Update of the ESCB climate-change related indicators

14 May 2024

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Overview

Introduction

Release of climate change-related indicators

- Following the **Governing Council (GC) action plan**, the ECB and national central banks have collaboratively developed **harmonised statistical indicators at the euro area level for climate-related analysis**.

- **Indicators depict how climate change (will) affect the financial sector**
  → can inform monetary policy making, provide reference for financial stability analyses and support public understanding.

- The **first set of indicators** was released in **January 2023**.

- Updated **climate-related indicators** were released on **18 April** as outlined in the **Climate and nature plan 2024-2025**, accompanied by a **statistical paper** that explains the methodology.

	Sustainable finance	Carbon emissions	Physical risk
Released as:	**Experimental indicators**	**Analytical indicators**	
Indicators cover:	issuances and holdings of sustainable debt securities	financial sector loan and securities portfolios	
→ come with limitations and should be used and analysed with care → project is work in progress (feedback is very welcome!)			

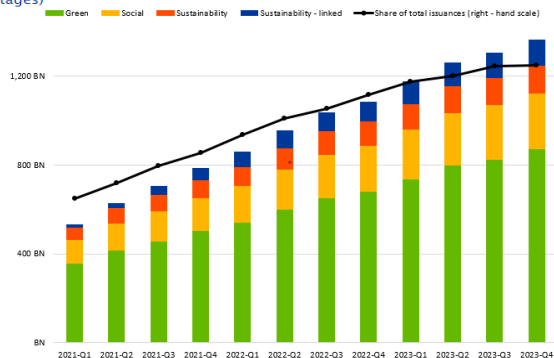# Sustainable finance

Experimental indicators

Experimental indicators on sustainable finance

- Based on ESCB data sources: Centralised Securities Data Base (CSDB), Securities Issues Statistics (CSEC) and Securities Holdings Statistics (SHS)

- Time-series information on outstanding amounts and financial transactions related to the **issuances and holdings of sustainable debt securities in the euro area**

- First publication **January 2023**: all sustainable debt securities considered for the calculation of the aggregates, irrespective of the level of assurance, including only self-labelled

- As of **November 2023**: **additional** aggregates by restricting the universe of sustainable instruments to those <u>externally reviewed</u> **with a second party opinion** (validating the sustainability claims of the issuer)

Issuances of sustainable debt securities in the euro area

Chart 1 – Euro area issuances of sustainable debt securities – all levels of assurance

(Left–hand scale: EUR, outstanding amounts at face value; right–hand scale: percentages)

Legend: Green, Social, Sustainability, Sustainability - linked, Share of total issuances (right - hand scale)
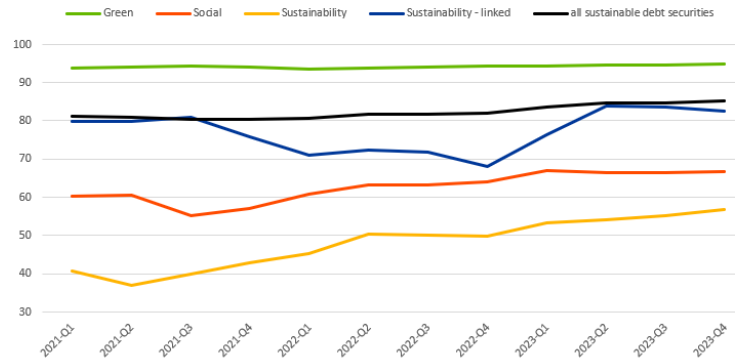
Source: Centralised Securities Database (CSDB).

Notes: "Share of total issuances" refers to the amount of all sustainable securities as a share of all debt securities issued in the euro area.

Chart 1b – Euro area issuances of sustainable debt securities – share of issuances with second party opinion

(Percentages)

Legend: Green, Social, Sustainability, Sustainability - linked, all sustainable debt securities

Source: Centralised Securities Database (CSDB).

Notes: "Share of issuances with second party opinion" refers to sustainable debt securities with second party opinion as a share of all sustainable debt securities.

Key findings

- Outstanding amount of sustainable debt securities issued by EA has *almost tripled the last three years*
- Green and social bonds account for majority of the market
- Sustainability-linked bonds recorded the largest growth rate
- Relevance of these instruments in the overall debt securities market remains minor, even when observing the looser level of assurance

- Overall, euro area issuers obtain external review of their sustainable bond issuances: around **85% of all sustainable debt in the EA has a SPO**
- Virtually all green debt securities issued in the euro area have obtained a second party opinion
- More than 80% of the sustainability-linked debt securities have been reviewed by an external (SPO) provider
- Social and sustainability instruments have slightly lower SPO assurance levels but in general above 55%

Holdings of sustainable debt securities in the euro area

Chart 2 – Euro area holdings of sustainable debt securities – all levels of assurance

(Left-hand scale: EUR, outstanding amounts at face value; right-hand scale: percentages)
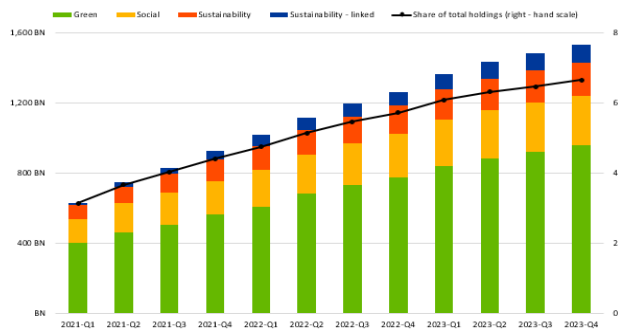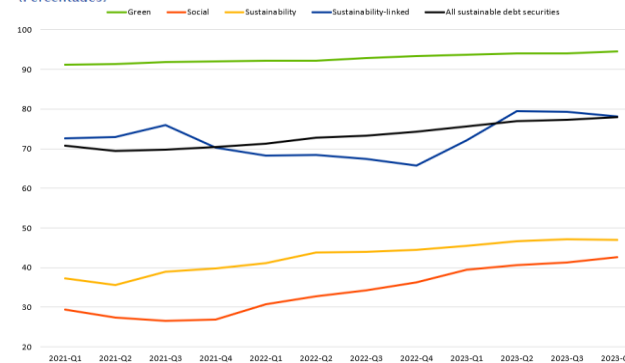

Sources: CSDB and Securities Holdings Statistics (SHSS).

