EUROPEAN CENTRAL BANK
EUROSYSTEM

# Towards climate-related statistical indicators

## Technical Annex

This annex provides all the technical details needed to understand and use the various experimental and analytical climate change indicators compiled by the European Central Bank (ECB). It also allows users, subject to access to the appropriate source data, to reconstruct the indicators. The information will be updated in line with methodological improvements.

## 1 Experimental indicators on sustainable finance

### 1.1 Issuance of debt securities

#### 1.1.1 Indicator description

The following sustainability classifications have been added to the Securities Issues Statistics (CSEC):

- Green (GRE) – debt securities where the proceeds are used to finance green projects;
- Social (SCL) – debt securities where the proceeds are used to finance social projects;
- Sustainability (STN) – debt securities where the proceeds are used to finance a combination of both green and social projects;
- Sustainability-linked (STL) – debt securities where the issuers are committed to future improvements in sustainability outcome(s) with no restrictions on how the proceeds can be used.

Initially, four groups of experimental indicators are being published:

- the amount outstanding of euro area and EU issuances of sustainable debt securities by sustainability classification: total amount outstanding (at face, nominal and market value) of all sustainable debt securities issued by residents in the euro area (EA) and/or European Union (EU), broken down by sustainability classification;
- the amount outstanding of EA issuances of green debt securities by institutional sector: total amount outstanding (at face, nominal and market value) of green

debt securities issued by residents in the EA broken down by institutional sector;

- the amount outstanding of issuances of green debt securities by individual EA country: total amount outstanding (at face, nominal and market value) of green debt securities issued by individual EA countries;
- net EA issuances (financial transactions) of green debt securities: net issuances (at face and market value) of green debt securities issued by residents in the EA.

### 1.1.2 Limitations and constraints

The indicators are calculated, taking into account all sustainable debt securities, irrespective of the level of assurance, i.e. whether they are “self-labelled”, or also include a “second-party opinion” or are “certified”.

In addition, the underlying standard/framework against which the sustainability classification of the sustainable debt security is aligned (e.g. International Capital Market Association (ICMA) or Climate Bonds Initiative (CBI)) is not used to restrict the universe. In other words, all standards are considered, including (a very minor number of) securities without a recognised standard.

Both dimensions will be considered to restrict the universe of eligible sustainable debt securities in subsequent extensions of the indicators.

### 1.1.3 Code list

CUST_BREAKDOWN

| Code | Label |
|---|---|
| GRE | Green |
| SCL | Social |
| STN | Sustainability |
| STL | Sustainability-linked |

The full code list for the CSEC dataset is available in the metadata section of the ECB Statistical Data Warehouse.

### 1.1.4 Data sources

Centralised Securities Database (CSDB)

### 1.1.5 Compilation method

Sum of all debt securities issuances labelled green, social, sustainability or sustainability-linked. The indicators are calculated directly from the CSDB as part of the CSEC compilation. All calculations are based on attributes associated with individual securities, which are then used to calculate aggregate series.

### 1.1.6 Periodicity/update frequency

Data are published at a monthly frequency and disseminated at around t+10 working days after the end of the reference month.

### 1.1.7 Contact

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## 1.2 Holdings of debt securities

### 1.2.1 Indicator description

As for the issuance of sustainable debt securities, the following sustainability classifications will also be available for securities holdings statistics by sector (SHSS):

- Green (GRE) – debt securities where the proceeds are used to finance green projects;
- Social (SCL) – debt securities where the proceeds are used to finance social projects;
- Sustainability (STN) – debt securities where the proceeds are used to finance a combination of both green and social projects;
- Sustainability-linked (STL) – debt securities where the issuers are committed to future improvements in sustainability outcome(s) with no restrictions on how the proceeds can be use.

Initially, five groups of experimental indicators are being published:

- EA holdings of sustainable debt securities by sustainability classification and counterpart area: total holding amount (at face and market value) of all sustainable debt securities held by residents in the EA, broken down by sustainability classification and counterpart issuing area (EA, EU, Rest-of-the-world and Total);

- EA holdings of green debt securities by institutional sector: total holding amount (at face and market value) of green debt securities held by residents in the EA, broken down by institutional sector;
- holdings of green debt securities by individual EA country: total holding amount (at face, nominal and market value) of green debt securities, broken down by individual EA country;
- net EA acquisitions (financial transactions) of green debt securities: total net acquisitions (at market value) of green debt securities issued by residents in the EA.

### 1.2.2 Limitations and constraints

The indicators are calculated, taking all sustainable debt securities into account, irrespective of the level of assurance, i.e. whether they are “self-labelled”, or also include a “second-party opinion” or are “certified”.

In addition, the underlying standard/framework against which the sustainability classification of the sustainable debt security is aligned (e.g. ICMA or CBI) is not used to restrict the universe. In other words, all standards are considered, including (a very minor number of) securities without a recognised standard.

Both dimensions will be considered to restrict the universe of eligible sustainable debt securities in subsequent extensions of the indicators.

### 1.2.3 Code list

CUST_BREAKDOWN

| Code | Label |
|---|---|
| GRE | Green |
| SCL | Social |
| STN | Sustainability |
| STL | Sustainability-linked |

The full code list for the SHSS dataset is available in the metadata section of the ECB Statistical Data Warehouse.

