EUROPEAN CENTRAL BANK

EUROSYSTEM

Designing a macroprudential capital buffer for climate-related risks

An application to transition risk

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1

Introduction

Motivation for a macroprudential approach of addressing climate risk

Classic systemic risk channels

- Spillovers
- Non-linearities
- Interconnections

Climate risks' unique features

- Concentration + correlation of risks
- Irreversibility of climate-related losses
- Unpriced externalities from lending to carbon-intensive firms, leading to risk build up
- Interaction btw. physical & transition risk

Risk of underestimation / late response

- Uncertainty over scale and timing
- Lack of data and unsuitability of backward-looking historical data
- Endogeneity of climate risk

Macroprudential policy can address **systemic aspects of climate risk** by:

1. making the system **less prone to climate risks** by preventing the build-up of risks
2. building systemic **resilience to climate risks** by increasing loss-absorbing capacity
3. having a **system-wide perspective**, preventing the migration of risks across financial system
4. usefully **complementing supervisory efforts and microprudential measures**

See also: ECB-ESRB: Towards macroprudential frameworks for managing climate risk (November 2023)
ECB blog: Climate risk, the macroprudential view (December 2023)

Policy context

FSB	Climate change is likely to represent a **systemic risk** for the financial sector, which may require **macroprudential approaches to complement** microprudential instruments
ECB-ESRB	Operationalising macroprudential policy for climate risks is **already possible in the EU**. ECB-ESRB work sets out key features of a macroprudential policy response
EU	**Capital Requirements Directive** (CRD) latest revision explicitly states that the **Systemic Risk Buffer** can be used to address climate-related financial risks

But…

Conceptual disagreements

- What is the relative role of micro- and macro-prudential polices?
- Are they complement or substitute?
- What is the right policy mix?

Practical challenges

- What is the best macroprudential tool for climate risks?
- What design?
- How to calibrate a capital buffer?

Concerns of unintended consequences

- How to avoid negative impacts on entire sectors, harming transition financing?

We propose a practical design and calibration methodology for general SyRB. Specific application to transition risk, but framework can be applied flexibly. We discuss concrete ways to minimize unintended consequences

Literature overview

1. Impact of climate-related (transition) risk on financial institutions and financial stability

- Disorderly transition to a low-carbon economy may cause shock to euro area banking system comparable to Covid-19 pandemic (Belloni et al., 2022)
- Large variation in US banks' exposure to transition risk, with high tail-end risk (Nguyen et al., 2023)
- Euro area banks have material exposure to climate-related risks, according to recent ECB bottom-up and top-down stress tests (Alogoskoufis et al., 2021; ECB, 2022; Emambakhsh et al., 2023)

→ **Main contribution:** extend coverage of Emambakhsh et al. (2023) and estimate unexpected losses due to transition risk for sample of euro area significant institutions

2. Interplay between climate change policies, prudential regulation and financial stability

- Ambitious climate policies may increase transition risk and financial instability, but (macro)prudential policies have potential to alleviate this (Lamperti et al., 2021; Oehmke & Opp, 2022, Carattini et al., 2023)
- Systemic risks (from fire sales), triggered by bank failures due to transition risk, could be avoided with moderate additional capital buffer requirements (Alessi et al., 2022)

→ **Main contribution:** move from theory to practice; develop a framework for macroprudential capital buffer to tackle climate-related risk, which can be applied flexibly by macroprudential authorities

High-level overview

1. ECB top-down climate stress test (ECB CST)

- **Short-term transition scenarios** (accelerated transition, current policies) and respective **NFC and household PDs**
- Stress test covers a subset of **NFC credit portfolio**, **household credit portfolio** and **NFC securities portfolio**

2. Extension of sample and coverage

- Sample: **107 significant institutions** in euro area
- **Portfolio coverage extended by using proxies** for exposures not covered with granular Anacredit/SHSS data
- **From PDs to projected losses** in accelerated transition and current policies scenario

3. Calibrating the SyRB requirements

- **Isolate unexpected losses due to transition risk** from expected losses and losses due to macroeconomic shocks
- Mapping of losses to **banks' capital positions**
- Banks assigned to climate SyRB buffer **buckets** based on **transition risk losses,** under different scenarios