Notes: "Share of total holdings" refers to the amount of all sustainable securities as a share of all debt securities held in the euro area.

Chart 2b – Euro area holdings of sustainable debt securities – share of holdings with second party opinion

(Percentages)

Source: CSDB and Securities Holdings Statistics (SHSS).

Notes: "Share of holdings with second party opinion" refers to sustainable debt securities with second party opinion as a share of all sustainable debt securities.

Key findings

- Continuous growth in EA holdings of sustainable debt securities
- EA as a whole is a net buyer of these instruments as holdings outperform the issuance
- Overall remains a minor portfolio

- **Most sustainable debt securities held** by euro area residents have obtained a **SPO** (77%)
- Almost all green and most sustainability-linked bonds held have been externally reviewed
- Holdings of social and sustainability bonds with SPO are significantly lower, below 50% => EA investors buy large proportion of social and sustainability bonds issued by non-EU residents that have no second party opinion

Experimental indicators on sustainable finance – future work
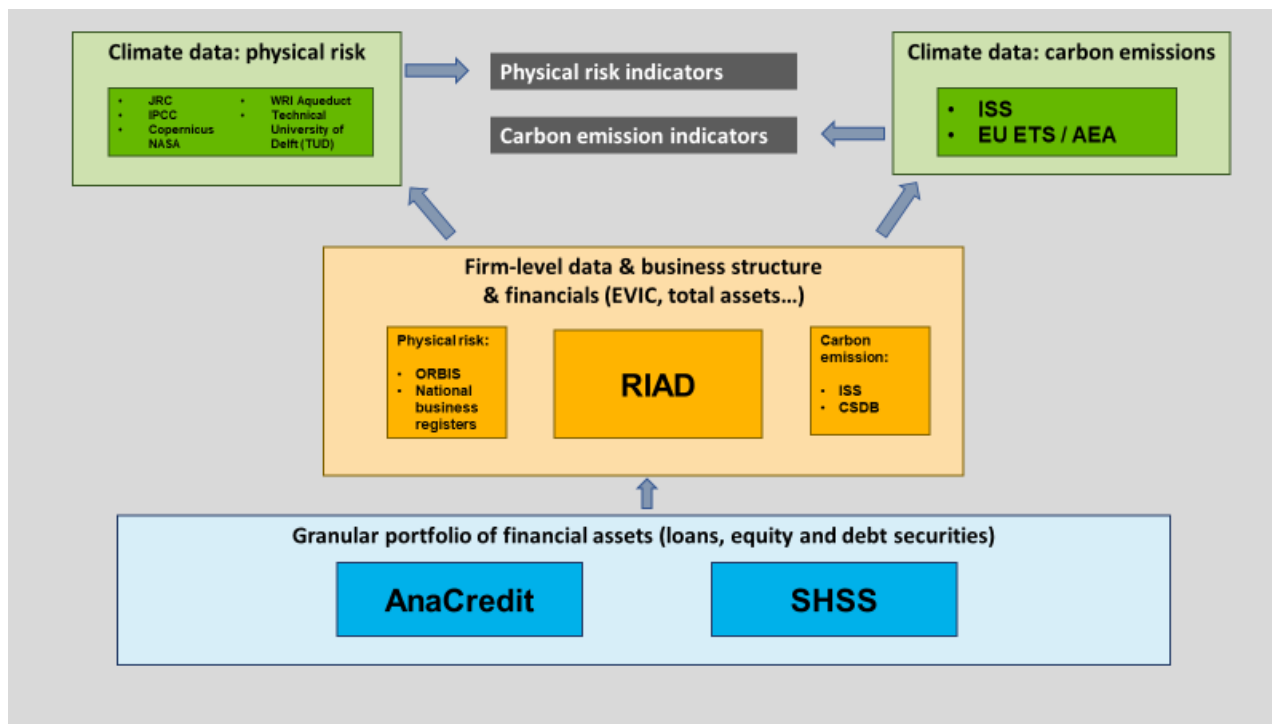
Plans for **2024**:

- Indicators become **official** ⟶ fulfil the required statistical quality standards in terms of coverage, harmonisation, and methodological soundness

- **More breakdowns available to the public**, e.g. all breakdowns for all sustainability categories and not just for green, including by sector and country, all individual EU non-EA countries (for issuances)

- Start working on developing **further aggregates** based on **alignment with the European Green Bonds Standard (EUGBS)**

Carbon emissions

Analytical indicators

Emission (and physical risk) indicators are constructed bottom up using micro data

Climate data: physical risk
- JRC
- IPCC
- Copernicus NASA
- WRI Aqueduct
- Technical University of Delft (TUD)

Physical risk indicators

Carbon emission indicators

Climate data: carbon emissions
- ISS
- EU ETS / AEA

Firm-level data & business structure & financials (EVIC, total assets...)