### 1.2.4 Data sources

Centralised Securities Database (CSDB)

### 1.2.5 Compilation method

The sum of all debt securities held and labelled green, social, sustainability or sustainability-linked in the CSDB. The indicators are calculated directly from the CSDB as part of the SHSS compilation. All calculations are based on attributes associated with individual securities, which are then used to calculate aggregate series.

### 1.2.6 Periodicity/update frequency

Data are published on a quarterly basis and disseminated at around t+2 months after the end of the reference quarter.

### 1.2.7 Contact

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## 2 Analytical indicators on carbon emissions

## 2.1 Emission indicators (loans – single entity level)

### 2.1.1 Indicator description

Carbon emission indicators from loans to euro area non-financial corporations are compiled at a single entity level.

The following indicators are available:

- financed emissions (FE) – the volume of weighted carbon emissions; the weight is equal to the percentage share of the investment held by financial institutions in a private company;
- carbon intensity (CI) – the volume of carbon emissions per million euro of revenue; calculated as the ratio between the weighted sum of emissions and the weighted sum of the emitter's revenues; the weight is equal to the percentage share of the investment held by financial institutions in a private company, both for the numerator and the denominator;
- weighted average carbon intensity (WACI) – the weighted sum of carbon emissions per million euro of revenue; the weight is equal to the percentage share of the investment in a private company in the portfolio value;

- carbon footprint (CFP) – carbon emissions per million euro invested by the financial institutions; calculated as the ratio between financed emissions and the portfolio value.

Components:

- The current value of the investment/value of the portfolio – all loans and lines of credit for general corporate purposes to non-financial companies that are on the balance sheet of the financial institution and have a nominal value above €25,000.
- Company value – total assets.
- Issuer's Scope 1 (i.e. only direct) greenhouse gas (GHG) emissions – verified CO2 equivalent emissions (EU ETS) for companies participating in the EU ETS; imputed emissions (air emissions accounts) for remaining companies.
- The issuer's revenue – invoicing-based turnover.

Coverage:

- Instruments and creditors – loans with a nominal value above €25,000 from credit institutions (S122).
- Debtors – non-financial corporations (S11).
- The average coverage of total outstanding nominal amount with balance sheet and emission information is 47% for the euro area across the years (2018, 2019 and 2020). Coverage figures are published together with the respective indicators.

Available breakdowns:

- Euro area and selected country-level aggregates by reference year.

### 2.1.2 Limitations and constraints

Data-related aspects:

- Owing to limited availability of single entity emission data, all indicators only consider lending within the euro area.
- Emission and balance sheet information are not available for the full loan population, and this therefore leads to bias in the intertemporal results for both absolute and relative indicators.
- The total assets and revenue information of firms is affected by valuation effects, including price (i.e. inflation) and exchange rate effects.

- Total assets and revenue data are imputed when single entity data is unavailable. This procedure is shared with the analytical indicators on physical risks described below.[1]

- Owing to a lack of source data, emissions for firms outside of the EU ETS are imputed using the number of employees at sector level when available (see below). Overall, the average share of imputed emissions across the three years for the euro area is 49%.[2]

Limitations related to the FE indicator:

- Owing to the limited coverage of the full loan population with regard to the emission and balance sheet information, financed emissions need to be understood as the lower bound of actual financed emissions.

- Because emissions are not normalised, when used to compare banks or portfolios, it is not possible to disentangle differences as a result of bank/portfolio size from differences deriving from the emissions themselves.

- The indicator is not normalised by the production value of the firm and hence leaves out efficiency considerations.

Limitations related to the CI, WACI and CFP indicators:

- The data are sensitive to exposures to companies with volatile input prices, for example owing to a high energy component.

- The data are sensitive to outliers and composition changes in the underlying sample. This is particularly the case for WACI.

- Owing to the limited coverage of the full securities population with regard to the emission and balance sheet information, an assumption is made that the covered sample is representative in terms of carbon intensity and carbon footprint.

1 As outlined in Section 3, balance sheet information for total assets and revenues from Orbis is available for between 28-32% of the relevant RIAD entities (see procedure in Section 2.1.5). In general, the overlap between RIAD and Orbis is around 40%. After imputation, the coverage rates for the balance sheet variables are around 84% of the relevant RIAD entities.

2 The imputation share is calculated as the three-year average of 1-(total euro area emissions using EU ETS data/total imputed euro area emissions).

### 2.1.3 Code list

| Name | Description |
|---|---|
| **indicator_class** | Indicator class |
| **ghg_protocol_class** | Scope of covered emissions according to GHG protocol |
| **holder_creditor_country** | Euro area country of holder or creditor |
| **year** | Year of transaction |
| **holder_creditor_sector** | Sector of the holder/creditor |
| **issuer_debtor_sector** | Sector of the issuer/debtor |
| **status_flag** | Status flag for data row |
| **financial_instrument** | Financial instrument |
| **fe** | Financed emissions indicator (tons) |
| **cint** | Carbon Intensity indicator (tons/ mn EUR) |
| **waci** | Weighted Average Carbon Intensity indicator (tons/ mn EUR) |
| **cfp** | Carbon Footprint indicator (tons/ mn EUR) |
| **holder_creditor_country_coverage** | Coverage of country nominal outstanding amount or market value with emission and financial data (%) |

For additional metadata, please refer to the statistical metadata file for the analytical carbon emission indicators.

