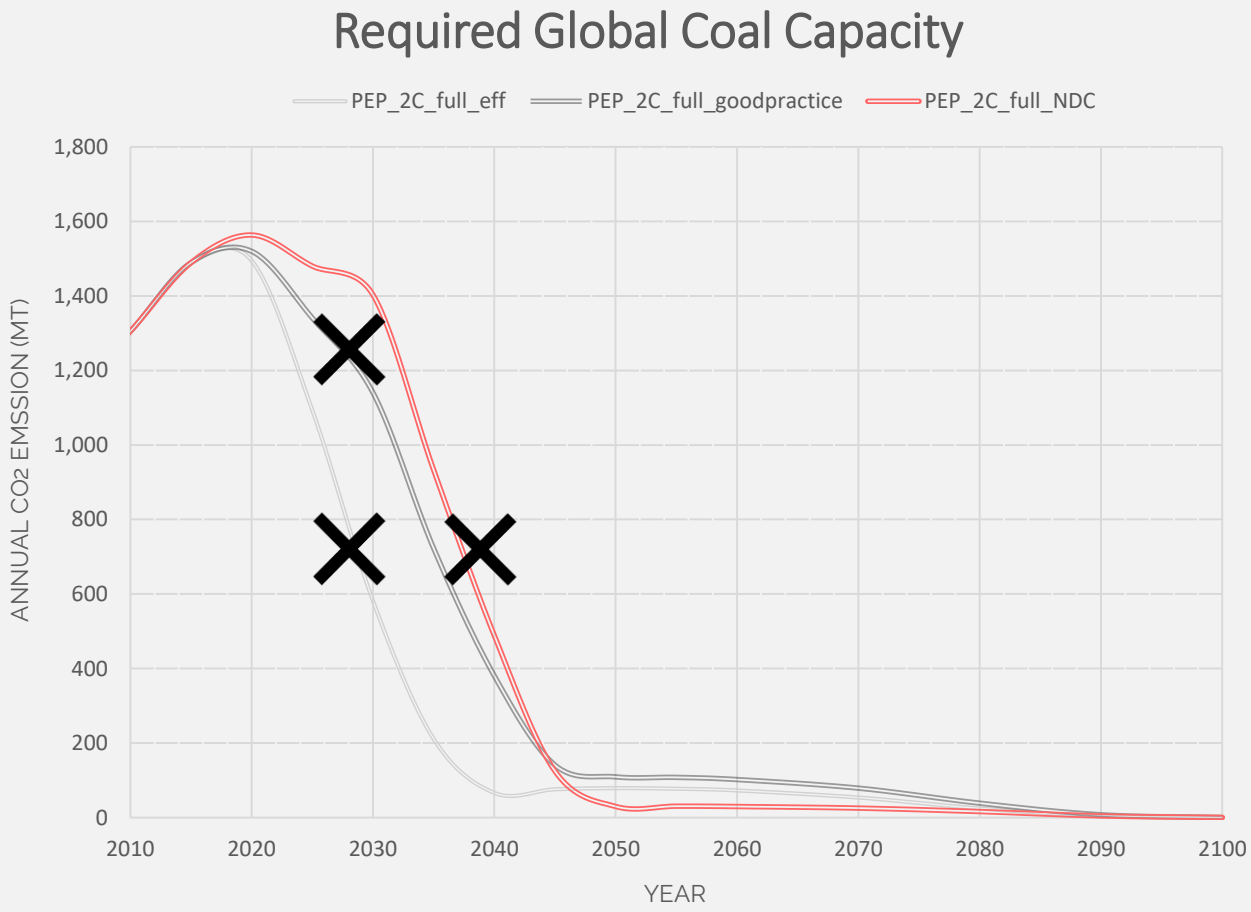




The change in sectorial revenues would not be cyclic



Too soon, too sudden for price cost-efficient outcomes



Proposed next steps

1. Identification of relevant financial indicators that that drive relationship between industrial GHG emissions and firm profits

2. Identification of the appropriate granularity of the above indicators and sourcing the corresponding business as usual data for each

3. The formulation of a wide range of plausible abrupt late & sudden scenarios

4. Identification of an appropriate evaluation methodology to suit each financial asset class

5. Benchmarking each firm/portfolio or market BAU evaluation against the range of scenarios developed through step iii.

1. Impact on equity evaluation

Net profit formulation

Net profits = (Production volume * Prices) – Costs of Goods Sold – OPex – (Taxes + Interests)