Physical risk:
- ORBIS
- National business registers

RIAD

Carbon emission:
- ISS
- CSDB

Granular portfolio of financial assets (loans, equity and debt securities)

AnaCredit

SHSS

- **Carbon emission indicators** capture financial sector's transition risks by measuring the carbon emissions associated with corporate securities and loan portfolios of financial institutions.

- **Physical risk indicators** capture financial system exposures to companies located in areas susceptible to natural disasters (such as flooding, windstorms, wildfires or droughts) and chronic physical risks (heat and water stress).

Notes: AnaCredit: Analytical credit datasets. SHSS: Securities Holdings Statistics by Sector. RIAD: Register of Institutions and Affiliates Data. ISS is a commercial data provider offering carbon emission information at company level. CSDB: Centralised Securities Database. EU ETS denotes the European Emission Trading System and AEA the Eurostat Air Emissions Accounts. JRC: Joint Research Centre. IPCC: Intergovernmental Panel on Climate Change. WRI: World Research Institute. EVIC: Enterprise value including cash

Focus of indicators and key improvements in 2023

| Financed emissions | Carbon intensity | Weighted average carbon intensity | Carbon footprint |

Indicators show the amount (and share) of carbon emissions that can be attributed to financial institutions via their securities and loan portfolios.
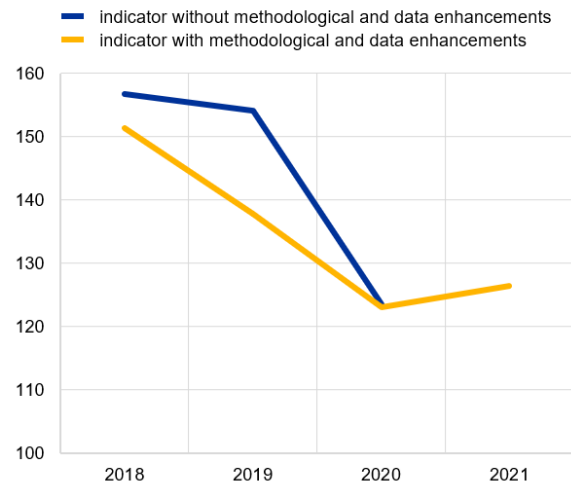→ provide insights into the financial sector's monetary contribution to high-emitting economic activities and associated exposure to transition risks.

1. **New imputation** strategies for financial and emission data to increase coverage

2. **Introduced time series methodologies**
   - **Balancing** to account for compositional changes of non-financial corporations and investment/divestment
   - **Exchange rate/inflation adjustments**
   - **Time series decomposition** to distinguishes between greening of the portfolio and changes due to investment decisions
   - **Outliers check** to deal with large fluctuations in time series dynamics

3. **Introduced new bank loan indicator compiled at corporate group level** allows studying global emissions

4. **Improved accessibility moving to ESCB Open-Source Data:** Using RIAD/ISS instead of Orbis/Refinitiv

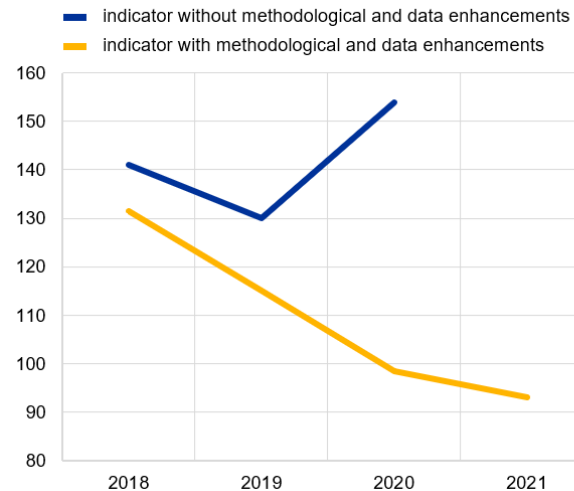# Selected results (loan-based indicators, single entity, scope 1[1])

a) Financed emissions (FE), euro area aggregate, Scope 1, single entity-level loans

(y-axis: million tonnes of CO2)

— indicator without methodological and data enhancements
— indicator with methodological and data enhancements

b) Weighted average carbon intensity (WACI), euro area aggregate, Scope 1, single entity-level loans

(y-axis: tonnes of CO2 per million euro)

— indicator without methodological and data enhancements
— indicator with methodological and data enhancements

Financed emissions:
Tons of GHG emissions financed by euro area financial institutions

Weighted average carbon intensity:
Tons of GHG emissions per million EUR of revenue → proxy for the exposure of a creditor to climate transition risks

Sources: ESCB calculations based on AnaCredit, Register of Institutions and Affiliates Database (RIAD), EU Emissions Trading System (EU ETS), and Eurostat Air Emissions Accounts (AEA).
Notes: The charts comprise only loans computed on single entity level for Scope 1 emissions. The WACI is adjusted for inflation and exchange rate effects.
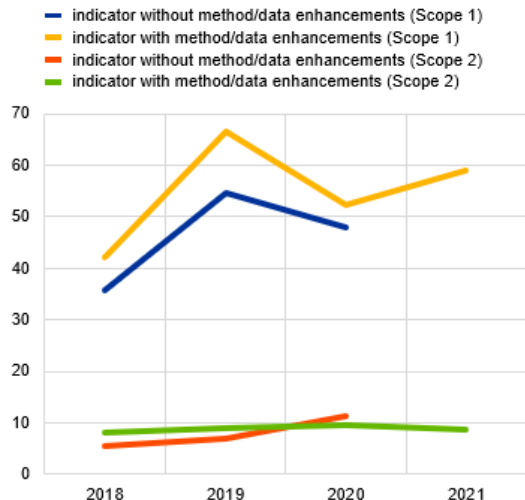
- **Downward trend** over the period → could be attributed to diverse impacts of **COVID-19 pandemic** on global economy, be driven by other economic factors, or a broader time trend.
- **Methodological and data enhancements** led to an overall **smoothing of the time series** (new imputation methods have largest impact) → statistically more robust time series analysis.