### 2.1.4 Data sources

Analytical Credit Dataset (AnaCredit)

EU Emissions Trading System (ETS)

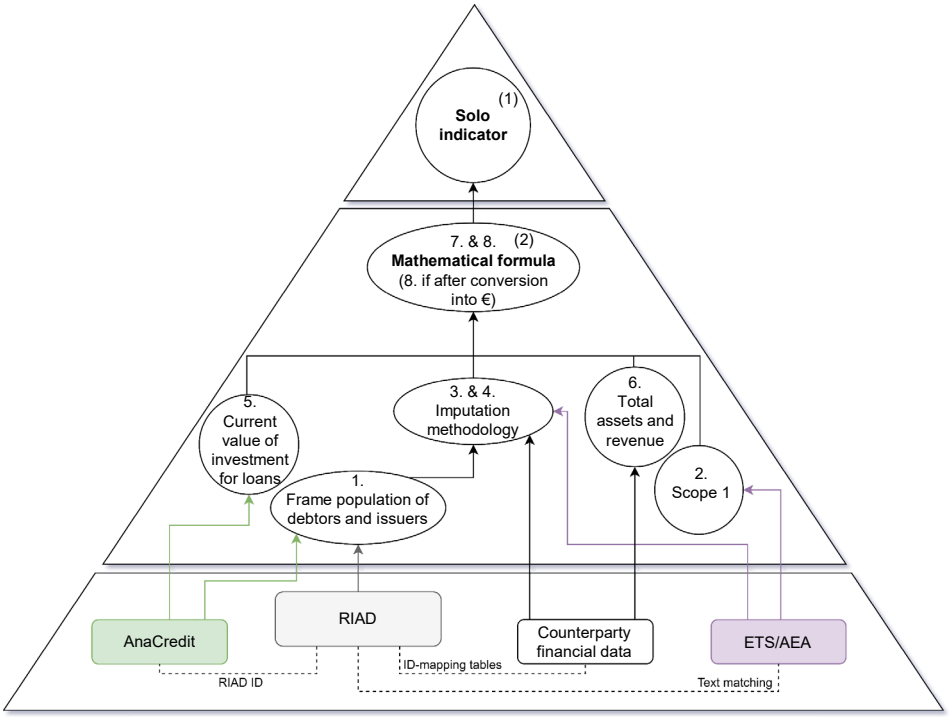
Eurostat Air Emissions Accounts (AEA)

Eurostat national accounts employment data

Register of Institutions and Affiliates Data (RIAD)

Orbis by Bureau van Dijk

## 2.1.5 Compilation method




| Indicator | Mathematical formula |
|---|---|
| **Financed emissions (FE)** | $FE_{b,s} = \sum_{i \in s} \left( \frac{investment_{b,i}}{total\ assets_i} \times company\ GHG\ Scope\ 1\ emissions_i \right)$ |
| **Carbon intensity (CI)** | $CI_{b,s} = \frac{FE_{b,s}}{\sum_{i \in s} \left( \frac{investment_{b,i}}{total\ assets_i} \times revenue_i \right)}$ |
| **Weighted average carbon intensity (WACI)** | $WACI_{b,s} = \sum_{i \in s} \left( \frac{investment_{b,i}}{portfolio\ value_{b,s}} \times \frac{company\ GHG\ Scope\ 1\ emissions_i}{revenue_i} \right)$ |
| **Carbon footprint (CFP)** | $CFP_{b,s} = \frac{FE_{b,s}}{portfolio\ value_{b,s}}$ |
| **Portfolio value** | $portfolio\ value_{b,s} = \sum_{i \in s} investment_{b,i}$ |

(1) RIAD at EU/euro area level is used for a frame population of debtors/issuers.

(2) EU ETS data on Scope 1 emissions are used where available. For debtors/issuers not included in EU ETS, the Scope 1 emissions are imputed using a waterfall model.

(3) and (4) The waterfall imputation methodology uses air emission accounts (AEA) for Scope 1 emissions whenever there is a lack of EU ETS data. In the absence of EU ETS data, sector-level AEA Scope 1 emissions are attributed to a single entity in proportion to the entity's employment share in the given sector. Therefore, the imputation procedure in turn requires the availability of employment data and a

sector classification and hence can only be conducted to the extent that this information is jointly available.

(5) Current value of investment for loans (outstanding amounts of domestic and euro area loans) is acquired from AnaCredit.

(6) Company value is proxied by total assets acquired from Orbis. When no firm-level information is available, both revenue and total assets are imputed using size classes (number of employees) at sector level. If no size class information is available, the methodology assumes the smallest size class.

(7) The mathematical formulae used to derive the indicators (see table).

### 2.1.6 Periodicity/update frequency

A new data point will be published at an annual frequency and disseminated in due time after the end of the reference period. A revision of the data may occur every six months.

### 2.1.7 Contact

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## 2.2 Emission indicators (listed shares and debt securities – group level)

### 2.2.1 Indicator description

Carbon emission indicators of listed shares and debt securities issued by non-financial corporations are compiled at group level.

