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Climate and collateral: the design and scope of the Eurosystem's climate factor

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Summary

Central banks are increasingly integrating climate considerations into collateral frameworks, with the climate factor proposed by the European Central Bank (ECB) representing the most recent and novel development in this space. Scheduled for implementation in June 2026, the climate factor introduces adjustments to collateral valuations based on assets' exposure to uncertainties around the low-carbon transition. This report examines the climate factor's design and scope, outlining the risk-based case for extending it to credit claims, asset-backed securities (ABS), covered bank bonds and sovereign bonds.

Collateral frameworks are becoming increasingly important as the normalisation of central banks' balance sheets reduces excess reserves in the economy and the use of secured lending operations grows. Collateral rules determine which assets central banks accept and on what terms, influencing asset pricing, funding conditions and issuance incentives. There is evidence that climate risks are insufficiently captured in the credit assessments that determine collateral eligibility and in the market price dynamics that underpin haircut calibration.[1] This could weaken the protection that collateral frameworks are intended to provide to balance sheets.

The ECB's climate factor is a significant innovation in climate-related collateral policy. It is designed to adjust collateral valuations in line with uncertainties related to the low-carbon transition. The climate factor is based on the idea that, as it stands, such uncertainties may not be adequately reflected in the market prices or risk management practices on which a collateral framework relies. These adjustments, which are intended to protect the Eurosystem's balance sheet, will be based on uncertainty scores derived from three elements:[2]

- An issuer-specific exposure reflecting corporate climate scores developed by the ECB.
- A sector-specific stressor drawn from the results of climate stress tests.
- An asset-specific vulnerability based on residual maturity.

The climate factor will apply to non-financial corporate bonds, which constitute a small share of the eligible and pledged collateral in the Eurosystem. Non-financial corporate bonds make up 10% of eligible collateral, and less than 2% of pledged collateral. The currently limited scope of the climate factor may partly result from data challenges that discourage the ECB from extending it to other asset classes. As a result, most pledged collateral is left without a dedicated adjustment to mitigate transition-related uncertainties.

Extending the European Central Bank's climate factor

The risk-based principle behind the climate factor applies to other asset classes in the ECB's collateral framework. The climate factor could be extended to the four largest asset classes by share of pledged collateral: credit claims (29%), ABS (21%), covered bank bonds (29%) and central government securities (9%). Given that the nature of the entity exposed to transition uncertainties differs across asset classes, there are varying rationales for extending the climate factor to each of them, and varying methods for adapting the uncertainty score accordingly. Credit claims may be exposed to low-carbon transition

[1] A haircut is a deduction from the value of an asset, mainly calibrated on market and credit risks that could materialise between the default of the counterparty and the sale of the collateral (ECB, 2015). The applicable haircuts are summarised in tables that group assets by characteristics such as the credit quality step, type of coupon and residual maturity (Guideline 2015/510 of the European Central Bank).

[2] The uncertainty score is then transformed into the climate factor via a formula governed by two parameters set by the ECB's Governing Council, which determine the floor and sensitivity of the adjustment.

uncertainties through the vulnerabilities of borrowers (usually SMEs), which may face heightened default risk. For ABS, transition uncertainties could increase operating costs and reduce the collateral value of homes and vehicles, increasing default rates and losses. For covered bank bonds, the issuing bank itself may be exposed to transition uncertainties while their underlying cover pool faces similar risks to ABS. Lastly, for sovereign bonds, the low-carbon transition may affect fiscal revenues, debt sustainability and sovereign creditworthiness. Therefore, the adapted uncertainty score needs to reflect the respective risks to each asset class.

The uncertainty score could be adapted to each asset class using available data through a phased approach that can accommodate future improvements in data coverage. For credit claims, existing loan-level reporting by banks already provides the sectoral and maturity data needed for two of the three components of the uncertainty score, while a debtor-specific dimension could be phased in with the expansion of climate data on smaller firms. For ABS, exposure depends not on a single issuer but on the energy performance of the underlying assets, such as the houses and vehicles that back securitised loans. Covered bank bonds are exposed to transition uncertainties through the creditworthiness of the issuing bank, and through the underlying asset pool. Political and fiscal sensitivities notwithstanding, the climate factor could, in principle, be extended to sovereign bonds using emerging sovereign climate frameworks.

Design considerations: methodology, scope and transparency

The current methodology of the climate factor involves several design and policy choices that could benefit from further development. The multiplicative structure of the uncertainty score has a clear risk-based rationale: concentrating adjustments in assets with the highest joint exposure. However, as this approach leads to a sharp decline in the overall adjustment when any of the three elements trends towards zero, alternative formulations could affect the distribution of adjustments. Given that green bonds may receive larger adjustments due to their typically longer residual maturities, the ECB could draw on the Hungarian National Bank's experiences with haircut discounts for green securities and the People's Bank of China's preferential collateral treatment of green bonds. Meanwhile, the ECB could begin to integrate physical risk into the scope of the collateral framework, as the Bank of England has through adjustments to mortgage haircuts.

The climate factor could have a positive market impact as a side-effect, but this may depend on the transparency of the policy. Although the climate factor is designed as a risk management tool, any systematic adjustment to collateral valuations has the potential to affect financial markets. The empirical evidence suggests that transparent climate-related adjustments can have measurable effects on asset pricing, whereas opaque adjustments have little or no discernible impact. Therefore, the ECB could support the new policy's market transmission by publishing climate factor values alongside standard haircuts in its list of eligible assets.

1. Introduction: collateral frameworks in a changing macroeconomic context

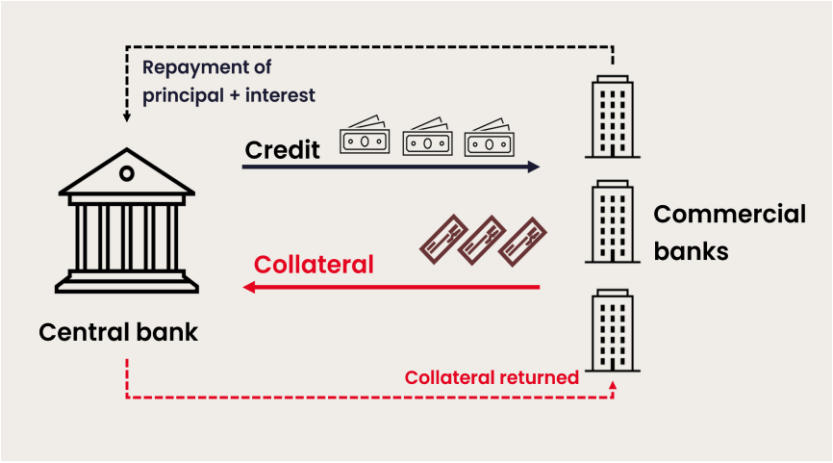
As major central banks shrink their balance sheets, the use of secured lending operations is rising. This means that collateral frameworks are becoming increasingly consequential. Credit assessments and market pricing that fail to adequately capture climate risks could weaken the protection that collateral rules provide to balance sheets. In this report, we explore how the development of the ECB's climate factor could significantly extend climate risk coverage across the Eurosystem's collateral pool.

Collateral frameworks are a core component of monetary policy implementation, as they determine the extent to which eligible financial institutions can access central bank liquidity. To safeguard market functioning and ensure the smooth transmission of monetary policy, central banks provide a variety of short- and long-term lending facilities to counterparties, predominantly commercial banks. Access to these facilities is conditional on the provision of eligible assets, which central banks accept as collateral to protect their balance sheets. Central banks hold these assets for the duration of the loan and, if the counterparty defaults, may sell them to recover funds. The rules and guidelines governing these transactions form collateral frameworks (see Figure 1.1 below).

Collateral frameworks specify a range of risk control measures, most notably eligibility criteria and valuation adjustments known as haircuts. Haircuts reduce the collateral value of assets below their market prices, providing a buffer against price volatility. Both eligibility criteria and haircut calibrations depend on the risk profile of the asset, including its credit rating, type of issuer and residual maturity.

Assets that are eligible as collateral and subject to smaller haircuts tend to be more attractive to market participants. Financial institutions favour assets that can be mobilised to access central bank reserves, especially in environments where access to liquidity is constrained. Therefore, collateral treatment in terms of eligibility and valuation can influence demand for assets and serve as a signal of relative asset risk. Collateral-eligible securities may benefit from a 'collateral premium', reducing funding costs for issuers and influencing issuance incentives.[3] Conversely, larger haircuts or exclusion from collateral frameworks can exert downward pressure on prices in secondary markets (Nguyen, 2020; Pelizzon et al., 2024).

Figure 1.1. Collateral's role in central banks' lending facilities



[3] Nyborg (2016) explains this mechanism by noting that "if central bank money is only available against igloos, or igloo-backed securities, more igloos will be built".