1 2 3 4

1 **Production**
Carbon intensity of production

2 **Upstream costs**

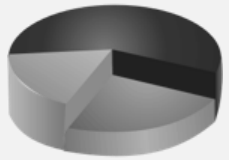
3 **R&D expenditures**
All other OPEX

4 **Production**
Prices
Carbon tax

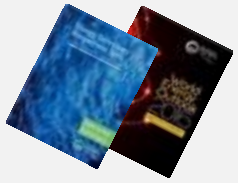
2. Business as usual data

Tracking real economic production at asset level

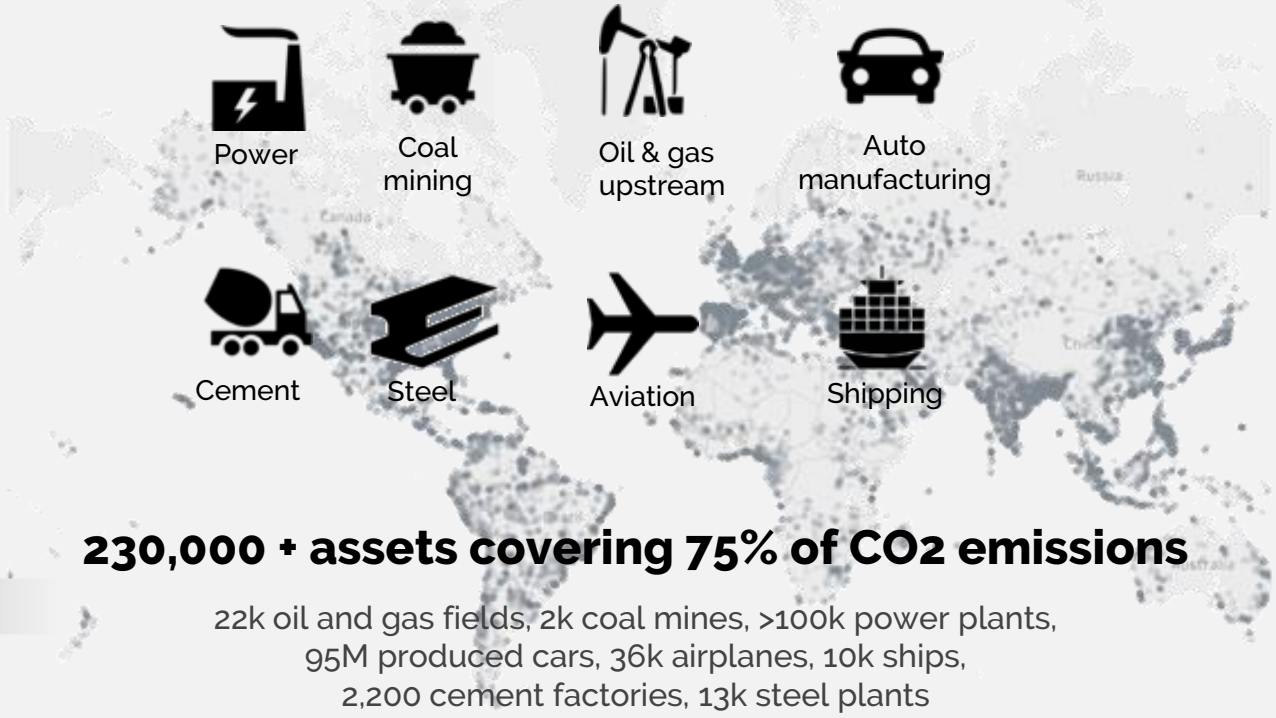
Portfolios



Climate scenarios

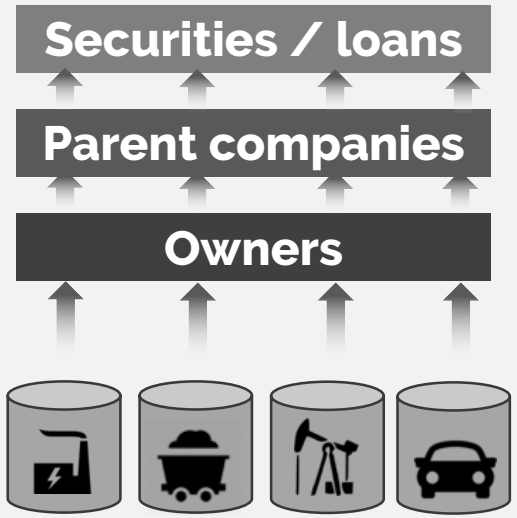


Physical asset data



230,000 + assets covering 75% of CO2 emissions

22k oil and gas fields, 2k coal mines, >100k power plants,
95M produced cars, 36k airplanes, 10k ships,
2,200 cement factories, 13k steel plants