The following indicators are available:

- financed emissions (FE) – the volume of weighted carbon emissions. The weight is equal to the percentage share of the investment held by financial institutions in a private company;
- carbon intensity (CI) – the volume of carbon emissions per million euro of revenue; calculated as the ratio between the weighted sum of emissions and the weighted sum of emitters' revenues; the weight is equal to the percentage share of the investment held by financial institutions in a private company, both at the numerator and the denominator;

- weighted average carbon intensity (WACI) – the weighted sum of carbon emissions per million euro of revenue; the weight is equal to the percentage share of the investment in a private company in the portfolio value;
- carbon footprint (CFP) – carbon emissions per million euro invested by the financial institutions; calculated as the ratio between financed emissions and the portfolio value.

Components:

- Investment: Market value of listed shares and debt securities (excluding short positions) issued by a non-financial corporation and held by euro area financial institutions.
- Portfolio value: Sum of market value (excluding short positions) of listed shares and debt securities issued by non-financial corporations and held by euro area financial institutions.
- Company value: Enterprise value including cash (EVIC), i.e. the market capitalisation of ordinary and preferred shares at fiscal year-end plus the book values of total debt and minority interests. When EVIC is not available, enterprise value (EV) or total assets are used as a proxy.
- Issuer's Scope 1 (or Scope 2) GHG emissions: CO2 equivalent emissions as reported by companies disclosing such information.
- Issuer's revenue: invoicing-based turnover.

Coverage:

- Instruments: Securities (listed shares and debt securities) held by deposit-taking corporations except the central bank (S122), non-MMF investment funds (S124), insurance corporations and pension funds (S128+S129).
- Issuers: non-financial corporations (S11).

Available breakdowns:

- Euro area and selected country-level aggregates by financial instrument, sector of the holder, scope of emissions and reference year.

### 2.2.2 Limitations and constraints

Data-related aspects:

- Emission and balance sheet information are not available for the full securities issuers population, and this therefore biases intertemporal results for both absolute and relative indicators.

- The market value of listed shares and debt securities, and company value and revenue information of firms are affected by valuation effects, including price (i.e. inflation) and exchange rate effects.

Limitations related to the FE indicator:

- Due to the limited coverage of the full securities population with regard to the emission and balance sheet information, financed emissions need to be understood as the lower bound of actual financed emissions. In addition, heterogeneity in coverage across countries do not allow a cross-country comparison of financed emissions.

- Abstracting from cross-country heterogeneity in coverage, because emissions are not normalised, it is not possible to disentangle differences due to financial sector/portfolio size from differences deriving from the emissions themselves when comparing financed emissions across countries.

Limitations related to relative indicators (CI, WACI and CFP):

- Owing to the limited coverage of the full securities population with regard to the emission and balance sheet information, the assumption is that the covered sample is representative in terms of carbon intensities and footprint.

- The indicators may be sensitive to outliers and composition changes in the underlying sample. This is particularly the case for WACI.

Limitations related to all indicators:

- The indicators may be sensitive to changes in market prices, which affect the market value of securities and company values.

### 2.2.3 Code list

| Name | Description |
|---|---|
| **indicator_class** | Indicator class |
| **ghg_protocol_class** | Scope of covered emissions according to GHG protocol |
| **holder_creditor_country** | Euro area country of holder or creditor |
| **year** | Year of transaction |
| **holder_creditor_sector** | Sector of the holder/creditor |
| **issuer_debtor_sector** | Sector of the issuer/debtor |
| **financial_instrument** | Financial instrument |
| **status_flag** | Status flag for data row |
| **fe** | Financed emissions indicator (tons) |
| **cint** | Carbon Intensity indicator (tons/ mn EUR) |
| **waci** | Weighted Average Carbon Intensity indicator (tons/ mn EUR) |
| **cfp** | Carbon Footprint indicator (tons/ mn EUR) |
| **holder_creditor_country_coverage** | Coverage of country nominal outstanding amount or market value with emission and financial data (%) |

For additional metadata, please refer to the statistical metadata file for the analytical carbon emission indicators.

### 2.2.4 Data sources

Securities holdings statistics (SHSS)

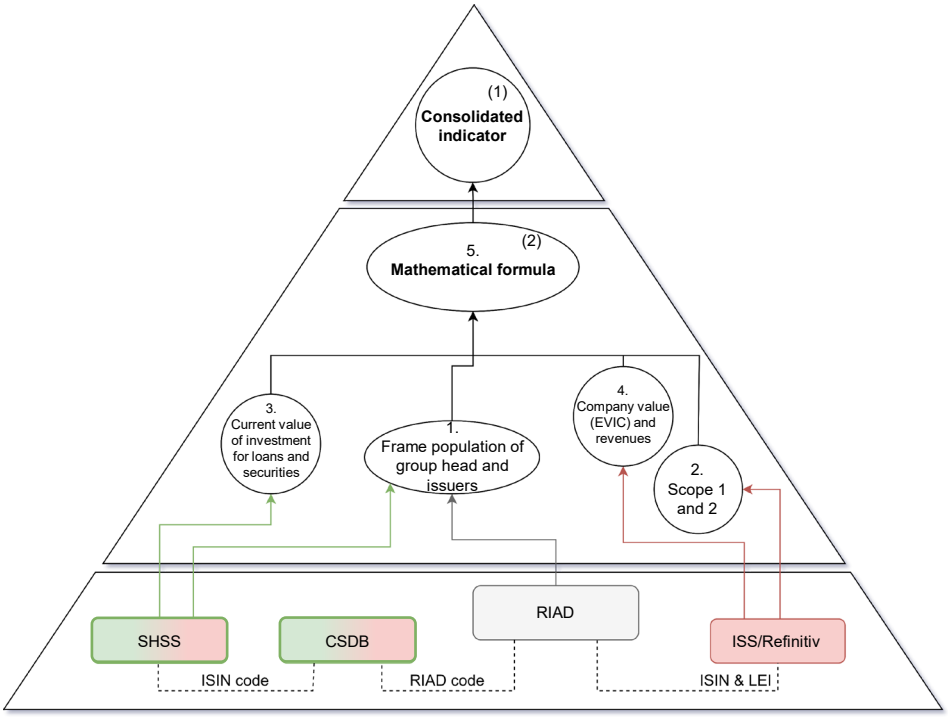
Centralised securities database (CSDB)