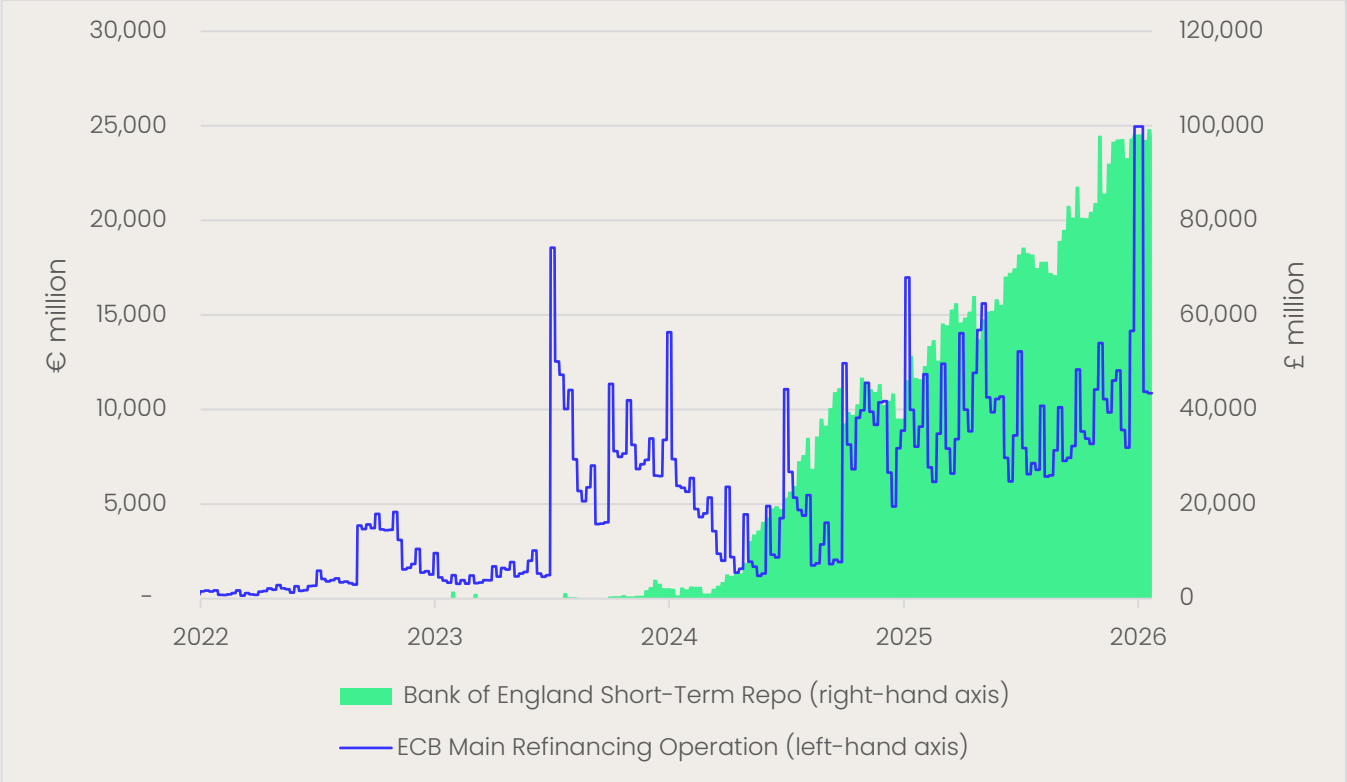
Source: Authors.

In times of financial stress, central banks tend to adjust their collateral requirements to support liquidity provision and monetary policy transmission. For instance, during the 2010–13 sovereign debt crisis in the euro area, the ECB temporarily implemented additional credit claims, allowing financial institutions to pledge credit claims that did not meet the previously established standard criteria. During the COVID-19 pandemic, many central banks eased their eligibility criteria and even haircut calibrations, helping financial institutions access central bank liquidity.[4]

Collateral frameworks become increasingly relevant as central bank balance sheets normalise and excess liquidity declines. As recently noted by the NGFS (2026), the impact of collateral rules decreases during times of abundant reserves, when commercial banks have relatively little need to access lending facilities and, as a consequence, there is less demand for pledgeable assets. However, the normalisation of central banks' balance sheets is shifting the focus of their secured lending operations towards liquidity provision, increasing the importance of collateral eligibility and haircut calibration.

This transition is evident in the Eurosystem and the UK, where fully allotted collateralised facilities have moved their operating frameworks towards a demand-led system (Bank of England [BoE], 2024; Saporta, 2024; Schnabel, 2025). As shown in Figure 1.2, the use of the ECB's Main Refinancing Operation and the BoE's Short-Term Repo facilities has increased since the end of quantitative easing during 2021 and 2022. Although Main Refinancing Operation volumes are still low relative to the size of the Eurozone economy, the ECB expects them to increase as the scarcity of reserves encourages banks to manage liquidity more actively (Iskaki et al., 2026).

Figure 1.2. Increased use of lending facilities at the Bank of England and the European Central Bank



Source: Authors' analysis based on ECB and BoE data. Note: The Short-Term Repo facility was introduced in 2022.

[4] Many monetary authorities eased their collateral frameworks during spring 2020. For instance, the Federal Reserve (2020) expanded the range of eligible assets under its Term Asset-Backed Securities Loan Facility, the Reserve Bank of Australia (RBA, 2020) lowered collateral credit requirements for its Domestic Market Operations and the ECB (2020b) broadened eligibility by including additional credit claims and implementing a general haircut reduction of 20%.

Liquidity conditions and operating frameworks differ across jurisdictions, shaping the extent to which collateralised lending facilities are used. At the People's Bank of China (PBoC), collateralised credit operations form an important part of liquidity management, with many facilities targeted at specific sectors (Ren and Lu, 2026; Li et al., 2023; Guo, 2022). By contrast, the Federal Reserve continues to manage its reserves through purchases of Treasury securities (Federal Reserve, 2025), while potential counterparties remain reluctant to use its Discount Window, a collateralised line of credit, due to the stigma around doing so (Armantier et al., 2026; Gorton et al., 2025; Ennis and Klee, 2023). The Bank of Japan's Complementary Lending Facility has also experienced extremely low usage in recent years (Bank of Japan, 2025). This is a result of the consistently high level of liquidity in the Japanese economy – higher than that in the Eurosystem (Cavallino et al., 2025). Nevertheless, both the Federal Reserve and the Bank of Japan maintain collateralised credit operations that could expand rapidly during periods of market stress.[5]

Given the growing importance of collateral frameworks, it is more vital than ever to understand how they interact with climate risks. Where there is failure to adequately account for these risks in market pricing and the credit assessments that underpin collateral eligibility and haircut calibration, this could weaken the protection that collateral frameworks are intended to provide to balance sheets. Furthermore, climate-related adjustments to collateral policy could have allocative effects that support climate mitigation and adaptation, even when implemented on the basis of risk. This could help mitigate the medium- and long-term financial risks of climate change.[6]

The ECB's climate factor represents the most recent and novel development in the integration of climate-related risks into central banks' collateral frameworks. Announced in July 2025 and scheduled for implementation in June 2026, the climate factor introduces an adjustment to the collateral value of non-financial corporate bonds based on their exposure to uncertainties related to the low-carbon transition. We examine the design and scope of the climate factor, along with its potential for further development. Section 2 explores the rationale behind the design of the climate factor and its impact on collateral valuations. Section 3 outlines the case for extending the climate factor beyond corporate bonds to credit claims, ABS, covered bank bonds and sovereign bonds. Section 4 considers avenues for further research and discussion linked to the methodology and scope of the climate factor, drawing on the experience of central banks other than the ECB. We conclude with a call for transparency in climate-adjusted collateral policy and reflection on priorities for future work.

[5] Most notably, amid the US financial turmoil that followed the failure of Silicon Valley Bank in March 2023, the Federal Reserve allowed collateral valued at par with zero haircuts under the emergency Bank Term Funding Programme (Arseneau et al., 2025).
[6] Central banks with explicit environmental objectives may aim to achieve such effects, but significant changes to collateral policy implemented on the basis of risk can also have allocative side-effects on markets.

2. Design and impact of the ECB's climate factor

This section explores the rationale behind the design of the ECB's climate factor and its impact on collateral valuations. The climate factor will influence the post-haircut collateral value of assets, based on an uncertainty score that draws on risks specific to different sectors, issuers and assets. We estimate the possible range and distribution of the resulting adjustments.

The climate factor emerged as an alternative to previously announced collateral measures that the ECB found challenging to operationalise. The process began in 2020, when the ECB granted eligibility to sustainability-linked bonds – a significant change in a framework that, until then, only accepted bonds with fixed coupons.[7] Following its 2021 Strategy Review, the ECB introduced a climate roadmap that included, among other planned measures, conditionality around compliance with the Corporate Sustainability Reporting Directive (CSRD). In addition to this conditionality, which applied to collateral eligibility, the ECB considered implementing climate-related limits on the concentration of collateral pools. However, many of these measures did not come into effect. The European Commission's Omnibus simplification package undermined the new conditionality by significantly reducing the number of firms covered by the CSRD. In mid-July 2025, the ECB's Governing Council postponed the application of the conditionality, citing EU Member States' incomplete transposition of the CSRD and the ongoing finalisation of amendments to the Omnibus. This followed the Governing Council's rejection of the concentration limits in July 2024, on the basis that they lacked the necessary technical preconditions for implementation. In their place, the Governing Council announced that a climate factor would be developed to integrate uncertainties related to the low-carbon transition into the valuation of corporate collateral (see Figure 2.1). The climate factor partly builds on methodological groundwork that the ECB conducted to tilt corporate bond reinvestments towards issuers with better climate performance.

