



EUROPEAN CENTRAL BANK

EUROSYSTEM

ECB economy- wide climate stress-test

All Things Energy forum

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Main elements of ECB economy-wide climate stress-test

Top-down exercise
30y horizon, based on NGFS
outputs

Climate
scenarios

Rich climate
data worldwide

Counterparty level
analysis
~4mln firms worldwide:
financials, emissions and
physical risk score (geolocated)
~1600 consolidated banks

Novel climate-specific models:

- *Damages to physical capital*
- *Impact of energy prices/efficiency and technology substitution*
- *Mitigants and amplifiers: insurance, insurance premia*

Novel models
to assess
climate risks

Climate stress-test of non-financial and
financial institutions

Feedback loop to real economy

Economy wide

Challenges in scenario design

NGFS scenarios

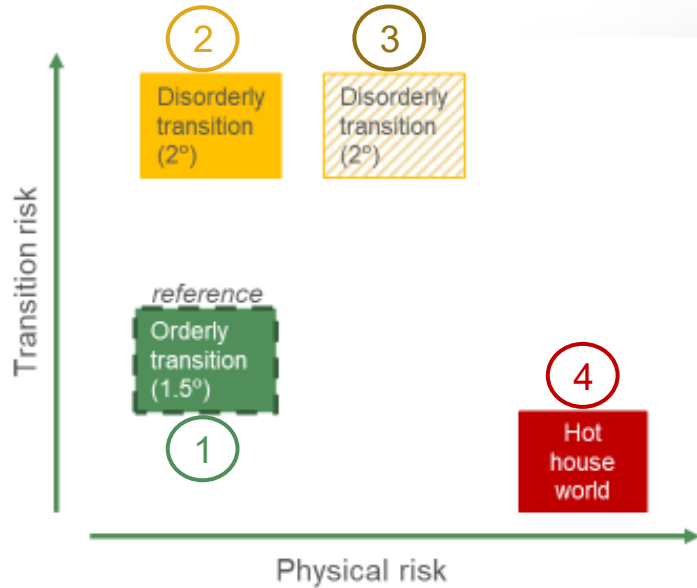
- Transition and physical risk impacts on GDP modelled and provided **separately**
- GDP impact from transition and physical risk **aggregated** in 11 macro regions worldwide

Our solution

- Matrix of 4 scenarios **combining** GDP impact from transition risk with damages from physical risk
- Use granular datasets to disentangle projected emissions and damages from physical risk (for different physical hazards) at **firm-level**

Four climate scenarios that combine transition and physical risk

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Expected impact

1. Orderly transition with limited physical risk

Early and effectively implemented policies
Limited costs associated with the transition and limited costs from damages from physical risk

2. Disorderly transition with limited physical risk

Delayed policies implemented
High costs associated with the transition and limited costs from damages from physical risk

3. Disorderly transition with higher physical risk

Delayed and ineffective policies implemented
High costs associated with the transition and higher costs from damages from physical risk

4. Hot house world with extreme physical risk

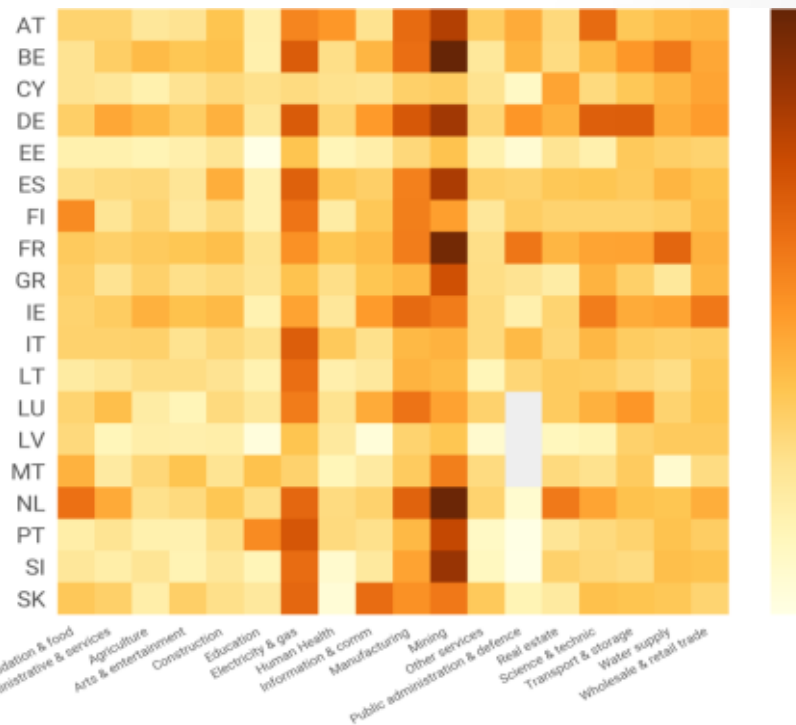
No new policies implemented (only current policies)
Very limited costs associated with the transition but extremely high costs from damages from physical risk