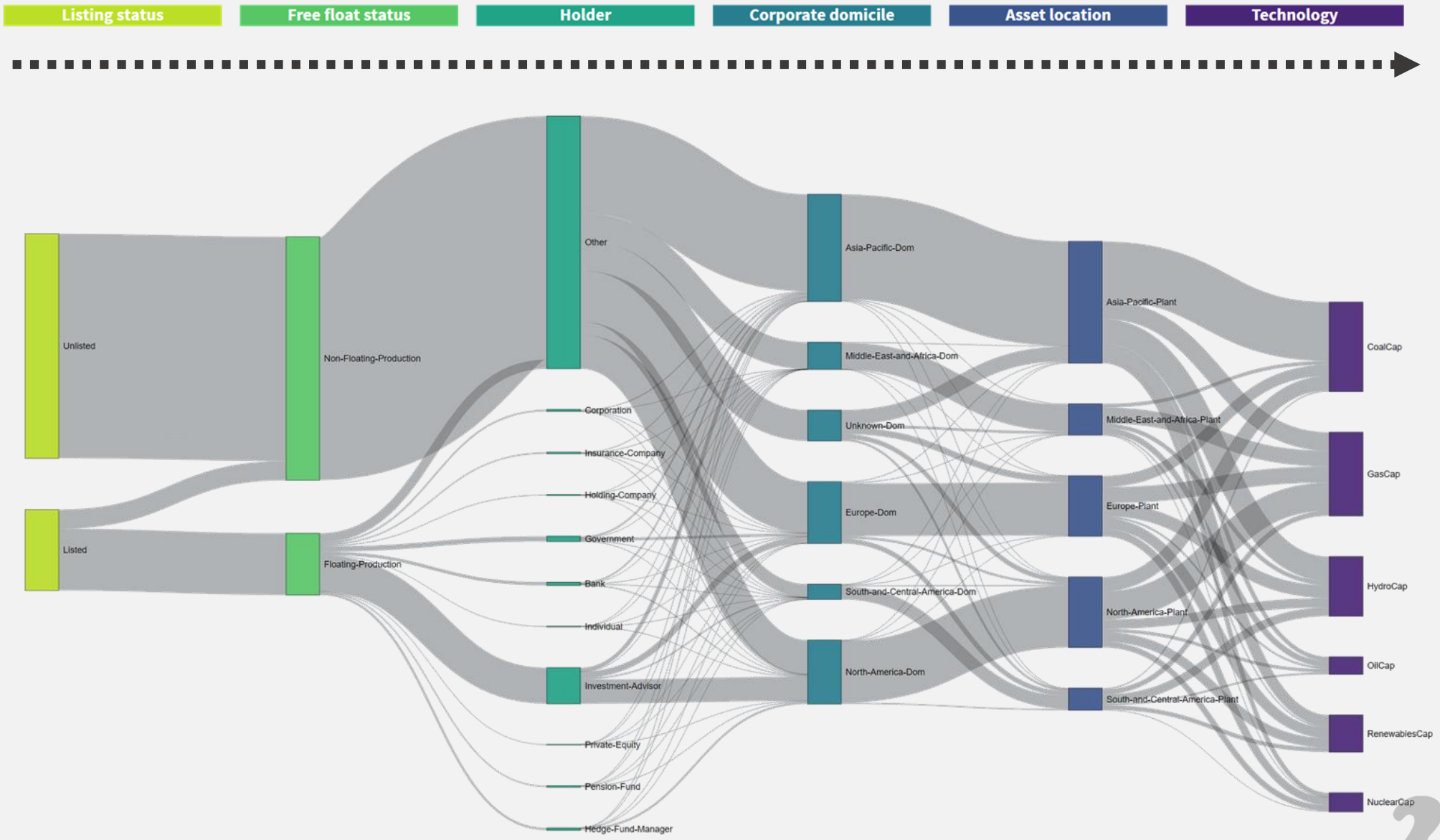


Physical asset data

Exposure to high/low carbon technologies

Global power capacity on capital markets

6.7 TW



3. Formulation of late and sudden scenarios

Estimating impact on profits

3. Formulation of late and sudden scenarios

Testing a wide range of stress test scenarios

Click here to expand options for the various scenarios.