Figure 2.1. Timeline of ECB climate policies in monetary operations

	2021	2022	2023	2024	2025	2026
Climate plans	First Climate Action Plan			Second Climate Action Plan		
Asset purchases		Net purchases discontinued Tilting of corporate reinvestments		Last corporate reinvestments discontinued		
Collateral	Sustainability-linked bonds made eligible	Climate pool limits announced		Climate pool limits rejected	Climate factor announced	**Climate factor implemented**

Sources: Authors' analysis of ECB press releases.

2.1. The rationale behind the climate factor

The ECB's climate factor is designed to protect the Eurosystem's balance sheet against climate-related uncertainties. Climate-related events present particular challenges for risk management: they are characterised by deep uncertainty and have complex transmission channels that can lead to abrupt and irreversible disruptions (Bank for International Settlements, 2020; Broeder and Schlooz, 2021;

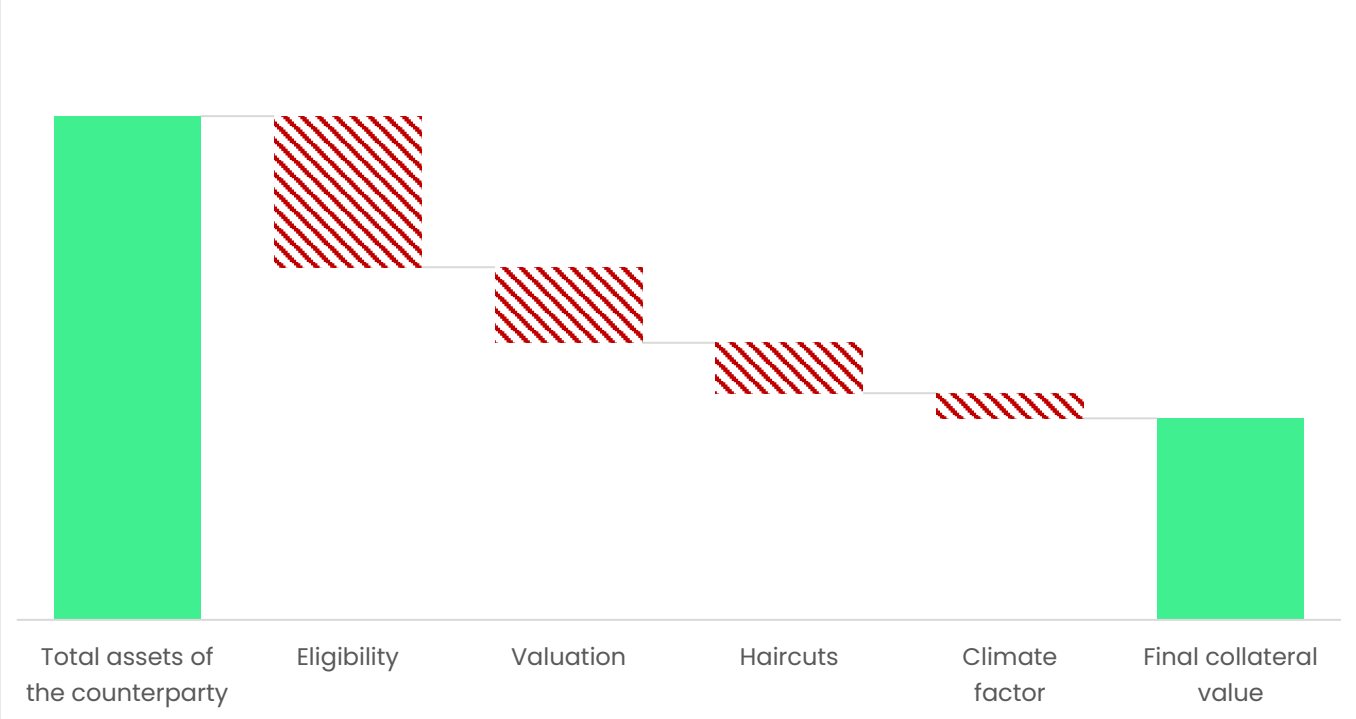
[7] Sustainability-linked bonds, in contrast, are debt instruments whose financial characteristics – such as the coupon – can change depending on whether the issuer meets predefined environmental targets.

Chenet et al., 2021).[8] The climate factor is designed to protect the ECB's balance sheet from such disruptions by mitigating uncertainties related to the low-carbon transition and, in doing so, ensuring that refinancing operations function smoothly.

Existing risk assessment frameworks may not adequately account for uncertainties related to the low-carbon transition. The Eurosystem already employs several risk control measures within its collateral framework, such as eligibility criteria or standard haircuts. These partly rely on the credit assessments of five external credit assessment institutions (ECAIs)[9] and internal credit assessments (ICAs) conducted at seven national central banks.[10] Although both ECAIs and ICAs now account for climate change risks, this rarely leads to rating changes, possibly due to complex diversification strategies that mask vulnerabilities (Piloiu et al., 2025) or short rating horizons (Levy et al., 2022).[11]

The climate factor is designed as an additional layer of protection that leaves the rest of the risk management structure intact. Standard haircuts manage risk through analysis of historical pricing data, whereas the climate factor is forward-looking, relying on climate stress testing to protect against uncertainties that pre-existing tools may not capture. Specifically, the climate factor is designed to address transition-related liquidation price risks that could materialise in the time it takes to sell financial assets in the market. Such risks could involve, for instance, market instability driven by evolving climate legislation, energy price shocks or shifts in consumer preferences. As shown in Figure 2.2, the climate factor is the last step in a series of risk control measures that includes eligibility criteria, the daily valuation of assets and regular haircuts.

Figure 2.2 Risk control measures in the Eurosystem's collateral framework



Source: Adapted from Adler et al. (2023). The climate factor adjustment is added by the authors. Note: The sizes of the bars are illustrative and are not intended to precisely represent the contributions of various factors to the process that determines the final collateral value. The collateral value could be higher relative to the nominal, depending on market prices. When there is no climate factor, *the collateral value will be unaffected after standard haircuts.*

[8] While the distinction between risk and uncertainty is an important one, this report (and ECB communications) sometimes uses the term "transition risk" when discussing the climate factor, in line with the terminology used in non-technical discussions.
[9] Morningstar DBRS, Fitch Ratings, Moody's Ratings, Scope Ratings and S&P Global Ratings.
[10] Specifically, those in Austria, Italy, Portugal, Spain, France, Germany and Greece. The first four have statistical in-house credit assessment systems that also assess climate considerations (Duarte et al., 2025).
[11] The scaling back of reporting requirements under the CSRD Omnibus proposal may further constrain progress in this area.

The climate factor can also be understood through the following formula:

$$V_i^* = (1 - h_i) \cdot V_i^m \cdot CF_i$$

- V_i^m is the market value for asset i.
- h_i is the standard haircut for asset i.
- CF_i is the climate factor for asset i.
- V_i^* is the final collateral value of the asset.

2.2. The design of the climate factor

The climate factor is based on an **uncertainty score** designed to capture transition-related uncertainty at three different layers of asset vulnerability:

$$u_{i,j,s} = V_i \times E_j \times S_s$$

- S is a **sector-specific stressor** – a uniform market factor – derived from the sector-level **expected shortfall** in the last available **Eurosystem climate stress test.** Specifically, it is the increase in the expected shortfall in an adverse transition scenario, relative to a baseline scenario in projections for 2030 (see Box 2.1 below for a more detailed explanation of the last available climate stress test). This metric is the same for all assets issued within each sector and will be periodically updated following each new climate stress test.
- V is an **asset-specific vulnerability** equal to the square root of the asset's **residual maturity.**
- E is an **issuer-specific exposure** based on the **inverse of the climate score** the ECB developed for tilting corporate bond purchases in 2022 (such that issuers with weaker climate performance receive higher exposure values). This metric is the same for all assets issued by the same entity. The corporate climate score is, in turn, derived from three sub-scores:
    - **Backward-looking climate metrics:** past greenhouse gas emissions per unit of revenue, as well as the rate of decarbonisation, drawing from Scope 1 and 2 data at the issuer level, alongside sector-level Scope 3 emissions.[12] (Sectoral Scope 3 emissions are used due to the insufficient quality of data at the firm level.)[13] These metrics combine a best-in-class approach – comparing an issuer with its peers in the same sector – with a best-in-universe approach, comparing an issuer with all companies.
    - **Forward-looking metrics:** expected changes in the issuer's future greenhouse gas emissions. Issuers that had set and adhered to credible and ambitious decarbonisation targets receive higher scores, especially when the targets were science-based and validated by a third party.
    - **Climate disclosures:** completeness and quality of emissions data reported by issuers, preferably verified by third parties. The ECB stated that it does not rely on estimated or modelled data on issuers' emissions.

  If companies failed to report any of the three subcomponents, they received the lowest score. This incentivised them to increase their climate data collection and disclosure. Although the

[12] According to the Greenhouse Gas Protocol developed by WRI and WBCSD, Scope 1 emissions are direct emissions from the company, scope 2 emissions are indirect emissions from purchased electricity, and scope 3 emissions are all indirect emissions occurring in the value chain of the company.