[1] Scope 1 covers emissions from sources that an organisation owns or controls directly.

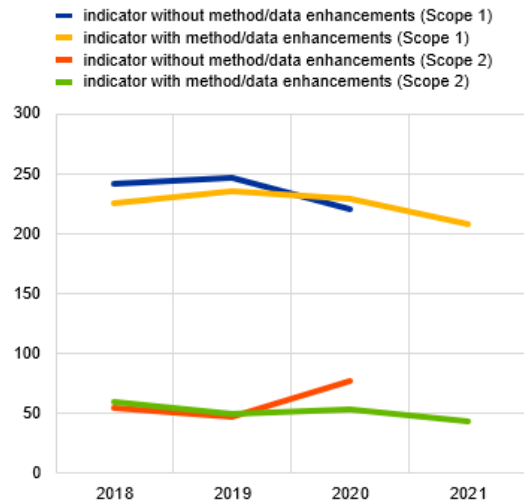# Selected results (securities-based indicators, group-level, scope 1 and 2)[2]

a) Financed emissions (FE), euro area aggregate, group-level issued securities

(y-axis: million tonnes of CO2)

- indicator without method/data enhancements (Scope 1)
- indicator with method/data enhancements (Scope 1)
- indicator without method/data enhancements (Scope 2)
- indicator with method/data enhancements (Scope 2)

b) Weighted average carbon intensity (WACI), euro area aggregate, group-level issued securities

(y-axis: tonnes of CO2 per million euro)

- indicator without method/data enhancements (Scope 1)
- indicator with method/data enhancements (Scope 1)
- indicator without method/data enhancements (Scope 2)
- indicator with method/data enhancements (Scope 2)

Financed emissions:
Tons of GHG emissions financed by euro area financial institutions

Weighted average carbon intensity:
Tons of GHG emissions per million EUR of revenue → proxy for the exposure of a holder to climate transition risks

Sources: ESCB calculations based on data from RIAD, Centralised Securities Database (CSDB), Securities Holding Statistics (SHSS), and Institutional Shareholder Services (ISS).
Notes: Securities include listed shares and debt securities of deposit taking cooperations (S122) and are computed at group level. The charts comprise Scope 1 and Scope 2 emissions. The WACI is adjusted for inflation and exchange rate effects.

- **Direct emissions** (scope 1) are **larger in magnitude** than indirect emissions (scope 2).
- **No clear direction identifiable in the absolute indicator (FE)**
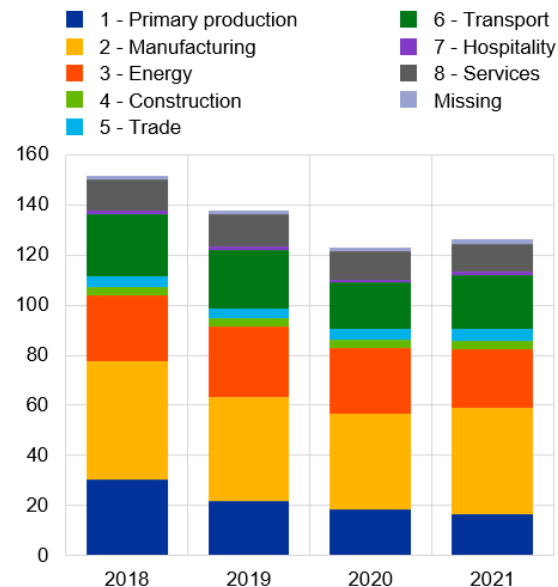- (Slight) **downwards movement in the carbon intensity (WACI)**

[2] Scope 1 covers emissions from sources that an organisation owns or controls directly.
Scope 2 emissions are indirect GHG emissions associated with the purchase of electricity, steam, heat, or cooling.

Sectoral breakdown of financed emissions (loan-based indicators, single-entity level, scope 1)

Financed emissions across EA countries, single entity-level loans

million tonnes of CO2

Legend:
- 1 - Primary production
- 2 - Manufacturing
- 3 - Energy
- 4 - Construction
- 5 - Trade
- 6 - Transport
- 7 - Hospitality
- 8 - Services
- Missing

- Sectors accountable for the **most substantial share** of financed emissions (single-entity level, bank loans) are **manufacturing, energy, primary production, and transport**.

- Primary production shows a **decreasing trend**.

- For the **group level indicators** (loans and security portfolio), **sector classifications of debtor/issuer are less reliable**, since multinational corporations are more prone to sectoral misclassifications.

Sources: ESCB calculations based on data from AnaCredit, RIAD, EU Emissions Trading System (EU ETS), and Eurostat Air Emissions Accounts (AEA).
Notes: The charts comprise only loans computed on single entity level for Scope 1 emissions.