4. Additional analysis and policy considerations

2

Data

Input from the ECB climate stress test and extensions

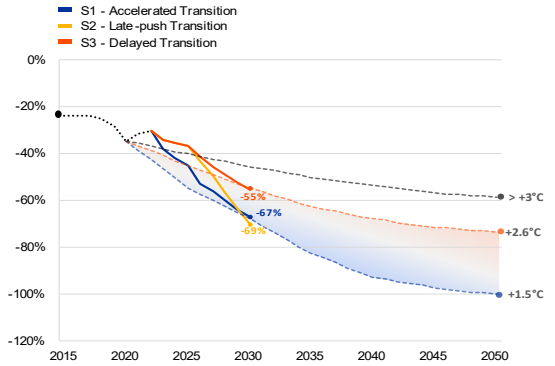
Short-term scenarios from the second ECB top-down climate stress test

Transition pathways over 8 years

S0: Current policies	*The energy crisis triggers economic downturns until 2025, followed by a recovery. There is no green transition which triggers long-term negative effects from physical risk.*
S1: Accelerated transition	*The energy crises triggers a quick and intense green transition starting immediately. Emission reductions by 2030 are compatible with "net-zero by 2050" and +1.5º targets.*

GHG emissions reductions (EA aggregate)

(y-axis: percentage change compared to 1990 level)



Sources: ECB calculations based on European Environmental Agency (EEA) and NGFS scenarios.
Notes: Temperatures increase refer to the year 2100. Emissions pathways until 2050 correspond to Net Zero 2050 and Nationally Determine Contributions (NDCs) scenarios of the NGFS.

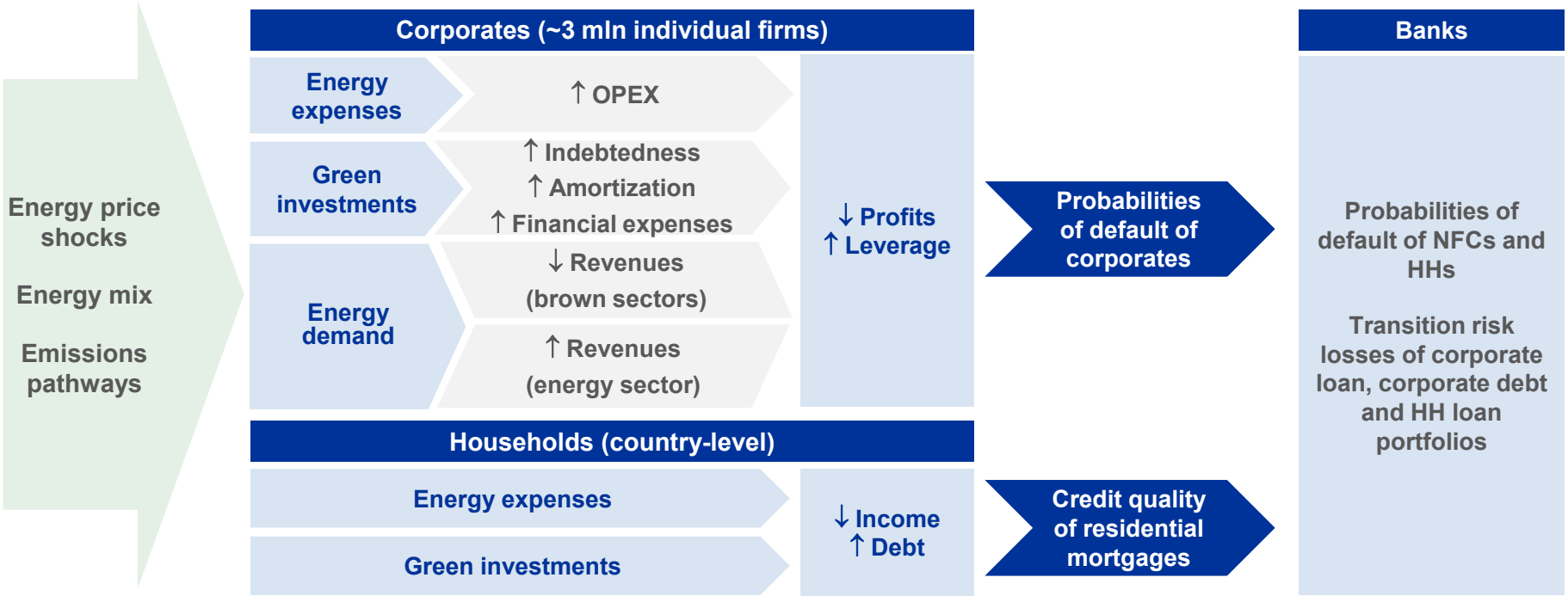
Main attributes of the accelerated transition

- **Inclusion of baseline macroeconomic developments based on BMPE projections**
- **NGFS delayed transition** happens **now instead of 2030**
- **Emissions reductions** compatible with +1.5°C target
- **Funding flows** are high, with more funding at the beginning
- **Fossil fuel and electricity prices** increase in the first years