Scenario selection:

Year of shock: 2024

Duration of shock: 5

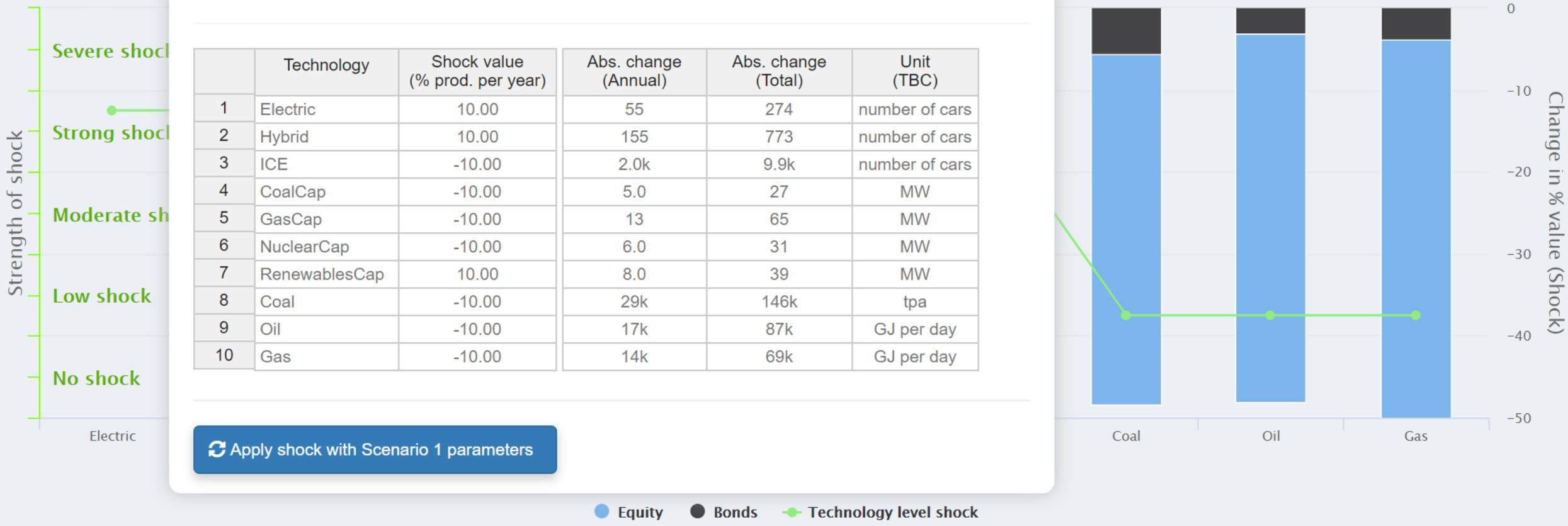
Scenario to follow: SDS

Select a scenario:

(•) Scenario 1 ( ) Scenario 2 ( ) Scenario 3 ( ) Scenario 4 ( ) Scenario 5 ( ) Custom scenario

	Technology	Shock value (% prod. per year)	Abs. change (Annual)	Abs. change (Total)	Unit (TBC)
1	Electric	10.00	55	274	number of cars
2	Hybrid	10.00	155	773	number of cars
3	ICE	-10.00	2.0k	9.9k	number of cars
4	CoalCap	-10.00	5.0	27	MW
5	GasCap	-10.00	13	65	MW
6	NuclearCap	-10.00	6.0	31	MW
7	RenewablesCap	10.00	8.0	39	MW
8	Coal	-10.00	29k	146k	tpa
9	Oil	-10.00	17k	87k	GJ per day
10	Gas	-10.00	14k	69k	GJ per day