[13] However, Scope 3 emissions can make up the bulk of many firms' emissions. See the TPI Centre's Climate Action 100+ assessments for a list of sectors for which Scope 3 reporting is most important in understanding a company's transition. These include oil and gas, auto manufacturing, mining, food production, chemicals production and the retail sector.

scores were never published by the ECB, a chart (see Figure 2.3) published in the 2023 climate-related financial disclosures showed that the bank's corporate portfolio is concentrated in medium-high climate scores (ECB, 2023).[14]

Figure 2.3. ECB portfolio holdings by issuer score, 20 January 2023

Source: ECB (2023).

Box 2.1. Scenario choice for the sector-specific stressor

As of 2026, the latest available Eurosystem climate stress test is the 2024 Fit-for-55 exercise, which analyses the effect of a sudden repricing of carbon-intensive, or 'brown', assets. The stress test was initiated by the European Commission and conducted jointly by the ECB and the European Supervisory Authorities: the European Banking Authority (EBA), European Insurance and Occupational Pensions Authority (EIOPA) and the European Securities and Markets Authority (ESMA). The stress test assesses the effects of this 'run-on-brown' shock on the EU financial sector in three scenarios:

- **In a baseline scenario, the Fit-for-55 package of policies is implemented without transition shocks.**[15] The EU meets its target of reducing emissions by 55% by 2030 compared to 1990 levels. To reflect the required transition investments, the scenario incorporates the European Commission's estimates of the green investment it needs to make. Long-term macro-financial and energy variables follow the trajectory of Nationally Determined Contributions (NDCs): emissions reduction targets under the 2015 Paris Agreement.

- **In a first adverse scenario, a run-on-brown shock causes gross-value-added (GVA) shocks as high as 8% in some sectors.** In this scenario, investors abruptly sell carbon-intensive assets due to a sudden rise in awareness about climate risks.[16] The degree of carbon intensity is measured as a firm's 'brownness', defined as Scope 1 and 2 emissions divided by revenue. The run-on-brown shock subsequently leads to lower firm profitability, which in turn affects the value that sectors contribute to the economy, measured as GVA shocks. Figure 2.4 shows

[14] For a more detailed analysis of the score methodology and an alternative proposed score, see Dafermos et al. (2023).

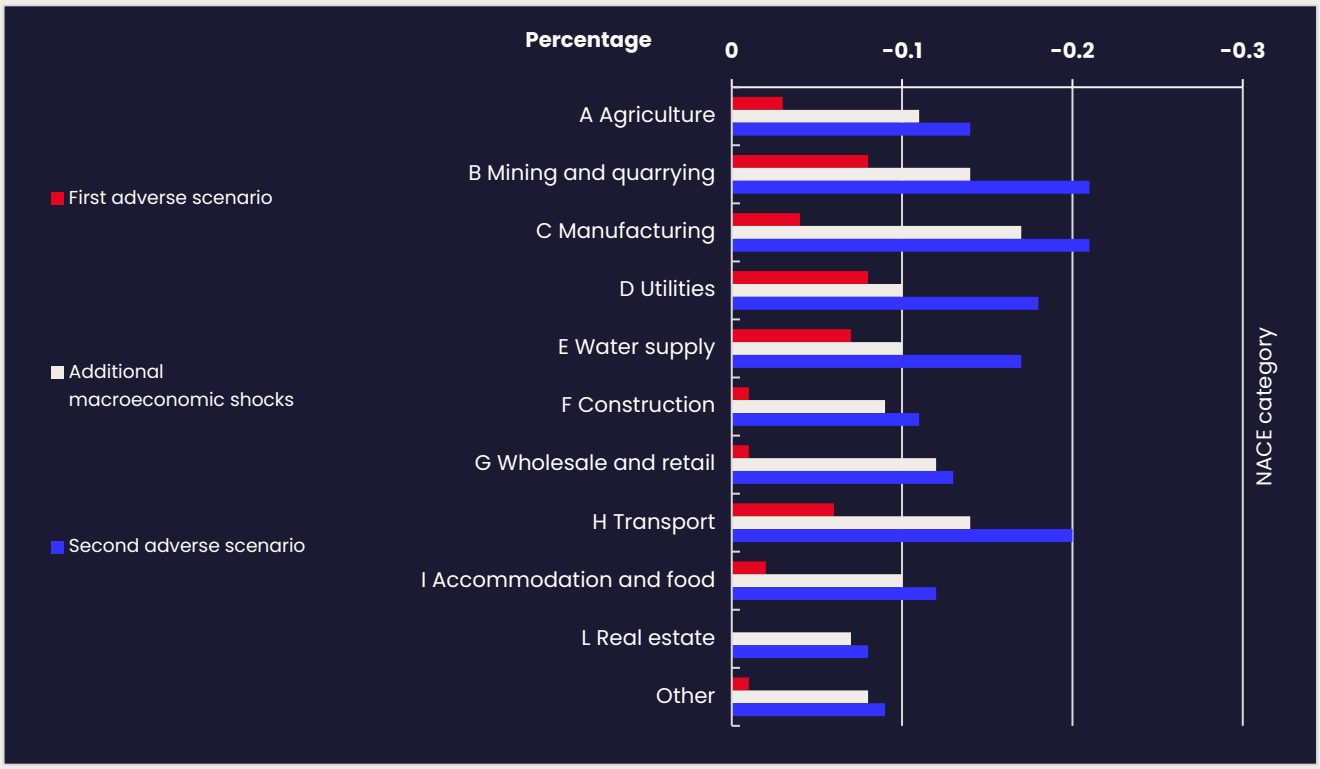
[15] The Energy Taxation Directive has not yet been implemented.

[16] This effect is assumed to take place as follows: "brown" firms see their financial constraints tighten, which affects their profitability and, through credit and market risk, the valuation of financial assets.

the expected GVA shocks in this scenario, in which the mining, utilities and water supply sectors are most affected.

- **In a second adverse scenario, the previous run-on-brown shocks are amplified by other standard macro-financial stress factors.** Figure 2.4 shows the macroeconomic shocks in this scenario, combining the first adverse scenario with additional shocks.

Figure 2.4. Gross-value-added shocks by sector and source of impact in the Fit-for-55 climate stress test (2023-2030, percentage deviations from baseline projection)



Source: European Banking Authority (2024). Note: Nomenclature of Economic Activities (NACE) is the statistical classification of economic activities in the European Community.

Although the ECB does not specify which of the two adverse scenarios will be used, that choice will significantly affect assets' uncertainty scores. In many sectors, the shock in the second adverse scenario is more than double that in the first. However, for the purposes of assessing transition uncertainties, the first adverse scenario could be the more appropriate choice, since much of the additional shortfall in the second adverse scenario reflects macroeconomic stressors rather than transition-related factors. Regardless of the scenario considered, bonds issued by mining, manufacturing, transport, utilities and water supply sectors will be the most affected.

The uncertainty score is then transformed into the climate factor via the following equation:

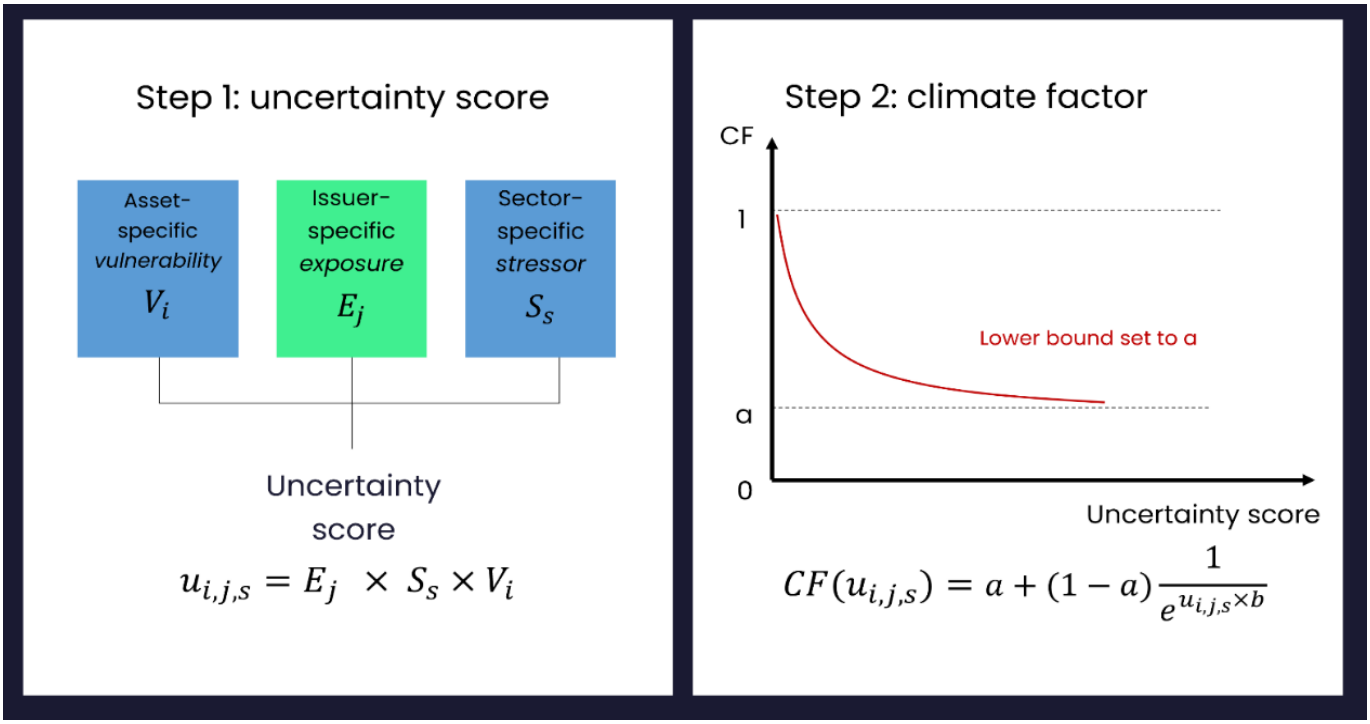
$$CF(u_{i,j,s}) = a + (1 - a)\frac{1}{e^{u_{i,j,s} \times b}}$$