3-year focus for SyRB calibration

- Focus on losses in **3-year timeframe** (until 2025) to capture combination transition risk (NGFS) and baseline macroeconomic projections (BMPE)
- **In line** with current **RRE SyRB** and **P2G approach**

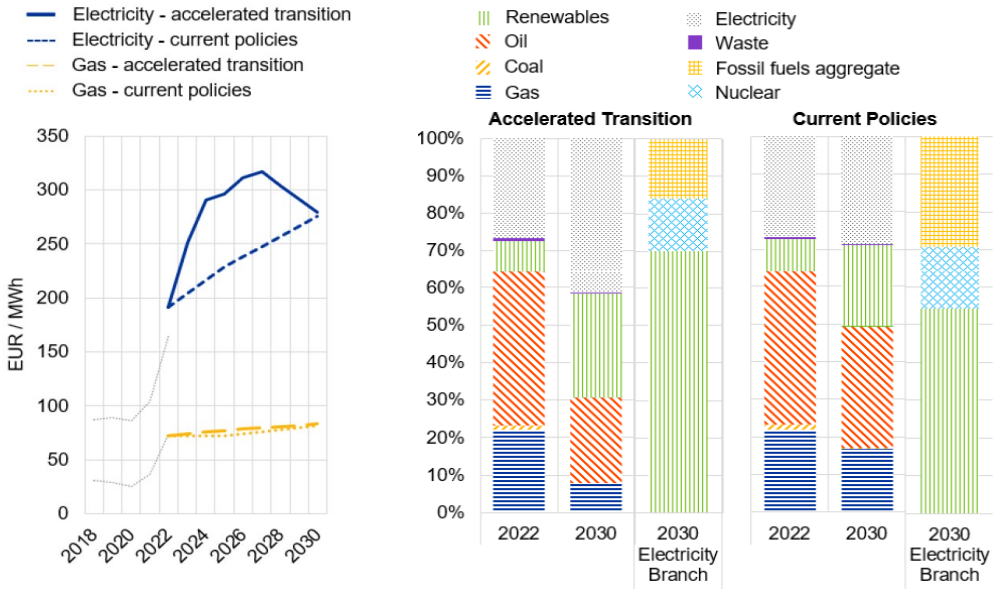
Losses computed based on the ECB climate risk models….



…for a quantitative assessment of the impact

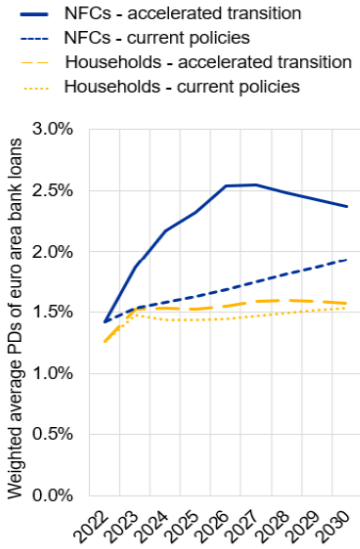
Main developments of the accelerated transition scenario in the second ECB top-down climate stress test

(left: energy prices in EUR/MWh, right: energy mix in percentages)



Projected PDs for NFCs and households

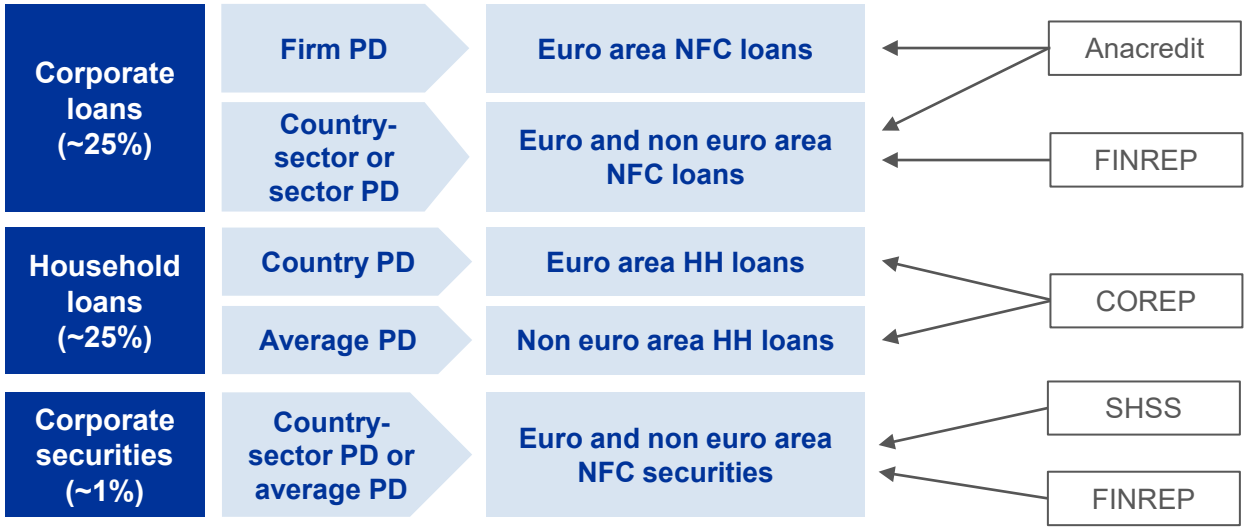
(y-axis: weighted-average of loan-level PDs, percentages)