Quantitatively, based on **NGFS scenario outputs**

Climate risk identification: granular forward-looking metrics

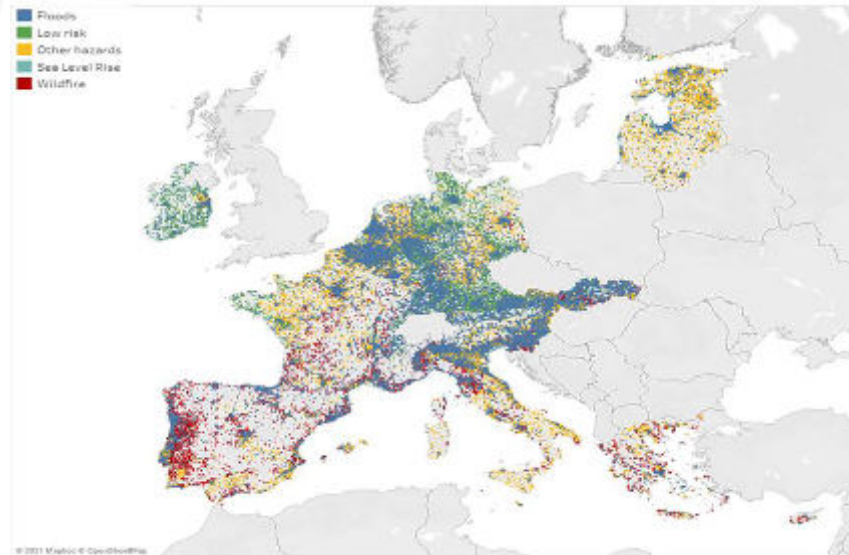
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Emissions by country-sector (tCO₂e)



Source: ECB calculations based on the Urgentem dataset. For simplicity only euro area firms are displayed in the chart, although data are available for a much broader sample.