Register of Institutions and Affiliates Data (RIAD)

Institutional Shareholder Services (ISS)

Refinitiv

## 2.2.5 Compilation method




| (1) Indicator | (2) Mathematical formula |
|---|---|
| **Financed emissions (FE)** | $FE_{b,s} = \sum_{i \in s} \left( \frac{investment_{b,i}}{company\ value_i} \times company\ GHG\ emissions_i \right)$ |
| **Carbon intensity (CI)** | $CI_{b,s} = \frac{FE_{b,s}}{\sum_{i \in s} \left( \frac{investment_{b,i}}{company\ value_i} \times revenue_i \right)}$ |
| **Weighted average carbon intensity (WACI)** | $WACI_{b,s} = \sum_{i \in s} \left( \frac{investment_{b,i}}{portfolio\ value_{b,s}} \times \frac{company\ GHG\ emissions_i}{revenue_i} \right)$ |
| **Carbon footprint (CFP)** | $CFP_{b,s} = \frac{FE_{b,s}}{portfolio\ value_{b,s}}$ |
| **Portfolio value** | $portfolio\ value_{b,s} = \sum_{i \in s} investment_{b,i}$ |

(1) RIAD at the EU/euro area level is used for a frame population of the group heads of the issuers. Securities holdings statistics at sectoral level (SHSS) for euro area financial institutions are used for a frame population of issuers. The matching is conducted via CSDB using ISIN and RIAD codes.

(2) Self-reported emissions (Scopes 1 and 2) are obtained from commercial data providers (ISS, where available complemented by data from Refinitiv).

(3) Investment value for securities (market value of listed shares and debt securities issued by non-financial companies and held by euro area financial institutions) is acquired from SHSS.

(4) Company value and revenue are acquired from ISS/Refinitiv.

(5) The mathematical formulae for the indicators (see table).

### 2.2.6 Periodicity/update frequency

A new data point will be published at an annual frequency and disseminated in due time after the end of the reference period. A revision of the data may occur every six months.

### 2.2.7 Contact

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## 3 Analytical indicators on physical risks

## 3.1 Expected annual loss-based indicators for equity, bonds and loans

### 3.1.1 Indicator description

The indicator provides a measure of portfolio at risk of financial institutions via their loans, debt and equity exposures to non-financial corporations located in areas susceptible to various physical risks.

- Normalised exposure at risk (NEAR): Each debtor/issuer exposure is weighted by a financial risk ratio – which puts the expected annual losses (EAL) of hazard events in perspective with measures of financial performance (revenues) or company size (total assets).

Components:

- Hazard Data: coastal floods, river floods, windstorms.
- Current value of the investment/value of the portfolio: All loans and lines of credit for general corporate purposes to non-financial EA-based companies that are on the balance sheet of the financial institution and have a nominal value above €25,000 as well as bond and equity holdings of EA-based non-financial companies.
- Location information of around 12 million legal entities.
- Group head ID.
- Balance sheet: total assets, tangible fixed assets and revenues.

- Damage functions as a link between hazards and exposures.
- Data and land cover types, as well as building characteristics.

Coverage:

- Hazard maps cover between 90-100% of RIAD entities, depending on the hazard type.
- Balance sheet information for tangible fixed assets, total assets and revenues from Orbis is available for between 28-32% of the relevant RIAD entities.[3] After imputation (see Section 3.1.5) coverage rates for the three variables are around 84%.

Breakdowns for euro area:

- Creditor/holder sectors: commercial banks (S122), investment funds (S124), insurance corporations & pension funds (S128/S129).
- Instrument type: equity, debt securities, loans.
- Debtor/Issuer NACE in seven categories: 1 Primary production, 2 Manufacturing, 3 Energy, 4 Construction, 5 Trade, 6 Transport, 7 Services.
- Debtor/issuer area: domestic/foreign.

Breakdowns for single countries:

- Creditor/holder sectors: total
- Instrument type: total
- Debtor/Issuer NACE: total
- Debtor/issuer area: total

### 3.1.2 Limitations and constraints

Data-related aspects:

- Owing to limited availability of some of the hazard data, all indicators only consider lending within the euro area.
- The location information of firms is based on RIAD, which collects information at the level of the legal entity and of one branch per country. Consequently, in case of multiple locations of a single company (e.g. production sites that are at a different location from the headquarters), the information necessary for a full assessment of physical risk is not currently available.

[3] Since the overlap between RIAD and Orbis is only around 40%, that constitutes the upper limit of the coverage.