Breakdown of annual changes in the WACI allows users to identify the key drivers of changes

Decomposition of Weighted Average Carbon Intensity (WACI), corporate group level security portfolio, euro area aggregate

(y-axis: tonnes of CO2 per million euro)
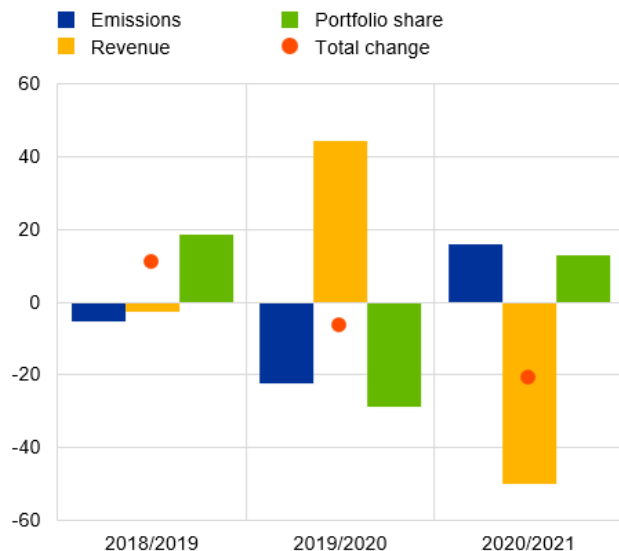
- **Decrease in emissions and revenue[1] from 2019 to 2020** (2019/2020) → could be due to disruptions of the economy from pandemic-related restrictions.

- **Emissions and revenue[1] increase from 2020 to 2021** (2020/2021) → could be due to economic recovery following pandemic-related restrictions.

- Time series breakdowns are also available for the **financed emissions** and **carbon footprint indicators**.

- The decomposition method underscores the **indicators' sensitivity** to changes in **financial components.**

[1] Notably, a reduction in revenue from one year to the next corresponds to a positive revenue component in the WACI breakdown and vice versa. In other words, when revenue decreases, carbon intensity increases.

Sources: ESCB calculations based on data from AnaCredit, RIAD, CSDB, SHSS, Institutional Shareholder Services (ISS), EU ETS, Eurostat Air Emissions Accounts (AEA).
Notes: Securities include listed shares and debt securities of deposit taking cooperations (S122) and are computed at group level. Loans are computed at single entity level. The charts comprise only Scope 1 emissions.

Financed emissions (FE), Scope 1, euro area aggregate

million tonnes of CO_2

- Single-entity level indicator
- Group level indicator
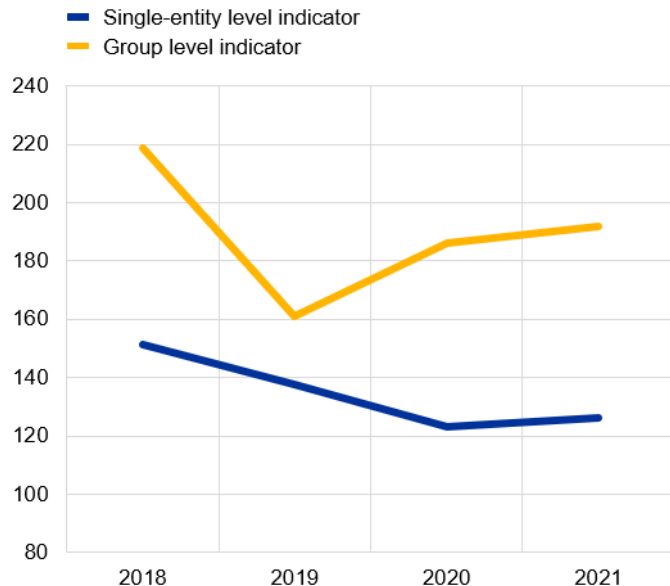
- • Single entity-level financed emissions only include local (euro area) emissions, whereas the group indicators encompass **global emissions.**
  → allows assessment of **global transition risk** of the banking sector through the lending channel.

- • The **Financed emission group-level indicator exhibit higher levels,** which confirms intuition.

- • Group-level indicators exhibit a slightly **more volatile dynamic** than the single-entity level ones throughout the studied timeframe

Sources: ESCB calculations based on data from AnaCredit, EU Emissions Trading System (EU ETS), and Eurostat Air Emissions Accounts (AEA).
Notes: Loans are computed at single entity and group-level. The charts include only Scope 1 emissions.

[1] Scope 1 covers emissions from sources that an organisation owns or controls directly.

Carbon emission indicators - future work

Refine methodology - group frame, imputations, outlier and sanity checks

Start of stocktake on **forward-looking indicators**

Assess newly available data from upcoming sustainability reporting standards and requirements

Develop/implement S**cope 2** (& 3 upstream) emission indicators - for single entity-level loan-based indicators

Physical risk

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Analytical indicators

Hazard data - overview

Hazard	Unit	Source	Damage function (dmf)	Scores	Time horizon	Climate scenarios
River flooding	water depth (m)	Delft University of Technology (TUD)	based on intensity & area type	based on dmf return periods: 10,30,100,300,1000	1971-2000, 2021-2050, 2071-2100	Historical, RCP 4.5 RCP 8.5
Coastal flooding	water depth (m)	Delft University of Technology (TUD)	based on intensity & area type	based on dmf return periods: 10,30,100, 300, 1000	1971-2000, 2021-2050	Historical, RCP 4.5 RCP 8.5
Windstorms	max gust speed (m/s)	Own calculations, based on Copernicus	based on intensity by NUTS3 & area type	based on dmf return periods: 10, 50, 100, 500	-	-
Wildfire	fire weather index (accounting for burnable area)	Own Calc, Copernicus	-	based on annual probability of fire event: low (up 0.01), medium (up to 0.1), high (above 0.1)	2001-2022, 2023-2050	Historical, RCP 4.5 RCP 8.5
Water stress	score based on ratio between total water withdrawals and available renewable surface water	Aqueduct WRI	-	original score from the source	1996-2010, 2030, 2040	Historical, SSP2 RCP4.5 SSP3 RCP 8.5
Landslides	predisposition to landslide (score 1-5)	JRC	-	based on original scores across return periods (10, 50, 100, 500)	-	-
Subsidence	susceptibility score based on soils' clay content	JRC	-	original score rescaled to: no risk (1), low (2), medium (3), high risk (4,5)	-	-
Consecutive Dry Days	maximum number of consecutive dry days (with precipitation < 1mm per day)	IPCC	-	based on number of days: no risk (up to 15), low (up to 20), medium (up to 40), high (above 50 days)	1986-2005, 2020-2040, 2041-2060	Historical, RCP 4.5, RCP 8.5
Standardised Precipitation Index (SPI-6)	compares cumulated precipitation for 6 months with the long-term precipitation distribution for the same location and cumulation period	IPCC	-	based on thresholds, scores from -3-extreme dry to 3-extreme wet rescaled to: no risk (0), low (-1,1), medium (-2,2), high risk (-3,3)	1986-2005, 2020-2040, 2041-2060	Historical, RCP 4.5, RCP 8.5