- Parameter a is set by the Governing Council, informed by the expected shortfall aggregated across all sectors in the climate stress test.
- Parameter b is also set by the Governing Council, informed by the median uncertainty score $\bar{u}$:

$$b = ln\left(1 + \frac{1}{u}\right)$$

Figure 2.5 provides an overview of the process, including the design of the uncertainty score and its transformation into the climate factor.[17]

Figure 2.5. Composition of the uncertainty score and climate factor



Source: Authors' analysis based on ECB (2026a).

2.3. Estimating the magnitude of the climate factor

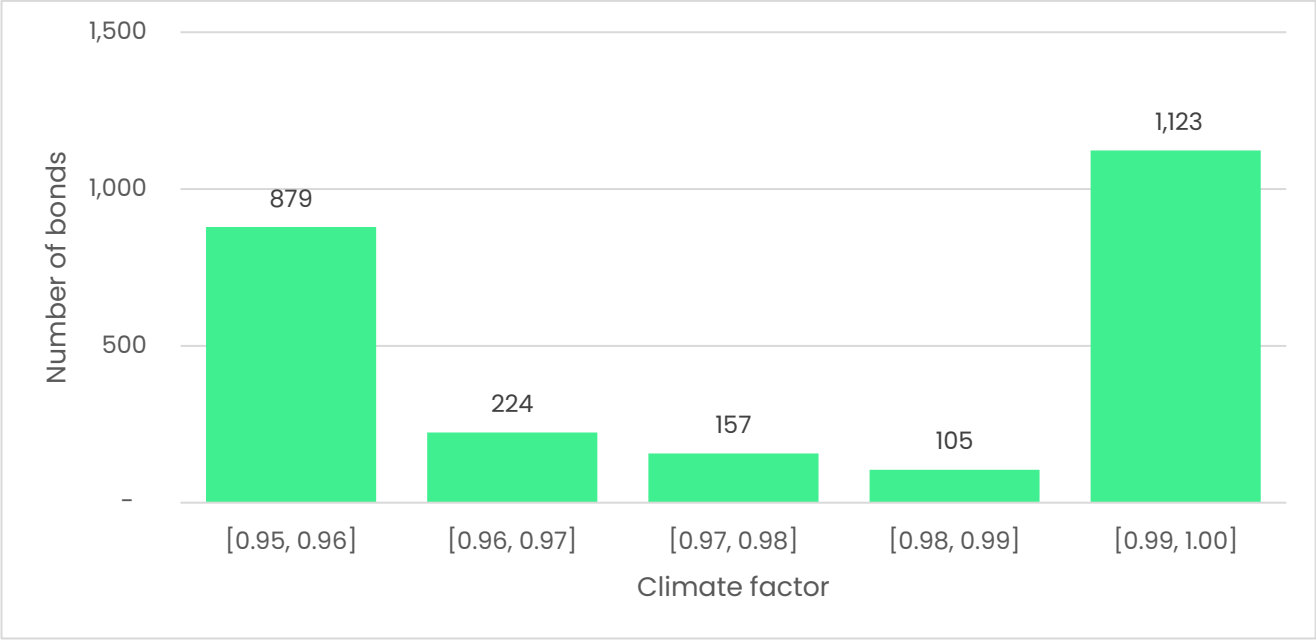
The ECB has signalled that the calibration of the climate factor will preserve adequate collateral availability (ECB, 2025a), implying that it will result in relatively modest adjustments. To illustrate how the methodology produces adjustments in practice, we conducted a simple estimation exercise.

Our estimation covers 2,488 corporate securities, representing 59% of corporate bonds in the ECB's list of eligible assets. The asset-specific and sector-specific components are relatively straightforward to obtain: data on residual maturity is publicly available, and the sector-specific stressor was derived from the sectoral GVA shocks in the 2024 Fit-for-55 climate stress test. The issuer-specific exposure, however, presents a significant challenge, since the ECB does not publish corporate climate scores. The exercise used the London Stock Exchange Group's (LSEG) emission intensity score as a proxy for the ECB's methodology (this should not be viewed as an equivalent to that methodology). Parameter *a* was assumed to be 0.95, consistent with the ECB's language suggesting a relatively high floor, while parameter *b* was derived from the median uncertainty score of the sample.

Figure 2.6 shows the resulting distribution of estimated climate factor values, which exhibits a bimodal pattern. A large share of assets cluster near the floor of 0.95, while another large share cluster near 1, with a relatively small amount in between. This bimodality may in part reflect the multiplicative structure of the uncertainty score, as assets for which at least one component is high (and none are at or near zero) are pushed towards the floor, while those with even one component that has a value of zero receive no adjustment.

[17] According to the relevant monetary policy implementation guideline, Guideline (EU) 2015/510, the climate factor will be updated for each asset class once a year. In between annual updates, new eligible assets will be given the median climate factor of the respective type of asset.

Figure 2.6. Estimated distribution of climate factor values



Source: Authors' analysis based on ECB and LSEG data. Note: the sample is made up of 59% of the eligible assets with haircut category L1C (corporate and other issuers). Issuer-specific exposure was proxied by the LSEG emission intensity score for each company using the following scale: 83.33–100: 5, 66.67–83.33: 4, 50–66.67: 3, 33.33–50: 2, 16.67–33.33: 1, 0–16.67: 0. The sector-specific stressor is derived from the run-on-brown GVA sectoral shock from the first adverse scenario in the 2024 Eurosystem climate stress tests, using NACE categories. The asset-specific component is the square root of the residual maturity rounded to the nearest year.

These results should be interpreted with caution, given that several limitations are likely to affect both the shape and scale of the distribution. Most significantly, the proxy used for the issuer-specific component does not replicate the ECB's climate score methodology, which incorporates forward-looking targets and disclosure quality alongside backward-looking emissions data. The sample covers only 59% of eligible corporate bonds, and the assumed values for parameters *a* and *b* may differ from those ultimately chosen by the Governing Council. Therefore, the resulting distribution is likely to differ from the final calibration.

Illustrating this methodology, Table 2.1 provides an example of the uncertainty score and climate factor for a corporate bond from ENI S.p.A, an Italian energy company. In this case, the estimated climate factor has a value of 0.95, which implies a 0.05 percentage point reduction in the post-haircut collateral value of the bond.

Table 2.1. Example of eligible corporate bonds

ISIN	Issuer-specific component	Sector-specific component	Asset-specific component	Uncertainty score	Climate factor
XS2065946837	0.5 Score of 2	8 (NACE category D: Utilities)	3 (residual maturity of nine years)	12	0.95