- At this stage, neither risk transmission mechanisms across financial sectors (e.g. insured assets) nor collateral are taken into account.
- The current methodology does not account for present or future mitigation or adaptation measures, such as dikes to prevent flooding. Moreover, the insurance of assets is not considered in the current indicators.
- For five of the seven indicators (coastal floods, river floods, windstorms, landslides, subsidence) only current hazard profiles are available. For water stress and wildfire, projected data are available for 2030 and 2030-2050 respectively.

Limitations related to the NEAR indicator:

- The indicators only account for the direct damage to assets (and not for production interruptions, increased cost of operations or damages in the supply chain).
- Total assets, tangible fixed assets and revenue data are imputed when single entity data is unavailable (see Section 3.1.5 for imputation methodology).

### 3.1.3 Code list

| Name | Description |
|---|---|
| **holder_creditor_country** | The euro area country where the holder or creditor is based |
| **holder_creditor_sector** | The sector in of the holder/creditor |
| **issuer_debtor_sector** | Sector of the issuer/debtor sector |
| **issuer_debtor_region** | Region of the Issuer/Debtor |
| **financial_instrument** | Financial Instrument under consideration |
| **hazard** | Natural hazard event |
| **near_indicator_asset** | Normalised exposure at risk indicator, normalized by total assets |
| **near_indicator_revenue** | Normalised exposure at risk indicator, normalized by revenues |
| **near_mioEur_asset** | Normalised exposure at risk indicator in million euro, normalized by total assets |
| **near_mioEur_revenue** | Normalised exposure at risk indicator in million euro, normalized by total revenues |

For additional metadata, please refer to the statistical metadata file for the analytical carbon emission indicators.

### 3.1.4 Data sources

Analytical Credit Dataset (AnaCredit)

Securities holdings statistics (SHSS)

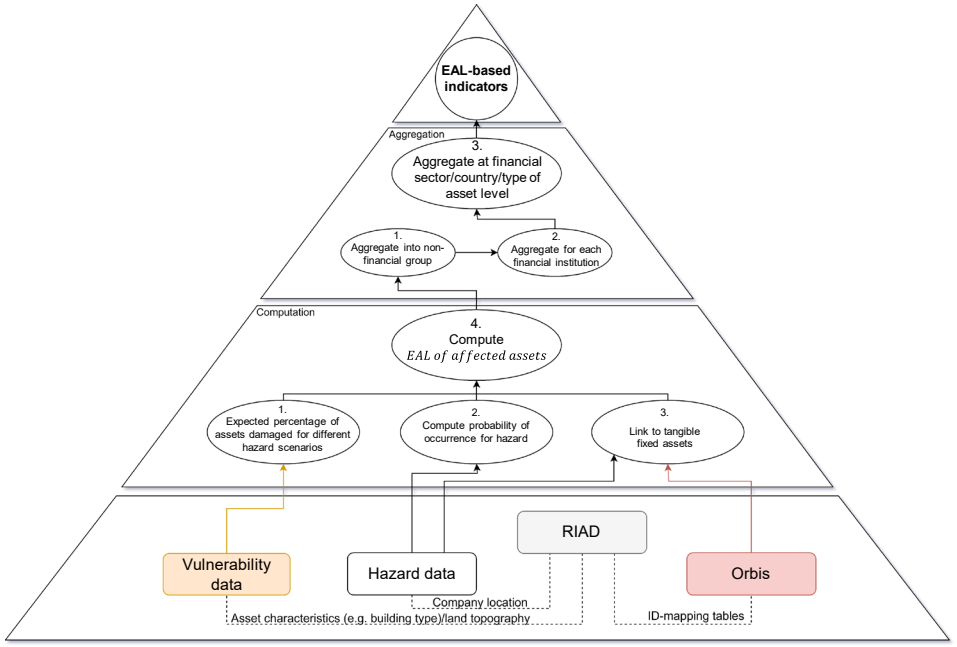
Register of Institutions and Affiliates Data (RIAD)

Orbis by Bureau van Dijk (non-financial corporation tangible assets and revenues)

Joint Research Centre of the European Commission,(coastal and river flooding)

Copernicus, ECB calculations (windstorms)

### 3.1.5 Compilation method




**Baseline specification (NEAR indicator based on revenue)**

*I/EAL computation:*

1. JRC damage functions[4] (for example water depth associated with financial damage) are joined to each RIAD entity by hazard intensity type and land cover type.

2. Company value is proxied by total assets acquired from Orbis. When no firm-level information is available, both revenue and total assets are imputed using size classes (number of employees) at sector level. If no size class information is available, the methodology assumes the smallest size class.

3. Hazard data (including return periods) are linked to tangible assets (from Orbis) of non-financial corporation i (identified via RIAD).

[4] See: Huizinga, J., De Moel, H. and Szewczyk, W., Global flood depth-damage functions: Methodology and the database with guidelines, EUR 28552 EN, Publications Office of the European Union, Luxembourg, 2017 for country level estimates. Damage function for windstorms was developed internally (see Annex 7 for details).

4. The probability pb for an extreme weather event to occur is calculated by using the given return periods of the event. A return period gives the number of years that a hazard of a certain intensity will occur under given climate scenarios/conditions. The available return periods differ according to the hazard.

5. Computation of estimated annual losses (in euro millions) at the RIAD code level: $EAL_i = \sum_{rp} dmf_{rp,i}\ x\ assets_i\ x\ pb_{rp}$, where dmf is the damage function of company i which depends on a hazard intensity, assets are the tangible assets of company i.