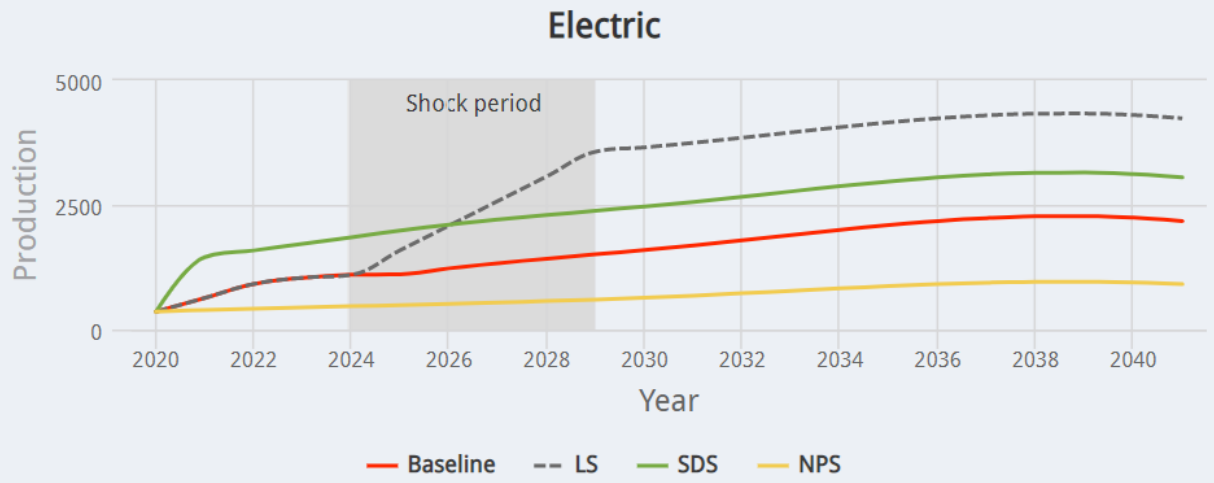
Apply shock with Scenario 1 parameters

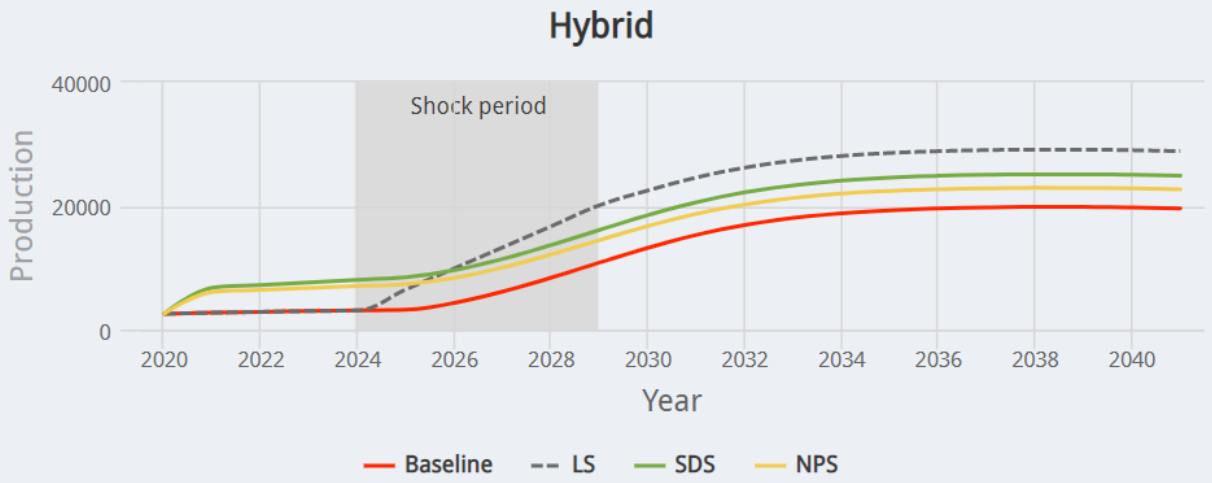


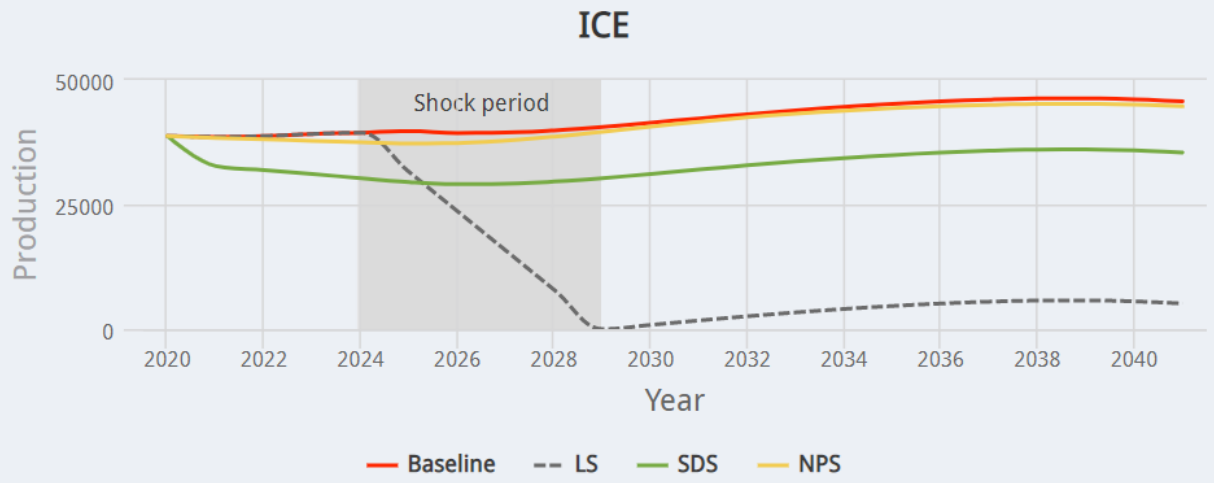