Sample of banks and portfolio coverage

Objective: maximise the coverage while maintaining the highest possible level of granularity

- 107 euro area significant institutions (SIs), extension with ~1500 less-significant institutions (LSIs)
- Main balance sheet categories and datasets:



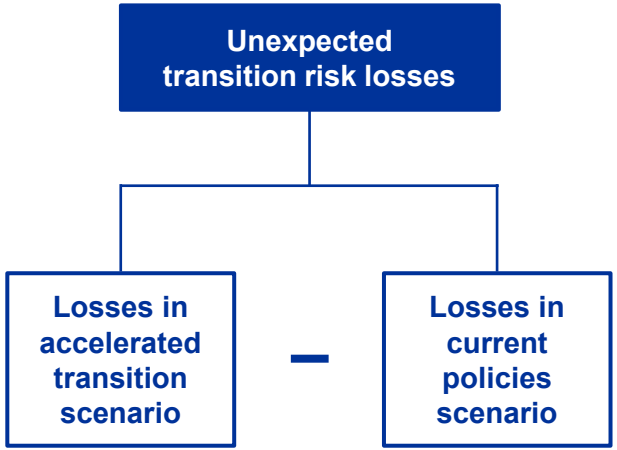
- Remaining categories: cash (~15%), other loans (~10%), other securities (~15%), other assets (~10%)

3

Calibrating the SyRB requirements

Transition risk losses and calibration of the SyRB requirements

- **Step 1: isolate unexpected losses due to transition risk**



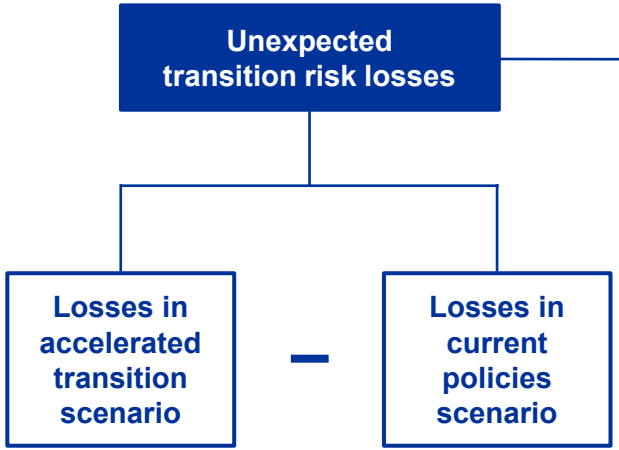
Main concern: targeted risks should not be covered by banks' provisions or targeted by other capital (buffer) requirements

1. Remove **expected** component of transition risk losses
2. Remove losses due to **macroeconomic environment**

➡ Both components are assumed to be present in current policies scenario

Transition risk losses and calibration of the SyRB requirements

- **Step 2: calibrate the climate SyRB**



Why buckets?

- SyRB: multiple of 50 bps
- Bank-level heterogeneity in projected losses
- Aligned with O-SII/G-SIB and P2G frameworks

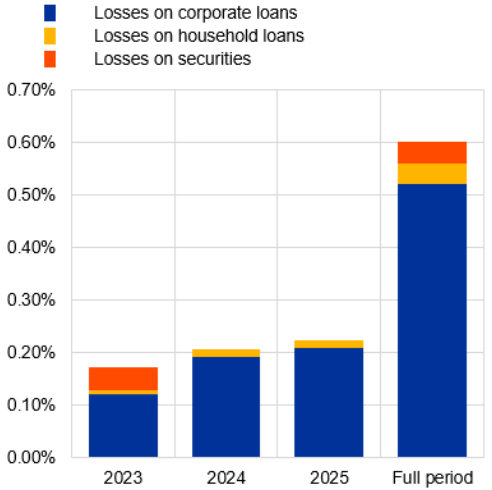
How: transition risk losses x calibration factor (CF)