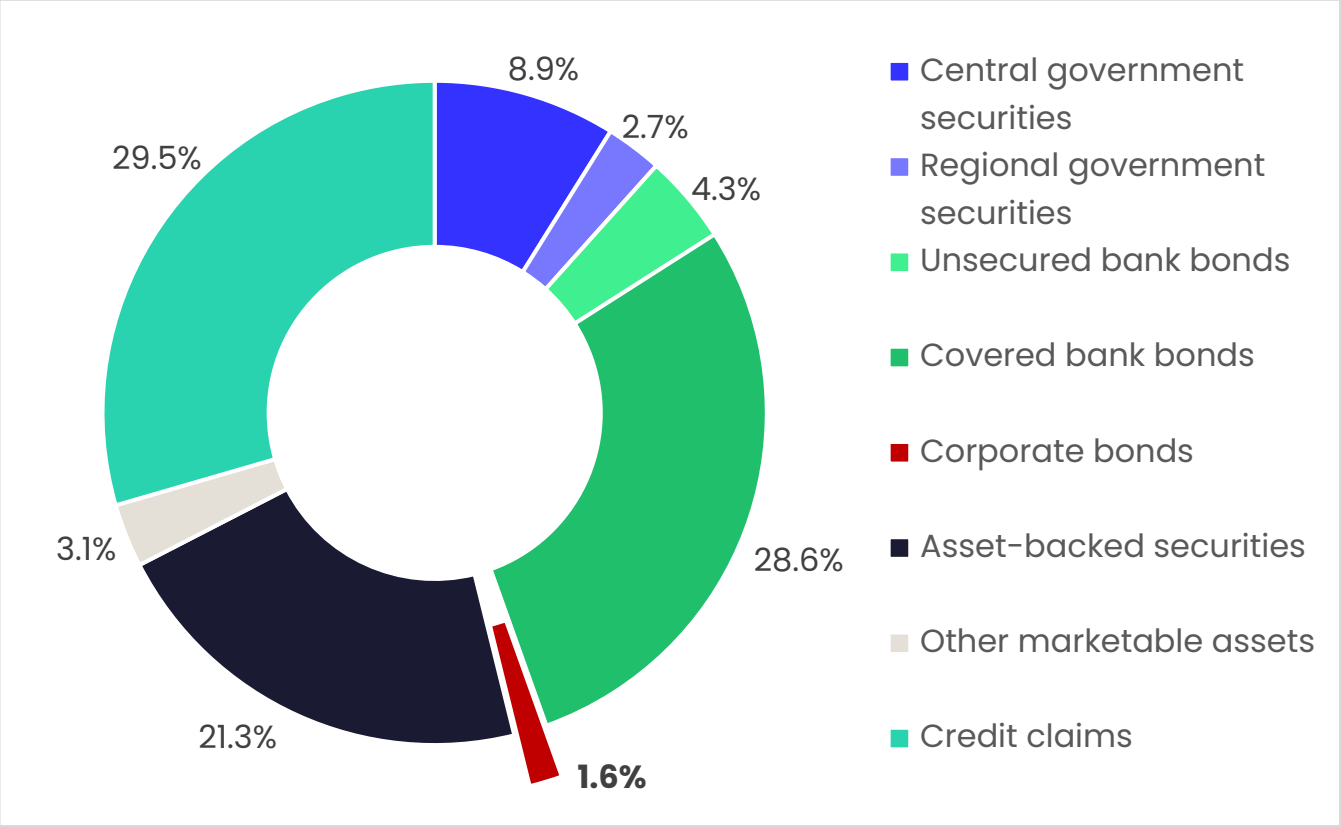
Sources: ECB; LSEG Refinitiv; authors. Note: the sample is made up of 59% of the eligible assets with haircut category L1C (corporate and other issuers). Issuer-specific exposure was proxied by the Refinitiv Emission intensity score for each company using the following scale: 83.33–100: 5, 66.67–83.33: 4, 50–66.67: 3, 33.33–50: 2, 16.67–33.33: 1, 0–16.67: 0. The sector-specific stressor is derived from the run-on-brown GVA sectoral shock from the first adverse scenario in the 2024 Eurosystem climate stress tests, using NACE categories. The asset-specific component is the square root of the residual maturity rounded to the nearest year.

3. Extending the climate factor to other asset classes

This section considers the case for extending the climate factor beyond non-financial corporate bonds to the four largest asset classes in the ECB's collateral framework: credit claims, ABS, covered bank bonds and sovereign bonds. For each, it assesses the risk-based rationale for extension and the feasibility of constructing an adapted uncertainty score, drawing on existing data infrastructure and third-party assessment frameworks.

The current version of the climate factor only applies to marketable assets issued by non-financial corporations, which account for less than 2% of pledged collateral (see Figure 3.1 below). Although the ECB's Governing Council has indicated that it will regularly review the scope of the climate factor, its current limitation to corporate bonds leaves the vast majority of pledged collateral without equivalent dedicated treatment to mitigate uncertainties related to the low-carbon transition.[18]

Figure 3.1. Composition of pledged collateral, average end-of-month data for 2025 Q3



Source: Authors' analysis based on ECB data.

The climate factor's rationale can be directly applied to other marketable instruments, and even to non-marketable assets such as credit claims. The climate factor was designed to capture liquidation price risk during the period necessary to sell assets to third parties. During the liquidation period, climate-related shocks could reduce the market value of not just corporate bonds but also asset-backed securities (ABS), covered bank bonds and sovereign bonds. Therefore, extending the climate

[18] There may also be a risk that counterparties respond by shifting their collateral composition further away from corporate bonds towards asset classes where no climate factor applies, undermining the measure's effectiveness.

factor to these other asset classes would involve adapting the structure of the uncertainty score to the nature of the entity exposed to transition-related uncertainties rather than altering the underlying rationale. In some cases, the nature of the underlying exposure would mean that certain components of the uncertainty score, such as the sector-specific stressor, are less relevant than the specific characteristics of the asset or asset pool. For credit claims, which are not traded on markets, the relevant risk operates through debtor creditworthiness rather than market price volatility, requiring a broader application of the rationale behind the climate factor.

The tripartite structure of the ECB's uncertainty score could be extended to other asset classes but, in each case, the main challenge would lie in adapting its issuer-specific component. As set out in Section 2, the uncertainty score for corporate bonds is constructed from a sector-specific stressor derived from climate stress test results, an asset-specific vulnerability based on residual maturity and an issuer-specific exposure based on the corporate climate score. In many cases, the first two components can be extended with relatively minor adjustments to data sources. The third, however, requires a rethink for each asset class, since the entities exposed to transition-related uncertainty are substantially different in nature: a loan debtor for credit claims, a pool of underlying assets for ABS, an issuing financial institution for covered bonds and a sovereign government for sovereign debt. For each asset class, we assess both the risk-based rationale for extension and the feasibility of constructing an adapted uncertainty score.

Any extension of the climate factor would need to address the challenge of maintaining risk efficiency and risk equivalence across all eligible assets. This would allow for a consistent and comparable level of residual risk across different asset types after the application of all risk controls (ECB, 2015). Risk efficiency reflects the central bank's ability to incur the lowest possible financial risk to achieve a given policy objective – or, in financial terms, a given expected return – and thereby maximise policy impact. Risk equivalence reflects the central bank's ability to calibrate risk controls so that, after it applies them, different assets are left with a comparable level of residual risk per unit of expected return. In the case of the climate factor, achieving risk equivalence would mean ensuring that the factor provided a fair and consistent reward for risk across all assets. While these principles should inform future implementation of the climate factor, the precise calibration to achieve consistency across all assets would require further work beyond the scope of this report.

3.1. Credit claims

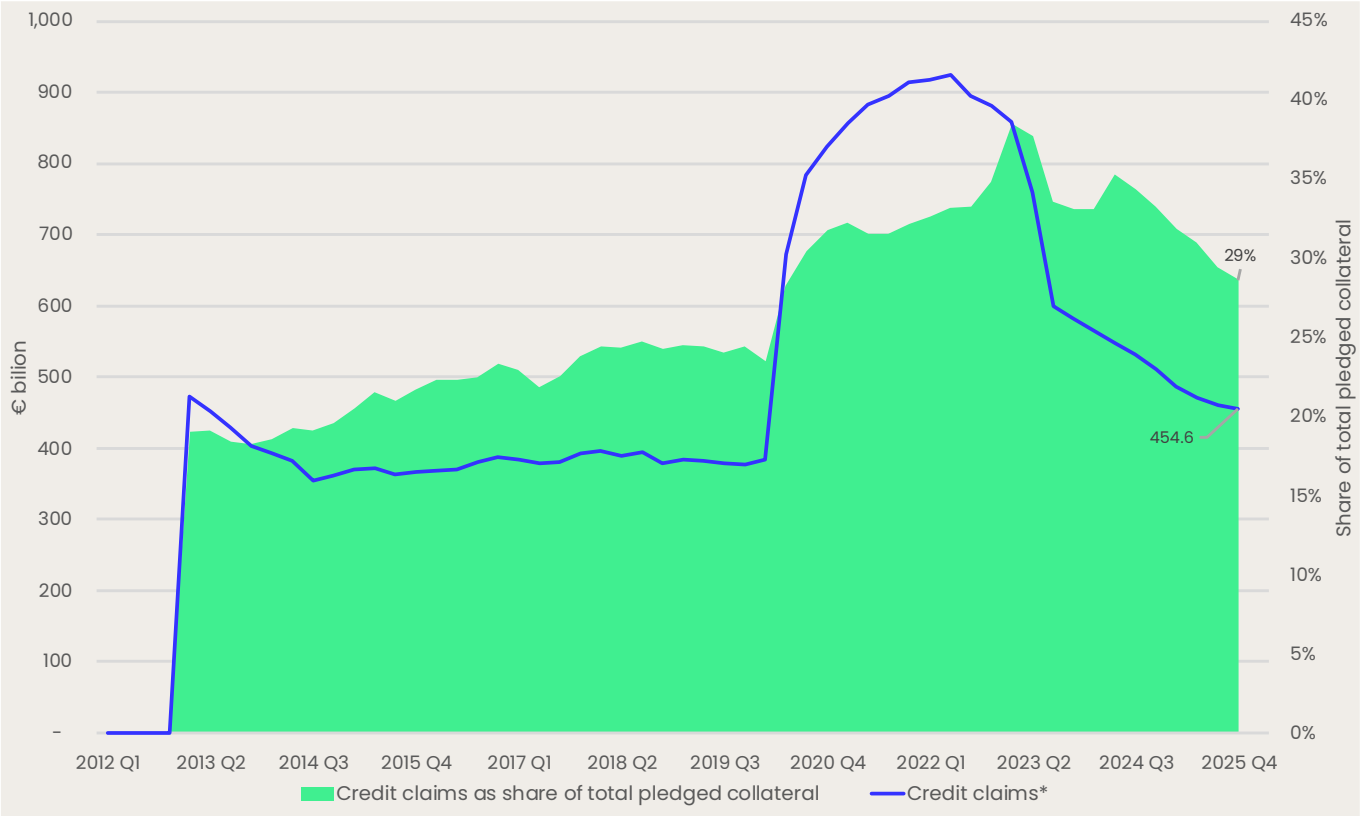
Risk-based rationale for extending the climate factor to credit claims