*II/Aggregation steps (NEAR indicator):*

1. Subsidiary-level EAL are aggregated into non-financial group head-level EAL, these are then normalised by (total group) revenues or total assets (in euro millions):

$$FINANCIAL\ RISK\ RATIO_i = \frac{EAL_i}{NORMALISATION\ VARIABLE_i}$$

2. $Financial\ risk\ ratio\ of\ group$ is multiplied for the share of the financial exposure of the group.

3. Values obtained at point II.2 are finally aggregated at creditor sector, creditor country, type of instrument, debtor NACE and debtor NUTS3.

$$NEAR = \frac{\sum_{i=1}^{N_C}(FINANCIAL\ RISK\ RATIO_i \cdot EXPOSURE_i)}{\sum_{i=1}^{N_C}(EXPOSURE_i)} \cdot 100$$

### Other specifications

NEAR indicator (alternative): normalised with total assets. $Total\ assets_i$ (in euro millions) is used instead of $Revenue_i$ at step II.1.

Where:

- $i$ is the debtor at group level (or individual level for entities without subsidiaries/branches reported);
- $EXPOSURE_i$ is the exposure toward the debtor $i$ (in euro millions);
- $EAL_i$ is the expected annual loss (EAL) of debtor $i$(in euro millions).

Note that the EAL corresponds to the expected financial losses debtor/issuer in the non-financial corporations' sector (S11) stemming from the damages caused by physical hazards. The indicator relates to expected losses for 2020.

### 3.1.6 Periodicity/update frequency

A new data point will be published at an annual frequency and disseminated in due time after the end of the reference period. A revision of the data may occur every six months.

### 3.1.7 Contact

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## 3.2 Score-based indicators for equity, bonds and loans

The indicators provide information on the share of financial institutions' portfolios exposed to non-financial corporations located in areas susceptible to various physical risks.

### 3.2.1 Indicator description

- Potential exposure at risk (PEAR): The PEAR indicator gives information on the total amount exposed to some type of natural hazard. It does not differentiate whether the probability or the intensity of the hazard event is high or low.
- Risk scores: Risk scores classify the potential exposure risk into four categories from 0 (no risk) to 3 (high risk). The identification of the risk groups is based on the expected intensity and probability of a hazard event at a specific location, thus not comparable across all hazards.

Components:

- Hazard Data: coastal floods, river floods, windstorms, wildfire, water stress, subsidence, landslides.
- Current value of the investment/value of the portfolio: All loans and lines of credit for general corporate purposes to EA-based non-financial companies that are on the balance sheet of the financial institution and have a nominal value above €25,000, as well as bond and equity holdings of non-financial EU-based companies.
- Location information of around 12 million legal entities.

Breakdowns for euro area:

- Creditor/holder sectors: commercial banks (S122), investment funds (S124), insurance corporations & pension funds (S128/S129).
- Instrument type: Equity, debt securities, loans.

- Debtor/Issuer NACE in seven categories: 1 Primary production, 2 Manufacturing, 3 Energy, 4 Construction, 5 Trade, 6 Transport, 7 Services.
- Debtor/issuer area: domestic/foreign.

Breakdowns for single countries:

- Creditor/holder sectors: total
- Instrument type: total
- Debtor/Issuer NACE: total
- Debtor/issuer area: total
- For Estonia, Cyprus, Latvia, Lithuania, Malta, Slovakia and Slovenia (smallest countries in terms of outstanding amounts): only the PEAR indicator is available

Coverage:

- Hazard maps cover between 90-100% of RIAD entities, depending on the hazard type.
- Score and PEAR indicators are computed independently of balance sheet information.

### 3.2.2 Limitations and constraints

Data limitations:

- Owing to limited availability of the hazard data, all indicators only consider lending within the euro area.
- The location information of firms is based on RIAD, which collects information at the level of the legal entity and one branch per country. Consequently, in case of multiple locations of a single company (e.g. production sites that are at a different location from the headquarters), the information necessary for a full assessment of physical risk is not currently available.
- At this stage, neither risk transmission mechanisms across financial sectors (e.g. insured assets) nor collateral are taken into account.
- The current methodology does not account for present or future mitigation or adaptation measures, such as dikes to prevent flooding. Moreover, the insurance of assets is not considered in the current indicators.
- For five of the seven indicators (coastal floods, river floods, windstorms, landslides, subsidence), only current hazard profiles are available. For water stress and wildfire, projected data are available for 2030 and 2030-2050 respectively.

Limitations related to the PEAR indicator:

- The indicator cannot give information about the actual financial loss caused by the physical hazard, since vulnerability data, such as damage functions or implemented mitigation and adaptation, are missing.

Limitations related to score indicators:

- For landslides, subsidence and water stress, the score classification is given by the original sources; for river flooding, coastal flooding and windstorms, it is based on the available damage functions; for wildfire, it is classified according to the size of the expected area burned of the total area. It is therefore not possible to compare the score classes recorded for different hazards.