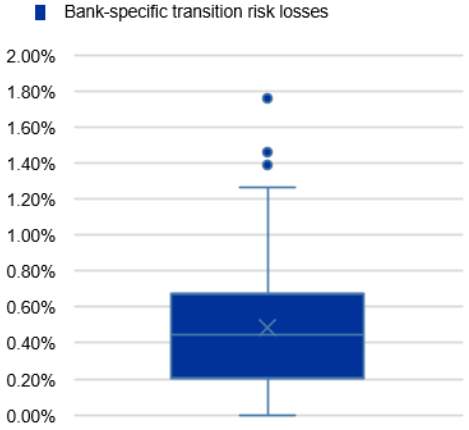
- Idea in line with other prudential capital buffer requirements
- Motivation: potential overlap of other (buffer) requirements, limitations of stress testing, transition plans
- Present results under several alternative CF choices

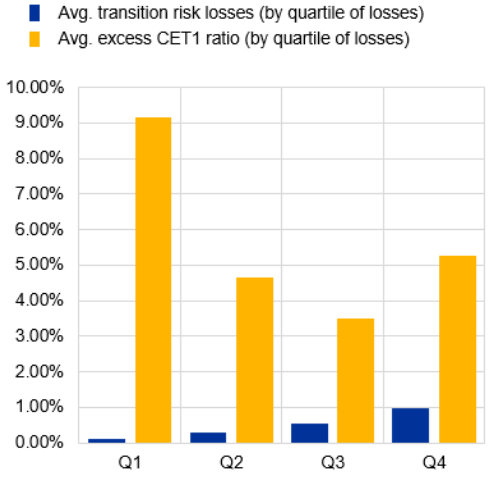
Step 1: Transition risk losses

System-wide (left) and bank-specific losses (middle); comparison with excess CET1 ratio (right)

(y-axis: % of RWA)





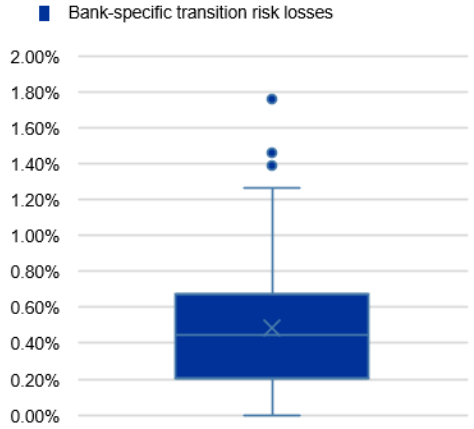


- **Aggregate transition risk losses** projected at **0.60% of RWA** (approximately 52 Bn EUR) over 2023-2025 period
- **Heterogeneity:** bank-level losses range from 0% of RWA to more than 1.75% of RWA
- Higher transition risk losses among banks with lower excess CET1 ratio

Step 2: Climate SyRB

From transition risk losses (left) to climate SyRB (right) under different calibration factors

(y-axis: % of RWA)



Bucket	SyRB	N. banks CF=1	N. banks CF=0.5	N. banks CF=0.25
$< 0.25\%$	0 bps	33	65	96
$[0.25\%, 0.75\%[$	50 bps	56	40	11
$[0.75\%, 1.25\%[$	100 bps	13	2	0
$[1.25\%, 1.75\%[$	150 bps	3	0	0
$>= 1.75\%$	200 bps	2	0	0

- **Bank-level heterogeneity** warrants SyRB bucketing approach
- **Calibration factor**: policy choices and implicit trade-off
- Coverage of projected losses: 99% (CF=1) vs. 57% (CF=0.5) vs. 3% (CF=0.25)

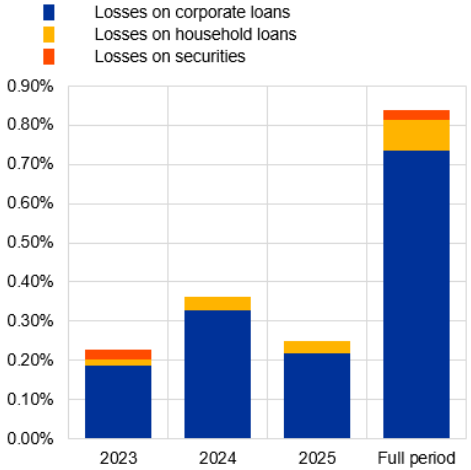
4

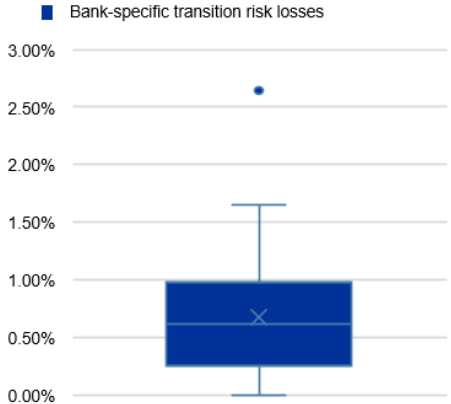
Additional analysis & policy considerations