3. Formulation of late and sudden scenarios

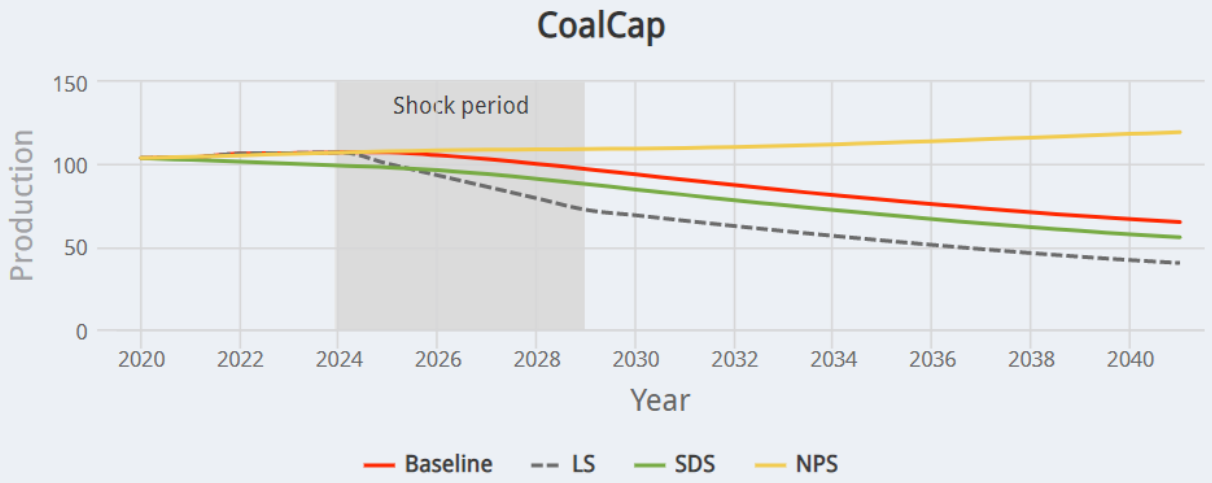
Technology level production profiles

Production charts by technology (Equity-Global)