Notes: RCP stands for Representative Concentration Pathways. RCP 4.5. corresponds to radiative forcing of 4.5 W/m² by end of the century and is considered as a moderate scenario. RCP 8.5 assumes high GHG emissions scenario, leading to a radiative forcing of 8.5 W/m² by 2100, and is considered a worst-case scenario.

Physical risk indicators – scores and expected losses-based indicators

Physical risk scores (RS)

- Value and percentage of portfolio associated with debtors located in areas of varying physical risk, on a scale from 0 (no risk) to 3 (high risk).
- Risk scores provide valuable insights for assessing relative risk levels across countries, climate scenarios and variations within the same hazard type.

Potential exposure at risk (PEAR)

- Sum of positive risk scores (categories 1-low to 3-high risk), reveals financial exposure to debtors in at-risk areas regardless of hazard's intensity or frequency.
- A measure of the prevalence of a natural phenomenon, encompassing all exposures without considering the vulnerability of affected debtors should an event occur.

Normalised exposure at risk (NEAR)

- Estimates the expected loss in bank portfolio, attributed to the inability of debtors to fulfil their repayment obligations as an aftermath of a natural disaster.
- It is assumed that the company's debt to financial institutions will be impaired in proportion to the expected loss to debtor's physical assets relative to its total assets.

Collateral-adjusted exposure at risk (CEAR)

- Based on NEAR but in addition takes into account financial and physical collateral pledged with loan commitment.
- Financial protection is included in full amount. However, physical collateral might also decrease in value due to consequences of natural disaster – this is reflected in the indicator.

Risk scores

Exposures to different hazards by risk score

Historical baseline and RCP 8.5 projections for 2050; loans, debt securities and equity portfolio of euro area financial institutions

(left-hand scale: EUR billion; right-hand scale: percentage of portfolio)
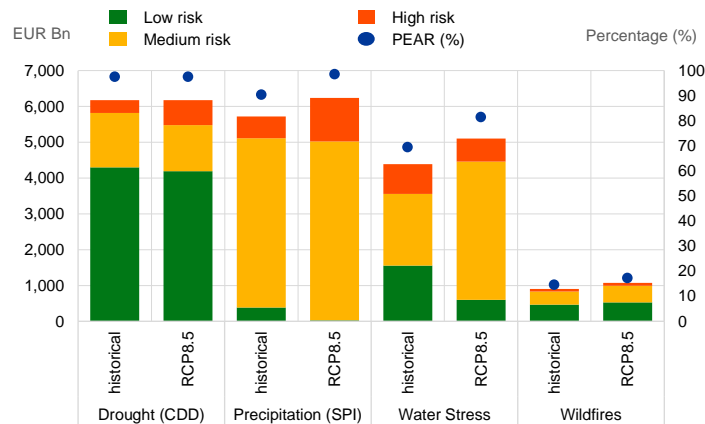
Exposures to coastal flooding by risk score

Historical baseline and RCP 8.5 projections for 2050 and 2100 with and without flood protections; loans, debt securities and equity portfolio of euro area financial institutions

(left-hand scale: EUR billion; right-hand scale: percentage of portfolio)
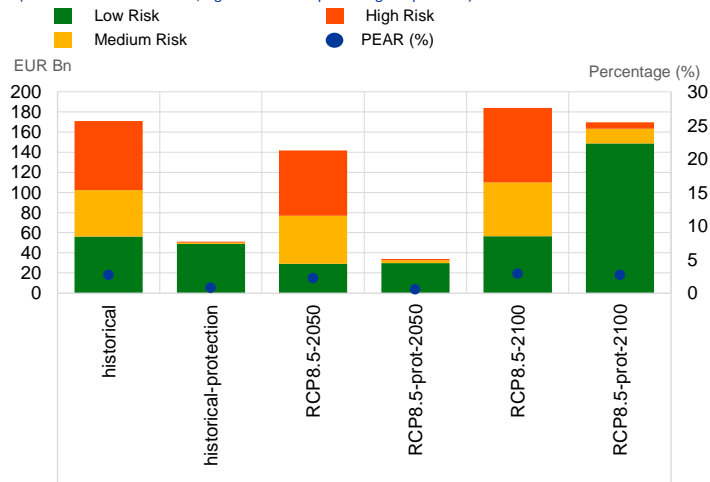
Source: ESCB calculations based on AnaCredit, RIAD, SHSS, IPCC Interactive Atlas, World Resource Institute (WRI), Joint Research Centre (JRC), Technical University of Delft (TUD) and Copernicus.
Notes: Financial institutions include Deposit-taking corporations except central banks (S122), Non-Money market funds investment funds (S124), Insurance corporations & Pension funds (S128, S129). AnaCredit and SHS data are for December 2020. Risk scores are not comparable across hazard types as they rely on different methodologies and sources.