Transition risk losses and climate SyRB – adverse scenario

System-wide (left) and bank-specific losses (middle); climate SyRB (right)

(y-axis: % of RWA)





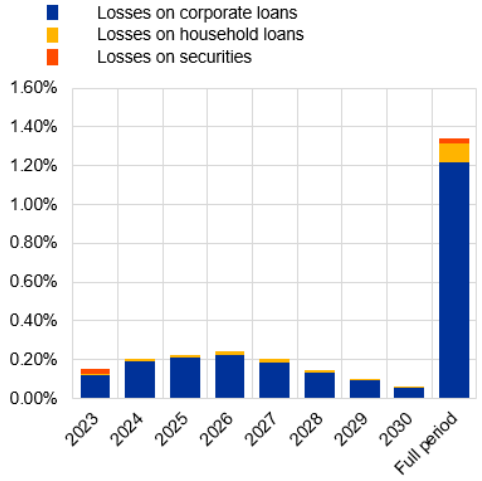
Bucket	SyRB	N. banks (baseline)	N. banks (adverse)
$< 0.25\%$	0 bps	33	26
$[0.25\%, 0.75\%[$	50 bps	56	41
$[0.75\%, 1.25\%[$	100 bps	13	28
$[1.25\%, 1.75\%[$	150 bps	3	10
$>= 1.75\%$	200 bps	2	2

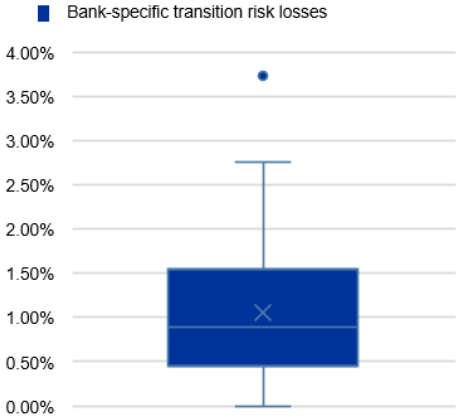
- Combine accelerated transition (and current policies) scenario with adverse macro scenario
- **Adverse macro scenario** causes **amplification of transition risk losses** (to 0.84% of RWA; approx. 72 Bn EUR)
- As a result, banks shift to higher climate SyRB buckets (CF=1)
- To consider: likelihood of both scenarios

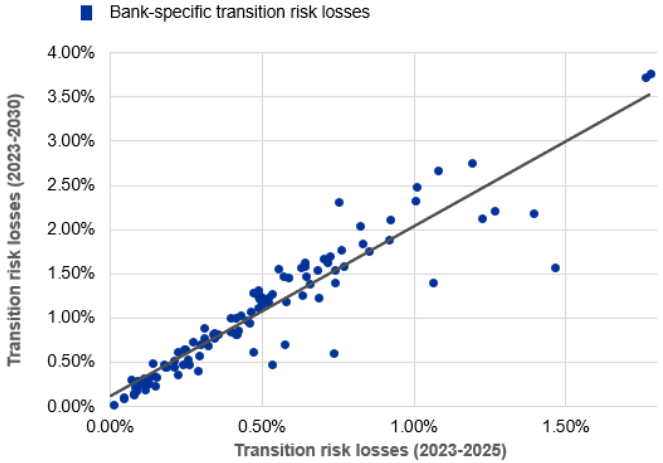
Transition risk losses and climate SyRB – longer time frame

System-wide (left) and bank-specific losses (middle); comparison with 3-year time frame (right)

(y-axis: % of RWA)







- Yearly transition risk losses increase until 2026
- **Relative ranking of banks robust to alternative time frame**
- Caveat: no dedicated macroeconomic scenario for the entire 2023-2030 horion

Potential implications of climate SyRB for credit growth

- Aggregate increase in capital ratio requirements:
  - Climate SyRB with CF=1 → +0.59 pp
  - Climate SyRB with CF=0.5 → +0.34 pp
  - Climate SyRB with CF=0.25 → +0.02 pp

- Frequent concerns in the literature about possible **unintended consequences** on transition financing