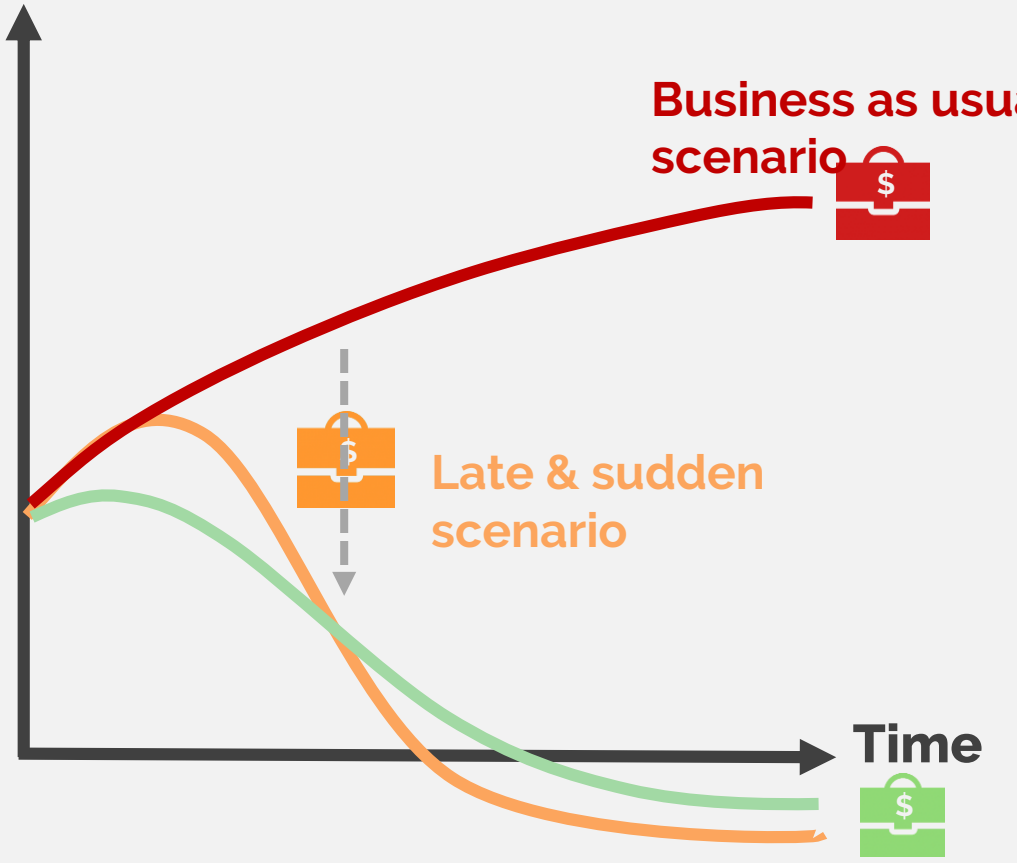






4. Impact of a late & sudden transition on portfolios

MegaWatts/Barrels of oil/# of vehicles etc..



Impact on:

A. Equity value

↳ By modelling the impact on net profit. Then Gordon's' formula to evaluate future dividends/impact on equity pricing.