### 3.2.3 Code list

| Name | Description |
|---|---|
| **holder_creditor_country** | The euro area country where the holder or creditor is based |
| **holder_creditor_sector** | The sector in of the holder/creditor |
| **issuer_debtor_sector** | Sector of the issuer/debtor sector |
| **issuer_debtor_region** | Region of the Issuer/Debtor |
| **financial_instrument** | Financial Instrument under consideration |
| **hazard** | Natural hazard event |
| **pear_mioEur** | Potential exposure at risk indicator in million euro. |
| **rs_indicator_zero_risk** | Risk Score in % with no risk |
| **rs_indicator_low** | Risk Score in % with low risk |
| **rs_indicator_medium** | Risk Score in % with medium risk |
| **rs_indicator_high** | Risk Score in % with high risk |
| **rs_mioEur_zero_risk** | Risk Score million euro with no risk |
| **rs_mioEur_low** | Risk Score million euro with low risk |
| **rs_mioEur_medium** | Risk Score million euro with medium risk |
| **rs_mioEur_high** | Risk Score million euro with high risk |
| **score_conf** | Indicates confidential values that have been removed from the data set |

### 3.2.4 Data sources

Analytical Credit Dataset (AnaCredit)

Securities holdings statistics (SHSS)

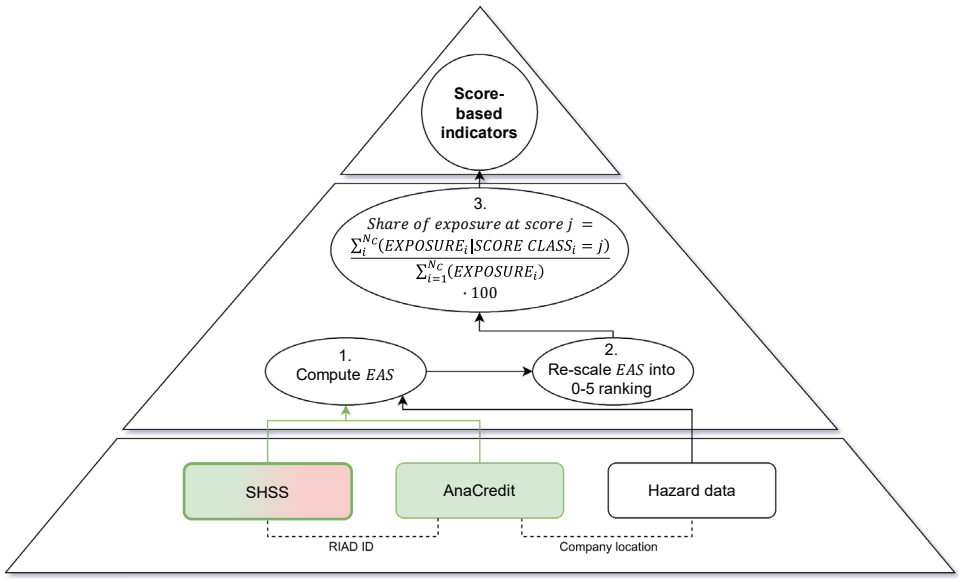
Register of Institutions and Affiliates Data (RIAD)

Joint Research Centre (coastal and river flooding, landslides, subsidence)

Aquaduct – World Resource Institute (water stress)

Copernicus, ECB calculations (windstorm, wildfire)

### 3.2.5 Compilation method




**Baseline specification (risk scores based on simple averages)**

1. For subsidence, water stress and wildfires, physical risk scores are computed as the share of exposure volume classified at score j out of total exposure volume at country/sector/asset level:

$$Share\ of\ exposure\ at\ score\ j = \frac{\sum_i^{N_C}(EXPOSURE_i|SCORE\ CLASS_i = j)}{\sum_{i=1}^{N_C}(EXPOSURE_i)} \cdot 100, where\ j = 0,1,23$$

2. For landslides, coastal and river flooding, and windstorms, different scores are available for different return periods. This requires the computation of an expected annual score:

   - Expected annual score (EAS) at company i level (rp = return period[5]):

$$Expected\ annual\ score_i = \frac{\sum_{rp} prob\ of\ occurrence_{rp} * score_{rp}}{\sum_{rp} prob\ of\ occurrence_{rp}}$$

   - The EAS is re-scaled into a 0-3 ranking (see Section: Statistical definitions).

[5] Common return periods of 10, 50, 100 and 500 years are included in the calculations.

- Physical risk scores are derived as the share of exposure volume classified at score j out of total exposure volume at country/sector/asset level.
- Risk scores (RS) indicators are calculated using simple averages. The scores are calculated at the group head level when multiple entities belong to the same group. The simple average assumes that the risk classes assigned to multiple entities within a group should have identical weights.

Risk scores rank from 0 to 3

| 0 | 1 | 2 | 3 |
|---|---|---|---|
| No risk | Low risk | Medium risk | High risk |

**Baseline specification (PEAR)**

The PEAR indicator does not normalise the EAL. Instead, it is the sum of all financial exposures at non-zero risk, i.e. it calculates the share of the portfolio that is at risk for any RS > 0. The PEAR indicator thus offers a potential ("maximum") value as a basis for the risk score indicators.

The indicator is computed using the following formula:

$$PEAR = \frac{\sum_{i=1}^{N_C}(EXPOSURE_i | \, RS > 0)}{\sum_{i=1}^{N_C}(EXPOSURE_i)} \cdot 100$$

### 3.2.6 Periodicity/update frequency

A new data point will be published at an annual frequency and disseminated in due time after the end of the reference period. A revision of the data may occur every six months.

### 3.2.7 Contact

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