Credit claims – loans that companies owe to banks, who then pledge them as collateral – currently represent the largest share of collateral in the Eurosystem, accounting for approximately 29% of the total (see Figure 3.1).[19] In times of financial turmoil, the ECB has eased the requirements for mobilising credit claims to support liquidity provision (Alexopoulou et al., 2025). Their share of the ECB's pledged collateral has grown considerably in recent years. As shown in Figure 3.2, credit claims expanded during the pandemic as a consequence of the addition of new credit claims frameworks. Because credit claim debtors tend to be smaller firms with more concentrated sectoral exposures, they may be acutely vulnerable to low-carbon transition shocks of the kind modelled in Eurosystem stress tests. At the same time, the fact that these entities' climate disclosures are relatively limited makes it harder for existing assessment systems to capture such risks.

While credit claims are already subject to relatively stringent general risk controls on account of debtors' smaller size, these claims do not receive dedicated treatment to mitigate transition-related uncertainties. Because credit claims are not traded on markets, they do not face the traditional liquidation price risk that the climate factor has been designed to capture for corporate bonds. Any potential losses the ECB incurred by realising the asset would usually come from partial repayment or default by the borrower. This implies that an uncertainty score for credit claims should target the potential effects of low-carbon transition shocks on credit risk.

[19] The Eurosystem's acceptance of credit claims helps guarantee broad collateral availability, as loans represent the most important asset class on banks' balance sheets and are comparatively convenient to mobilise (Levy et al., 2022). However, given their higher liquidity risk, credit claims are subject to larger haircuts under the Eurosystem's guidelines.

Figure 3.2. Use of credit claims as Eurosystem collateral



Source: Authors' analysis based on ECB data.

The Eurosystem already considers climate risks in its assessment of credit claims through its internal credit assessment systems (ICAs),[20] but this has had a limited impact on ratings. Reportedly, the seven ICAs in the Eurosystem analyse climate-related impacts, partly by conducting internal carbon stress tests to evaluate exposure to transition risk and by mapping environmental hazards to financial losses (Piloiu et al., 2025). Since January 2026, this process has been augmented by statistical in-house credit assessment systems (S-ICAs), which originated during the pandemic and take a more quantitative approach to assessing risks, including climate-related risks (Duarte et al., 2025). Nevertheless, this has not led to changes in credit ratings, likely due to short rating horizons (for instance, only one year in the ICAs) and a lack of access to data.

In addition, the current haircut structure for credit claims offers no continuous scale on which to calibrate climate uncertainties. Under the European Credit Assessment Framework, eligible credit claims must meet at least Credit Quality Step 3, corresponding to a minimum credit rating of BBB- or the equivalent. They are then grouped into two haircut buckets: one for higher-rated claims (Steps 1 and 2, covering ratings of A- and above) and another for those at the minimum threshold (Step 3, covering the BBB range). Two firms in the same credit quality step may have very different exposures to the low-carbon transition, but the binary structure cannot capture this variation. The climate factor could address this shortfall.

Building an uncertainty score for credit claims

The main adaptation required is the replacement of the issuer-specific component with a debtor-specific measure. The sector-specific and asset-specific components can be directly extended using loan-level reporting data. The ECB's AnaCredit framework, which requires banks to report detailed information on individual loans, provides much of the data infrastructure needed, including

[20] The Eurosystem also accepts ratings from five external credit assessments institutions, but they tend to cover only a small share of non-financial corporations – unlike the ICAs, which are used by small and medium-sized banks that lend to SMEs (Levy et al., 2022).

Nomenclature of Economic Activities (NACE) classification of debtors and the maturity of each loan. The debtor-specific component, however, presents a greater challenge.

Table 3.1 An uncertainty score for credit claims

Climate factor component	Content	Information source
Sector-specific stressor (S)	Gross-value added shocks to the sector of the debtor, as calculated in the last available climate stress test (e.g. the 2024 Fit-for-55 exercise)	NACE section code from AnaCredit
Asset-specific vulnerability (V)	Residual maturity of the loan	Available from the registration of the credit claim
Debtor-specific exposure (E)	Exposure of the loan debtor to transition risks that could increase the probability of default	To be phased in as data becomes available
$u_{i,j,s} = V_i \times E_j \times S_s$		

The sector-specific component could be directly extended, since AnaCredit reporting includes the NACE classification of each debtor,[21] allowing the same stress tests used for corporate bonds to be mapped onto credit claims. The scope of AnaCredit (loans with a value exceeding €25,000) overlaps with the eligibility threshold for credit claims (at least €25,000 for domestic mobilisation, and €500,000 for cross-border mobilisation).[22] Within AnaCredit's counterparty reference dataset, reporting institutions provide debtor identifiers.

The asset-specific component, based on the residual maturity of the instrument, is similarly straightforward to obtain from loan-level reporting data. The maturity date of the credit claim is available from both its registration during mobilisation and from AnaCredit. Since credit claims can have long maturities, particularly for investment or real estate-related lending, the residual maturity component may carry considerable weight in the uncertainty score.

The debtor-specific component presents a greater challenge because it relies on climate performance data that may be limited or unavailable for the smaller firms that account for many credit claims. Following a methodology analogous to that used for the issuer-specific exposure in corporate bonds, this component could draw on backward- and forward-looking emissions data, which is relatively hard to acquire for smaller debtors. AnaCredit could provide credit-risk characteristics of debtors, such as the one-year probability of default, but not assessments of transition-related risks. Although both ICAs and S-ICAs are reportedly collecting climate data, the scaling back of reporting requirements under the CSRD Omnibus proposal may have hindered their ability to access relevant information (Piloiu et al., 2025).

This gap could partially close over time due to initiatives such as the Banque de France's Indicateur Climat, which is designed to eventually cover up to 20,000 companies operating in France. The Banque de France's tool covers both the transition and adaptation dimensions through qualitative and quantitative assessments, which will target several sectors by 2027 (Amadei et al., 2025; Banque de France, 2026). Derived from the Assessing low-Carbon Transition (ACT) methodology, the Indicateur Climat assesses the degree of consistency between a company's greenhouse gas emissions

[21] The economic activity is part of the required counterparty data, according to the AnaCredit Reporting Manual (ECB, 2019). This attribute is at least the two NACE code (Regulation (EU) 2016/867 of the European Central Bank).

[22] Collateral management in Eurosystem credit operations (ECB, 2026b).

trajectory and a scenario aligned with the Paris Agreement. Although an existing strong historical infrastructure made data collection easier for the Banque de France , the Indicatuer Climat could set a precedent for other Eurosystem central banks, especially as its methodology can be implemented using external data providers. Firm-level data from sources such as the EU Emissions Trading System (ETS) and regional and sectoral databases could supplement these efforts where CSRD reporting falls short (Piloiu et al., 2025).

Stronger collaboration within and between institutions could help improve data quality without increasing the reporting burden for small and medium-sized enterprises. The multilateral Memorandum of Understanding between ESMA and the European Economic Area could serve as an example of cooperation aimed at exchanging expertise and repurposing existing information (ESMA, 2025). For the climate factor, a flow of information between the supervisory and monetary policy arms of the ECB could help produce estimated uncertainty scores for credit claims. Although the two arms are required to operate separately to safeguard confidentiality, exchanges of information are possible on a strictly need-to-know basis (Decision ECB/2014/39; ECB, 2015). The materiality assessments of climate risks that the Single Supervisory Mechanism expects banks to provide could offer valuable insights into the climate exposure of debtors.