- The financial institutions exposure to physical risk largely mirrors geographical distribution of hazards. For temperature- and precipitation-related hazards, outcomes derived for an adverse climate scenario indicate an escalated risk compared to the baseline.
- Climate adaptation strategies will play a crucial role in the future, yet without continuous investments they may become inadequate to cope with the anticipated intensification of floods.

Adaptation measures effects on floods

PEAR for river flooding with and without protection by country
RCP 8.5 projections for 2050 with and without protection; loans, debt securities and equity portfolio of euro area financial institutions
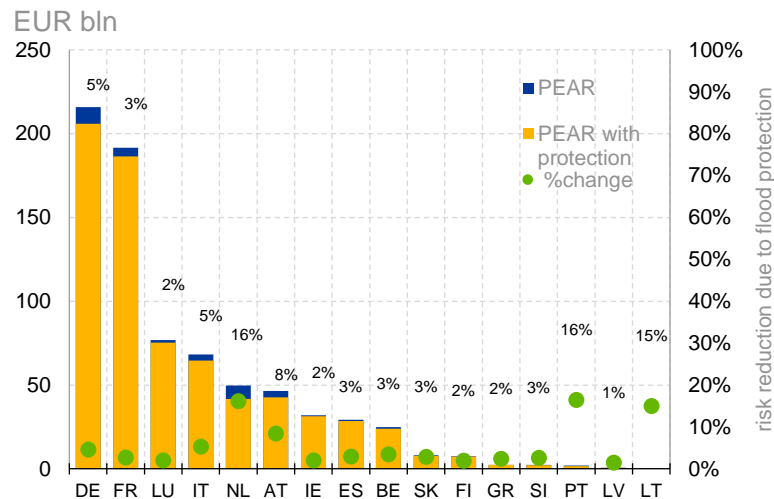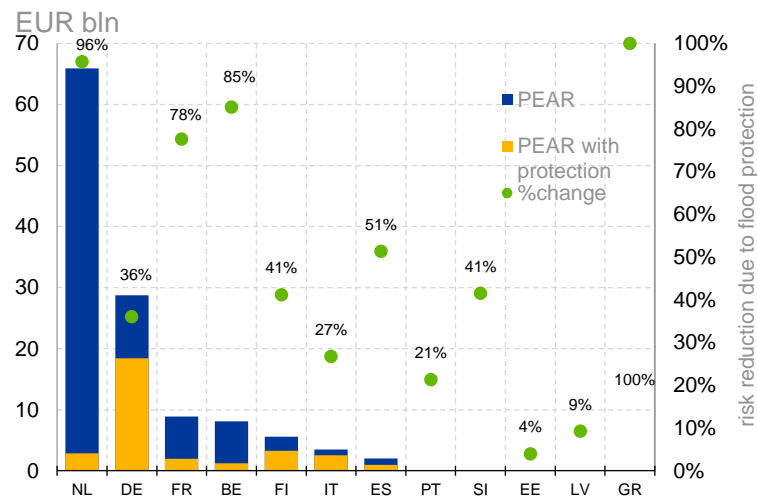
PEAR for coastal flooding with and without protection by country
RCP 8.5 projections for 2050 with and without protection; loans, debt securities and equity portfolio of euro area financial institutions

(left-hand scale: EUR billion; right-hand scale: percentage decrease in PEAR)

(left-hand scale: EUR billion; right-hand scale: percentage decrease in PEAR)

Sources: *ESCB calculations based on AnaCredit, RIAD, SHSS, Technical University of Delft (TUD).*
Note: Includes Deposit-taking corporations except central banks (S122), Non-Money market funds investment funds (S124), Insurance corporations & Pension funds (S128, S129) and all instruments (debt securities, equities, loans). On the right-hand side is represented the percentage decrease in total PEAR after accounting for protection. For river flooding: Cyprus, Ireland, Malta removed due to confidentiality. For coastal flooding: Cyprus, Estonia, Malta, Lithuania removed due to confidentiality.

- Among the highly exposed countries to river floods, the highest reduction is observed in the Netherlands, followed by Austria, Germany and Italy.
- As observed at the euro area level, flood defence standards in coastal areas demonstrate greater efficiency than those implemented for river floods, with notable example of the Netherlands where the financial exposures are reduced by over 90%.

Expected losses indicators – euro area and by country:
NEAR (normalised exposures at risk) and CEAR (collateral-adjusted exposures at risk)