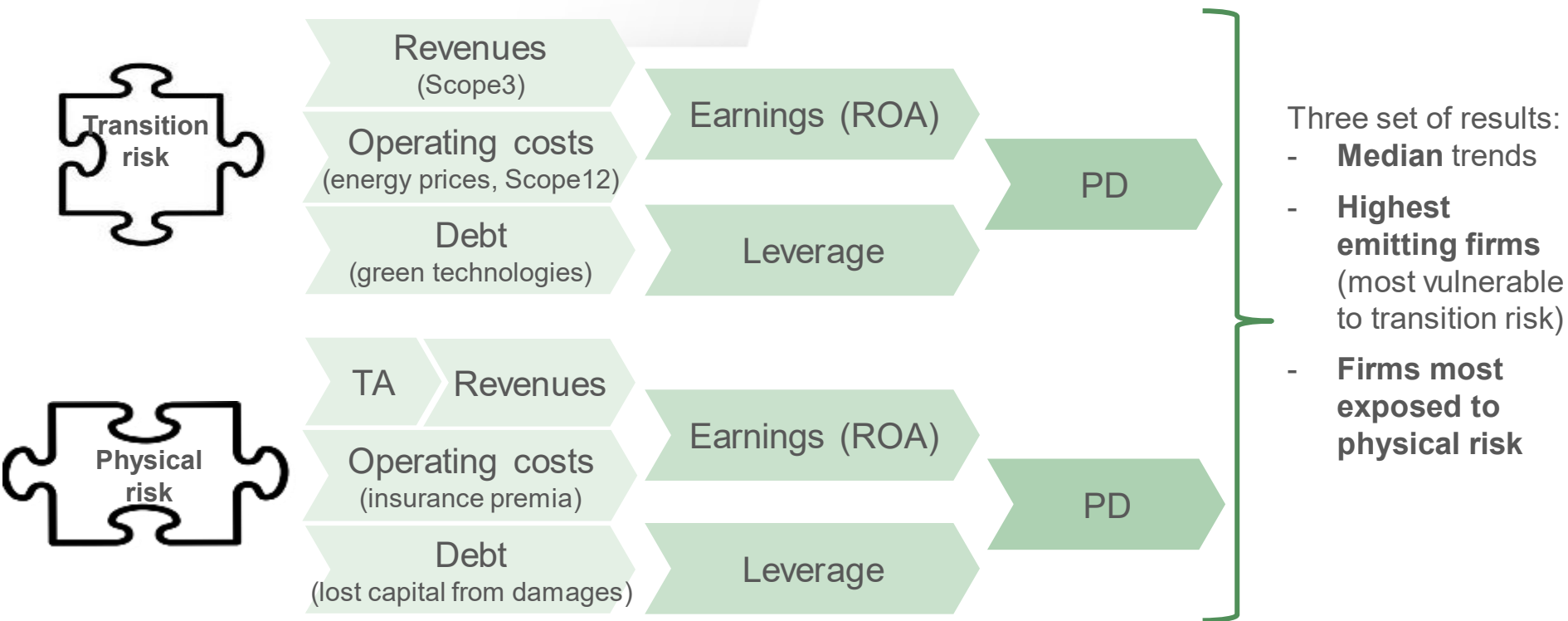
Physical risk intensity



Source: ECB calculations based on the Four Twenty Seven dataset. Each dot corresponds to a firm in the sample.. For simplicity only euro area firms are displayed in the chart, although data are available for a much broader sample.

- **Highest emitting sectors:** mining, electricity, manufacturing
- Physical risk hazards **heterogeneous across countries:** south more subject to wildfire, north to flood