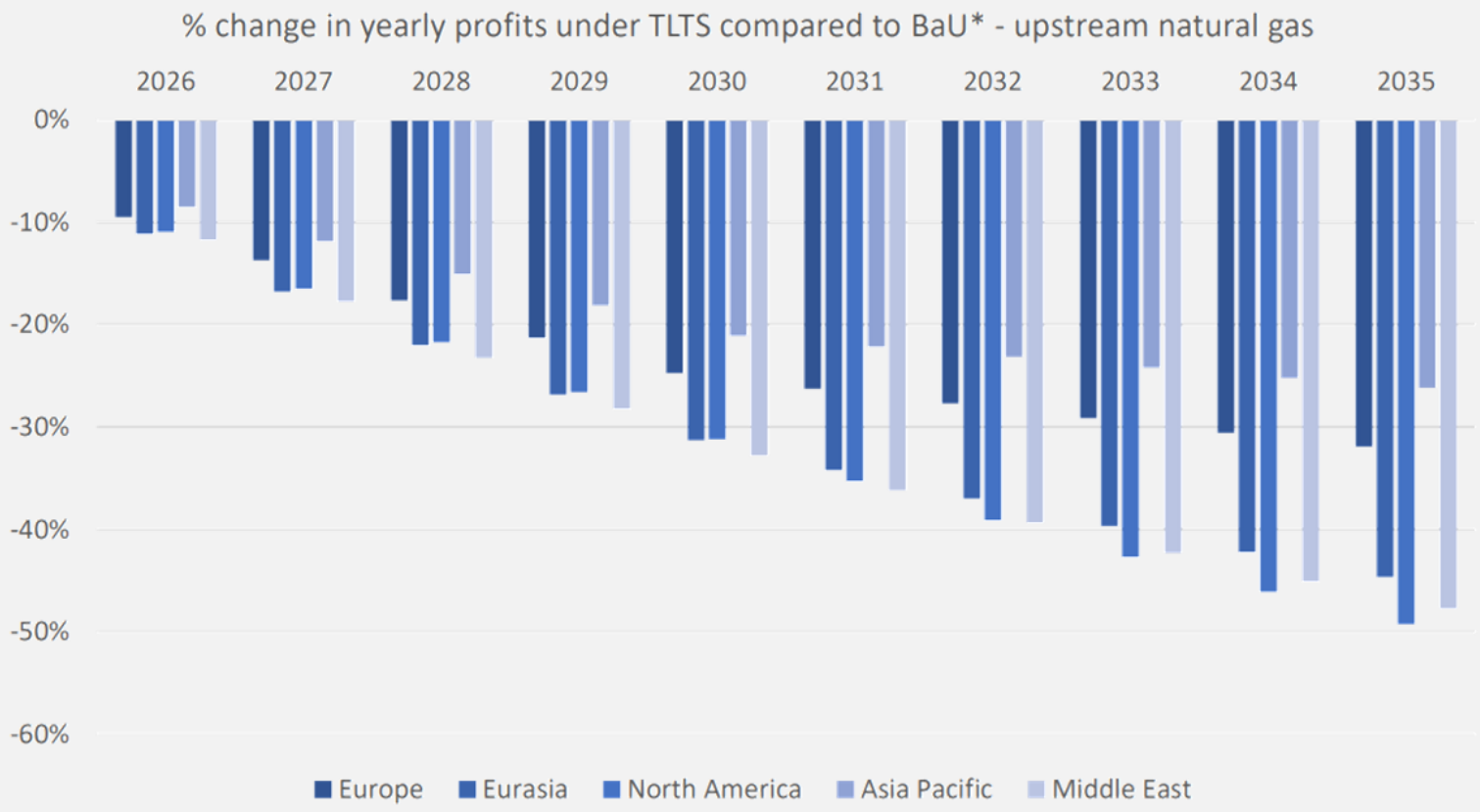
B. Corporate bond value

↳ By modelling corporate bond probability of default, then the change in probability weighted returns

5. Impact on equity evaluation

Estimating impact on profits

Example of results:



**BaU scenario is based on IEA's RTS & NPS scenarios*

5. Impact on equity evaluation

Estimating impact on equity

	Change in equity value (%)
Upstream Oil	-53.3%
Coal mining	-57.0%
Upstream gas	-30.8%
Coal electricity	-80.1%
Gas electricity	-20.3%
Solar PV	19.2%
Wind electricity	12.8%
Nuclear	19.9%
Crude steel	-52.0%
Cement	-27.0%
Automotive	-9.5%
Aviation	-21.0%

Mean change in equity value compared to a BaU scenario3 under a “too late, too sudden” transition scenario for key sectors, assuming a sudden repricing in 2025 (%)

5. Impact on corporate bonds

Estimating impact on default probability

	1	2	3	4	5	6	7	8	9	10
Steel	-0.2%	-0.7%	-1.2%	-1.9%	-2.6%	-3.3%	-4.1%	-4.9%	-5.7%	-6.5%
Cement	-0.2%	-0.5%	-1.0%	-1.5%	-2.2%	-2.9%	-3.8%	-4.7%	-5.6%	-6.6%
Oil	-1.4%	-2.9%	-4.6%	-6.4%	-8.3%	-10.0%	-11.7%	-13.3%	-14.8%	-16.2%
Coal	-0.8%	-1.9%	-3.2%	-4.6%	-6.2%	-7.7%	-9.2%	-10.6%	-12.0%	-13.1%
Gas	-0.5%	-1.1%	-1.9%	-2.9%	-3.9%	-5.0%	-6.1%	-7.2%	-8.2%	-9.3%
Coal power	-1.1%	-2.5%	-4.2%	-6.2%	-8.4%	-10.2%	-12.1%	-13.8%	-15.5%	-17.1%
Gas power	-0.4%	-0.8%	-1.2%	-1.6%	-2.1%	-2.8%	-3.5%	-4.2%	-5.0%	-5.7%
Nuclear	0.1%	0.3%	0.6%	0.9%	1.4%	1.8%	2.4%	3.0%	3.7%	4.4%
Solar PV	0.4%	1.1%	2.2%	3.5%	4.6%	5.6%	6.6%	7.6%	8.5%	9.3%
Wind	0.3%	0.9%	1.7%	2.8%	4.0%	5.1%	6.1%	7.0%	7.9%	8.8%
Airlines	-0.2%	-0.6%	-1.2%	-1.9%	-2.6%	-3.4%	-4.2%	-5.1%	-5.9%	-6.7%
Automotive	-0.2%	-0.5%	-0.8%	-1.1%	-1.3%	-1.5%	-1.8%	-2.1%	-2.4%	-2.7%

Mean change in bond values compared to baseline under a “too late, too sudden” transition scenario, depending on their remaining time to maturity, and assuming a sudden repricing in 2025 (%)