- **Estimates** based on existing literature on impact of higher capital requirements on credit growth:

Paper	Impact of 1 ppt increase in cap. req.	Period	Geography	Impact of SyRB with CF=1	Impact of SyRB with CF=0.5	Impact of SyRB with CF=0.25
Gropp et al. (2019)	-9 ppt	2010-2013	Europe	-5.35 ppt	-3.09 ppt	-0.15 ppt
Aiyar et al. (2014)	-5.7 to -8 ppt	1998-2007	UK	-3.39 to -4.75 ppt	-1.96 to -2.75 ppt	-0.1 to -0.14 ppt
De Jonghe et al. (2020)	-2.29 ppt	2013-2015	Belgium	-1.36 ppt	-0.79 ppt	-0.04 ppt
Favara et al. (2021)	-3 to -4 ppt	2014-2017	US	-1.78 to -2.38 ppt	-1.03 to -1.37 ppt	-0.05 to -0.07 ppt
Lang & Menno (2023)	-0.1 to -10 ppt	2005-2019	Euro area	-0.06 to -5.94 ppt	-0.03 to -3.43 ppt	-0 to -0.17 ppt

- **Overall impact on credit growth small to negligible. Likely be towards lower bound when introduced in "non-stressed times"** (Lang & Menno)

5

Conclusions

Conclusion

- **Quantify potential impact of short-term transition risk for euro area SI**
  - Based on forward-looking stress test approach
  - Maximize coverage and isolate unexpected losses due to transition risk
  - **Result: lower-bound estimate for transition risk losses (SI, 2023-2025) is sizeable: 52 to 72 Bn EUR**

- **Design harmonized framework to calibrate general SyRB for climate purposes**
  - From projected losses to climate SyRB buckets
  - Bucketing approach: **increase system-wide resilience to losses**, while remaining proportional
  - **Flexibility**: can be applied to other scenarios (e.g. physical risk; Fit-for-55 scenarios), and enhanced (more systemic risk channels, incorporate forward looking transition plans)
  - **Granularity**: avoid broad-based impacts on sectoral exposures, in contrast to predominant approaches in the literature and policy concerns regarding **unintended consequences**

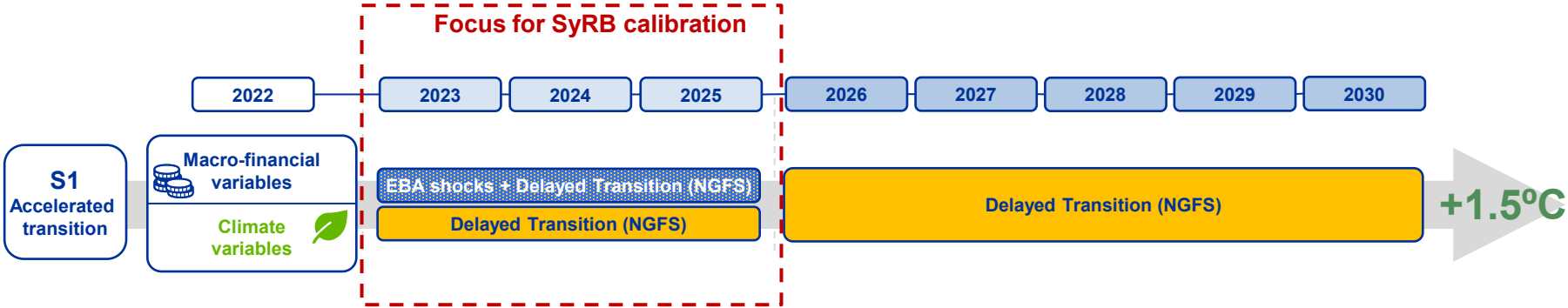
- **Directions for future research**
  - Choice of relevant climate scenario (incl. physical risk)
  - Stress testing approaches capturing additional systemic risk channels
  - Incorporate firm-level transition trajectories

Thank you

Annex

Accelerated transition scenario

	Main attributes	Focus for SyRB calibration
S1 Accelerated transition	• **Inclusion of baseline macroeconomic developments based on BMPE projections** • **NGFS delayed transition** happens **now instead of 2030** • **Emissions reductions** compatible with +1.5°C temperature target • **Funding flows** are high, with more funding at the beginning • **Fossil fuel and electricity prices** increase in the first years	• Focus on losses in the first 3 years (until 2025) to capture combination transition risk (NGFS) and baseline macroeconomic projections (BMPE) • Timeframe of 3 years also in line with current P2G approach and RRE SyRB