NEAR and CEAR over the maturity of the loan, % of portfolio
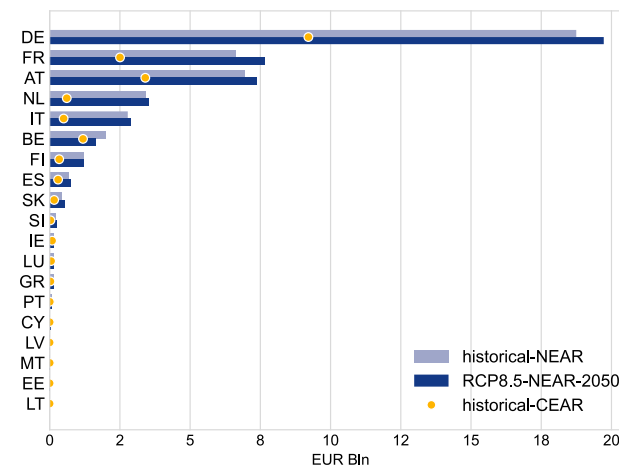Baseline and RCP 8.5 projections with and without protection; loans of euro area banks
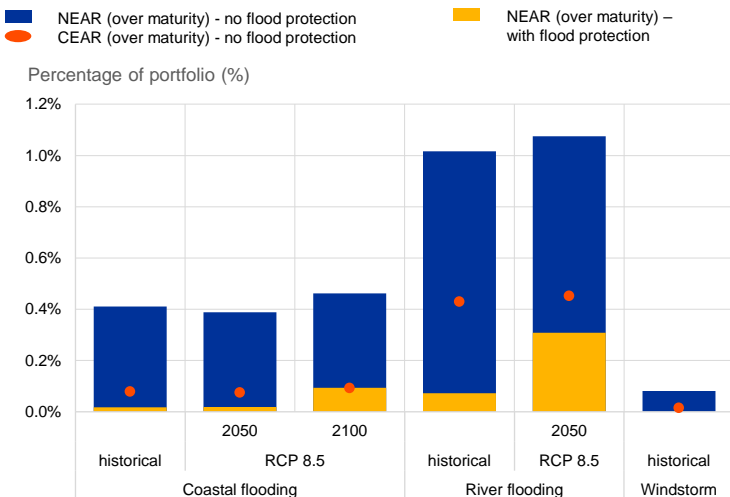
NEAR and CEAR for river flooding by country
Baseline and RCP 8.5 projections for 2050 without protection; loan portfolio of euro area banks; over the maturity of the loan

(left-hand scale: percentage of portfolio)

■ NEAR (over maturity) - no flood protection
● CEAR (over maturity) - no flood protection
■ NEAR (over maturity) – with flood protection

EUR billions

Sources: ESCB calculations based on AnaCredit, RIAD, for coastal and river flooding calculations based on data from the Technical University of Delft (TUD), for windstorm based on Copernicus.

- Expected losses indicators offer a valuable tool for comparing the climate impact across various hazards, climate scenarios, and countries applying a consistent methodology.
- In terms of minimizing financial losses, collateral pledged against loans and insurance coverage serve as robust mitigating factors. Nevertheless, there is considerable variation in national practices, which significantly influences country risk profiles.

Physical risk - future work
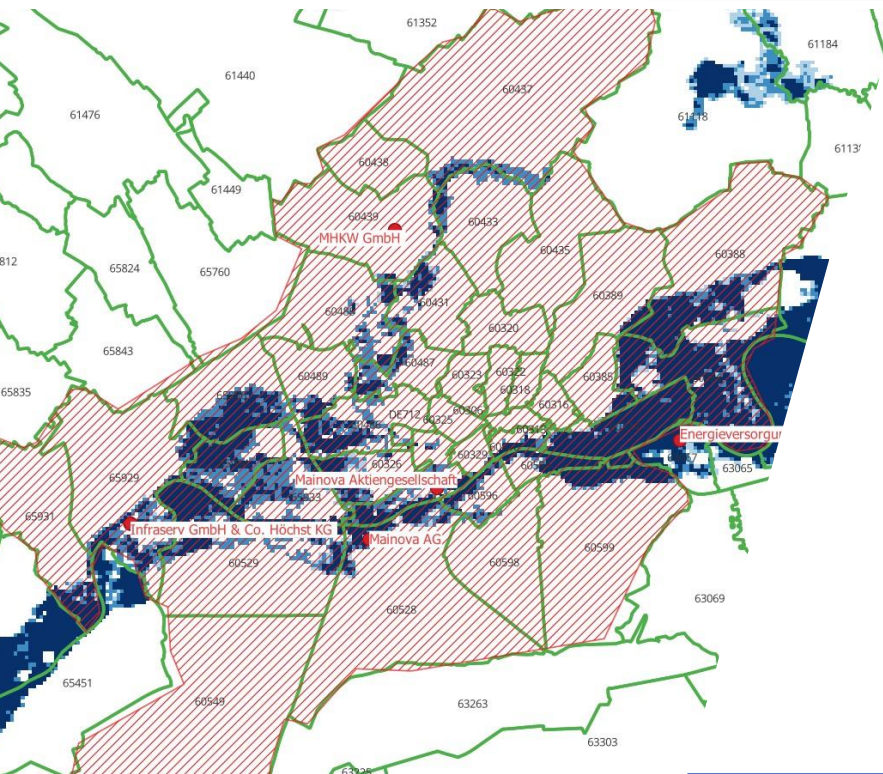
Expanding range of hazards and forward-looking measures (e.g. for windstorms) – upon consultation with users

Compounding risk – if available, but modelling still poses challenges for the climate scientists

Location of collateral – more granular assessment at postal code vs. NUTS3 (subject to improvements in AnaCredit reporting)

Location of local units (production sites, distribution centres) – might be the biggest value added from central bank statisticians

Conclusions

Climate-related indicators are necessary to understand the risks associated with climate change for the financial sector

Transparent and consistent methodology - facilitating comparison across countries and various specifications

Indicators based on public data sources to the extent possible – enabling data sharing

Aggregate indicators accompanied with **rich microdata** for detailed internal ESCB analysis

Continuous enhancements in line with ECB climate and nature plan 2024-2025

Where to find the data and how to reach us
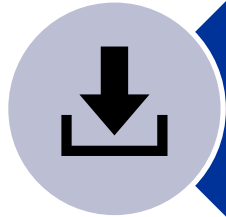
Documentation:

- [Statistical Paper](#)
- [Technical Annex](#)

Indicator-specific webpage to download data and metadata:

- [Sustainable finance indicators](#)
- [Carbon emission indicators](#)
- [Physical risk indicators](#)

Contact us at: statistics@ecb.europa.eu

Discussion, Q&A

EUROPEAN CENTRAL BANK

EUROSYSTEM