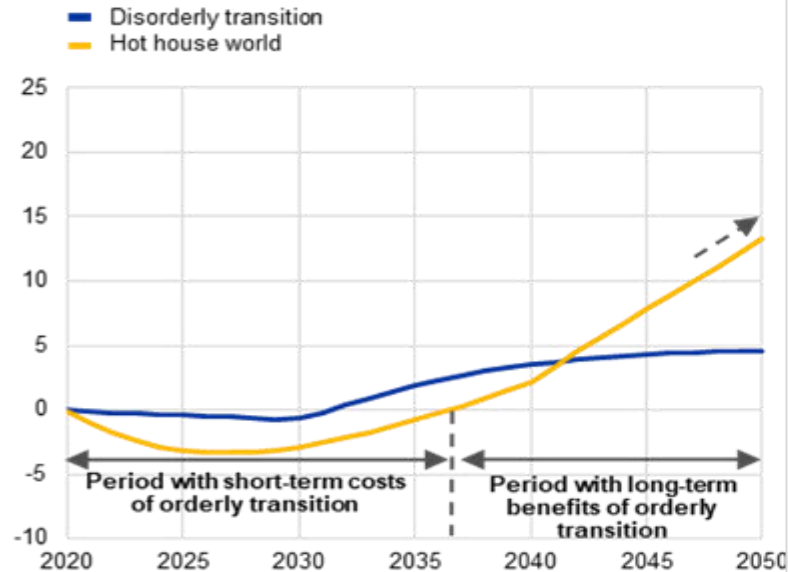
Modelling counterparty PDs



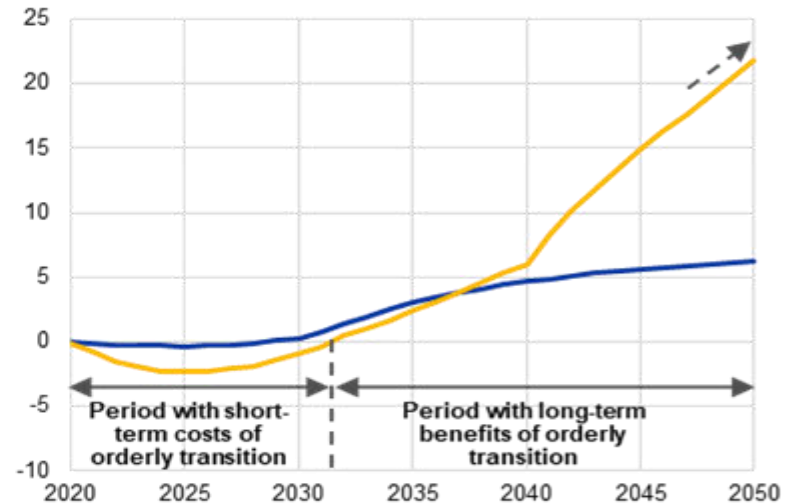
Preliminary results for corporates: PD evolution

Projected differences in firms' PDs in disorderly transition and hot house world scenarios compared with an orderly transition, for all firms

(2020-50, percentage differences in PDs)



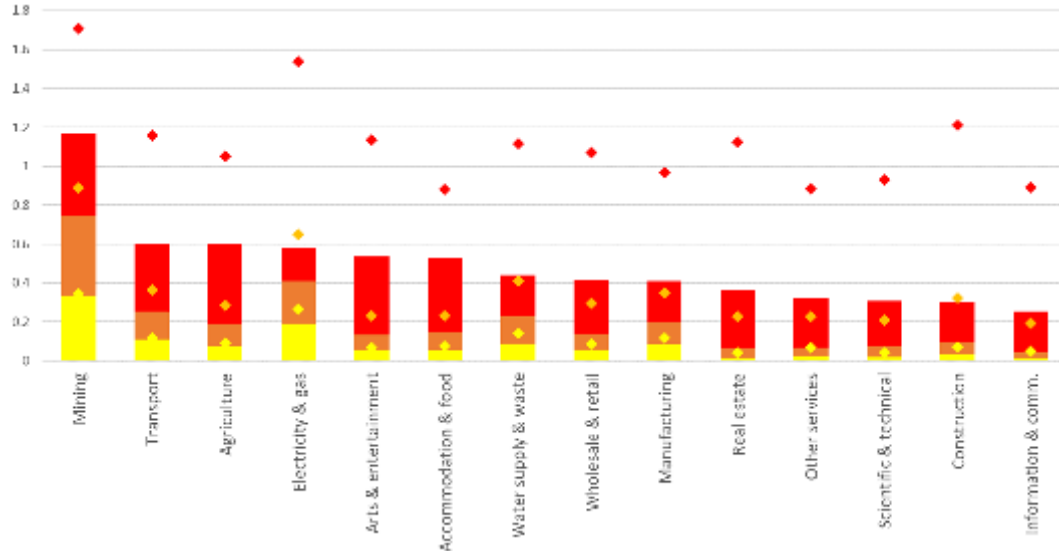
Projected differences in firms' PDs in disorderly transition and hot house world scenarios compared with an orderly transition, for firms most vulnerable to physical risk



- **Orderly transition** always **first-best** option: short term costs more than compensated by long-term benefits
- Benefits of transition stronger for firms most vulnerable to physical risk with respect to HHW

Preliminary results for corporates: PD changes

Differences in PDs over 30y with respect to baseline, by sector and for different sets of firms (%)



Median firms

- 2. Disorderly Transition - limited physical risk
- 3. Disorderly Transition - higher physical risk
- 4. Hot House World

Firms most vulnerable to physical risk

- ◆ 2. Disorderly Transition - limited physical risk
- ◆ 3. Disorderly Transition - higher physical risk
- ◆ 4. Hot House World

Impact of climate risks asymmetric across sectors and regions: most polluting firms and firms most geographically vulnerable to physical risk could have up to **four times** as much climate risk as the average firm