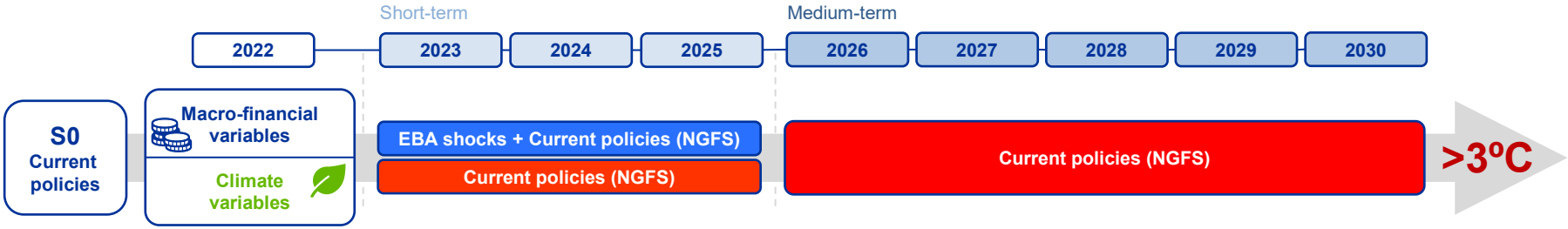
Current policies scenario

S0
Current policies

Main attributes

The economy faces downturns until 2025 due to the energy crisis, but recovers afterwards. There is no green transition taking place which will trigger long-term negative effects from physical risk.

- **NGFS current policies** as of 2022
- **No additional emissions reductions** besides those based on current transition policies
- **No green investments**
- **Fossil fuel and electricity prices** increase in the first three years, but recover after 2025
- **Very high long-term physical risk**



From probabilities of default to projected losses

- **Losses on corporate and household loan portfolio**

$$Loss_{i,t} = EAD_{i,t} \times LGD_{i,t} \times PD_{i,t} \times \prod_{s=1}^{t-1}(1 - PD_{i,s})$$

- **Losses on corporate debt securities portfolio**
  - Based on Vermeulen et al. (2018), calculate cumulative change in PD over full period:

$$Cumulative\ \Delta PD(T) = \sum_{t=1}^{T}(1 - \Delta PD_{t-1})^{t-1}\ \Delta PD_t$$

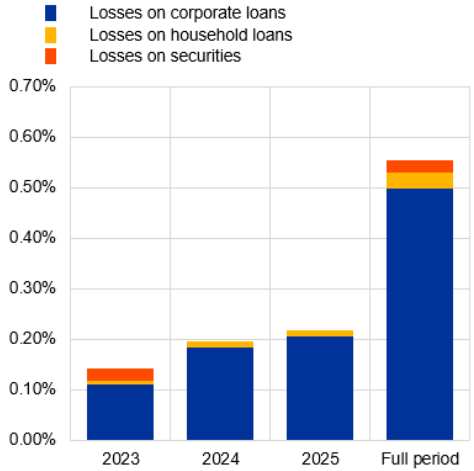
  - Compute change in spread of bond (Δy) as cumulative change in PD multiplied with sensitivity parameter, which depends on credit rating of bond
  - Compute price change of bond using modified duration formula:

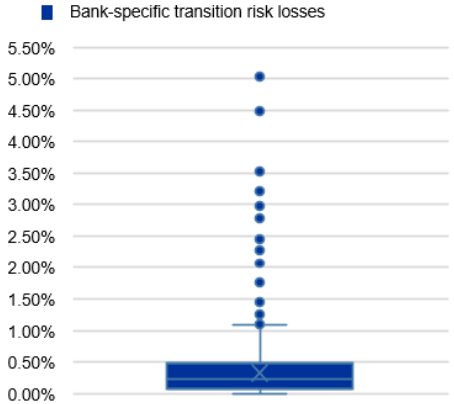
$$\Delta P = -P * ModD * \Delta y$$

Transition risk losses and climate SyRB – SIs vs LSIs

System-wide (left) and bank-specific losses (middle); climate SyRB (right)

(y-axis: % of RWA)





Bucket	SyRB	N. banks
$< 0.25\%$	0 bps	822
$[0.25\%, 0.75\%[$	50 bps	629
$[0.75\%, 1.25\%[$	100 bps	85
$[1.25\%, 1.75\%[$	150 bps	11
$>= 1.75\%$	200 bps	17

- Sample: 107 significant institutions (SIs) and 1457 less-significant institutions (LSIs)
- **Aggregate transition risk losses** projected at **0.55% of RWA** (approximately 83 Bn EUR) over 2023-2025 period
- Caveats for LSI: no corporate debt securities, less granular data