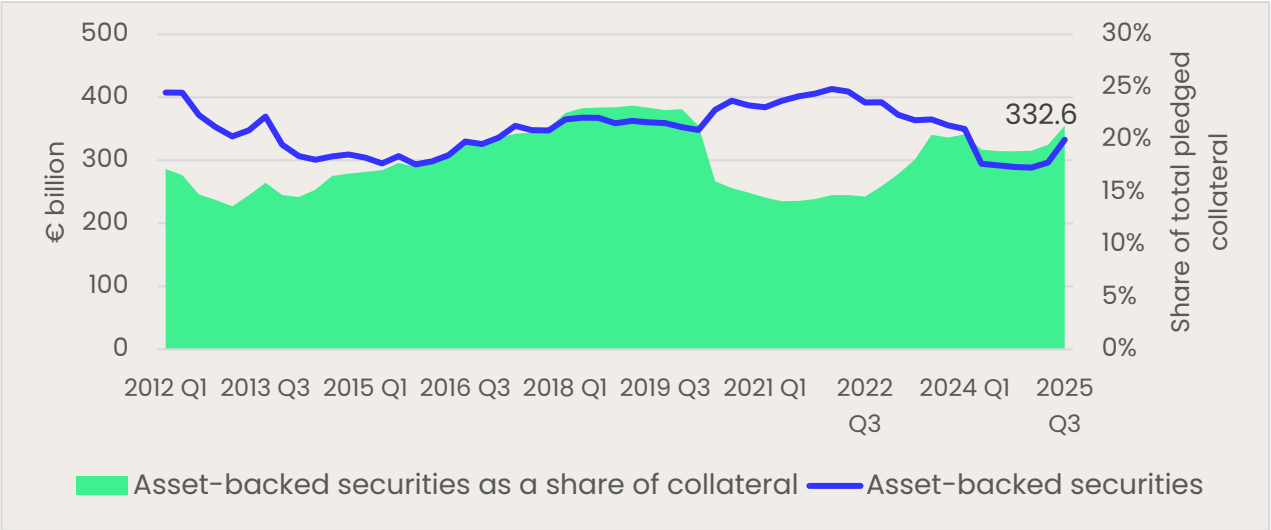
In the interim, a pragmatic approach would be to implement the climate factor for credit claims using only the sector-specific and asset-specific components. This architecture could be designed to incorporate a debtor-specific score should the relevant data and climate indicators for smaller companies become available and develop sufficiently. Firms that do not voluntarily disclose the required information could be assigned lower scores, mirroring the incentive structure of the Corporate Sector Purchase Programme (CSPP) climate score.

3.2. Asset-backed securities

Risk-based rationale for extending the climate factor to asset-backed securities

ABS are composed of a pool of underlying loans, such as mortgages or auto loans, that are transformed into tradable securities through securitisation. As of the third quarter of 2025, ABS account for approximately 20% of all collateral pledged to the Eurosystem, or €332.6 billion (see Figure 3.3).

Figure 3.3 Use of asset-backed securities as Eurosystem collateral

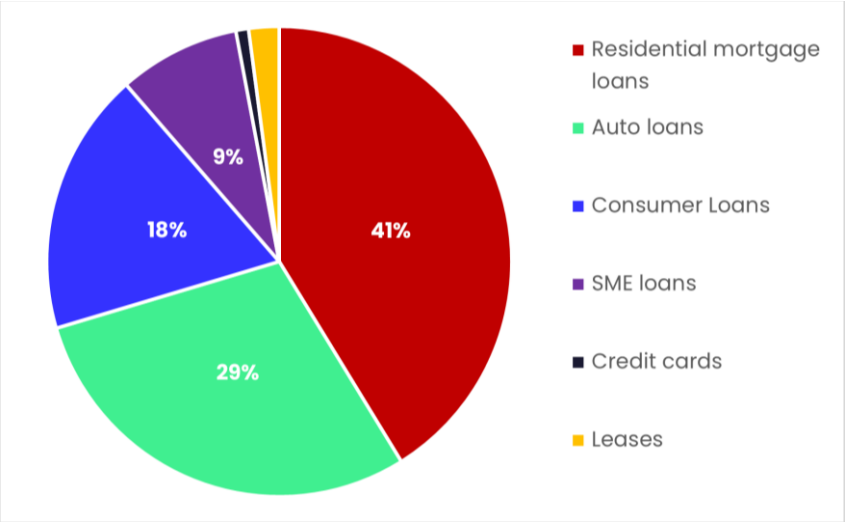


Source: Authors' analysis based on ECB data.

In the Eurosystem, more than half of ABS that are eligible to become collateral are backed by auto loans and residential mortgage loans (see Figure 3.4). The underlying exposures can be identified at the loan level through the European DataWarehouse (EDW), a securitisation repository that covers the EU and the UK and that also serves as a data source for the Eurosystem collateral framework. Given the predominance of ABS backed by auto loans and mortgages — and the availability of loan-level data

on the characteristics of the underlying assets – the development of a climate-related uncertainty score could begin with these two exposure types (before extending this to other forms of ABS).

Figure 3.4 Composition of eligible asset-backed securities by underlying loan type



Source: Authors' analysis based on EDW (2026b) and ECB (2026c).

Although different in nature, mortgages and auto loans are both exposed to transition risk through two main channels: higher operational costs and the declining value of underlying assets. On the former, energy price shocks or increased carbon pricing may raise fuel costs and energy bills for borrowers, potentially increasing the probability of default. On the latter, changes in regulatory standards, technological shifts and consumer preferences may reduce the market value of energy-inefficient houses or internal combustion engine (ICE) vehicles, thereby increasing the loss-given-default on these loans. Together, these dynamics may weaken the credit risk profile of securitised auto and mortgage loans. For mortgage markets, Thebault and Jamil (2024), Billio et al. (2022) and Schütze (2020) find links between energy efficiency and credit risk. For auto loans, Fliegel et al. (2025) and Klee et al. (2024) find evidence that markets price in higher default risk for loans associated with ICE vehicles in both European and US markets.[23]

Upcoming EU policy measures are likely to intensify these transition dynamics, particularly the extension of carbon pricing to buildings and road transport under the new Emissions Trading System for buildings and road transport (ETS2). Buildings consume 40% of all energy in the EU (European Commission, 2026) and the revised Energy Performance of Buildings Directive mandates a fully decarbonised building stock by 2050. Similarly, car manufacturers are expected to phase out almost all fuel-powered vehicle production by 2035.[24] Both the buildings and road transport sectors will be covered by ETS2, extending carbon pricing to these areas and thereby creating an additional cost channel for energy-inefficient housing and high-emission vehicles.

Building an uncertainty score for asset-backed securities

The structure of the uncertainty score requires a more fundamental adaptation for ABS than for credit claims. Unlike a corporate bond or credit claim, where transition risk can be attributed to a single entity operating in a known sector, the risk profile of an ABS depends on the transition risk exposure of the pool of underlying assets. Therefore, the sector-specific and issuer-specific components could be replaced with a single underlying asset pool component, which would measure the aggregate exposure to transition risk of the houses and vehicles backing the securitised loans.

[23] Conversely, Bena et al. (2024) argue that electric vehicles may face higher transition risk due to rapid technological progress that reduces their resale value.

[24] Regulation (EU) 2019/631, a new proposal presented as part of the automotive package in December 2025, has slightly reduced the ambition of the 2035 target by allowing 10% of tailpipe emissions to persist and be compensated through other uses.

The uncertainty score for ABS would be composed of the asset-specific vulnerability and an underlying asset pool exposure, but the appropriate metric for the latter would differ between mortgage and auto loan ABS. For mortgage-backed securities, the transition risk exposure of the underlying properties can be approximated through their energy consumption or Energy Performance Certificate (EPC) ratings, which measure each property's vulnerability to rising energy costs and regulatory standards. For auto loan ABS, the relevant metric is the CO_2 emission intensity of the financed vehicles, as suggested by André et al. (2022) and estimated by the EDW using European Environment Agency data.

In both cases, the overall transition risk exposure of the asset pool can be calculated as the weighted average of the individual underlying assets. Following Schoenmaker (2021), this would involve introducing three carbon categories C^j where $j = \{low, medium, high\}$ with corresponding scores[25] and where each individual underlying asset could be classified according to its climate risk (see Table 3.2). From this, a score could then be attributed to the ABS using its average underlying risk:

$$S_s{}^{j,average} = \Sigma_i w_i C_i^j$$

In this formula, w_i is the weight of each asset i in the underlying pool s. C^j represents a numeric score corresponding to the category of the EPC label for mortgages and vehicle emissions[26] for auto loans. The asset-specific component only requires a minor adaptation. There is no single maturity date for ABS, because they are composed of several loans that can have different expiration dates. Accordingly, the relevant measure for ABS is the weighted average lifetime (WAL) of the pool, which is available from EDW reporting.

Table 3.2 An uncertainty score for asset-backed securities

Uncertainty score component	Content	Information Source
Underlying asset pool score (S) component	High risk (score of 3): Mortgages: EPC labels F and G Auto loans: highest tertile of CO_2 emissions	EDW; AnaCredit
	Medium risk (score of 2): Mortgages: EPC labels C, D, E Auto loans: middle tertile of CO_2 emissions	
	Low risk (score of 1): Mortgages: EPC labels A and B Auto loans: bottom tertile of CO_2 emissions	
Asset-specific vulnerability (V)	Weighted average lifetime (WAL)	EDW
$\boldsymbol{u_{i,s} = V_i \times S_s}$		

[25] The exact values of the score for each category would be calibrated to maintain risk equivalency with the climate factor for corporate bonds and, in the future, other asset classes. Furthermore, to achieve even more consistency, the underlying asset pool risk could be broken down into six categories, with scores ranging from 0–5. This would be analogous to the CSPP scores used for the issuer-specific exposure in corporate bonds.

[26] In its response to an ESMA consultation on securitisation templates (2024), the ECB suggested that data on tailpipe emissions (grams of CO_2 per kilometre) were essential for assessing transition risk. This data could be used as the basis of a temporal neutral emissions measure that removed the differences between years and types of cars to ensure a more market-neutral approach, as developed by André et al. (2022).

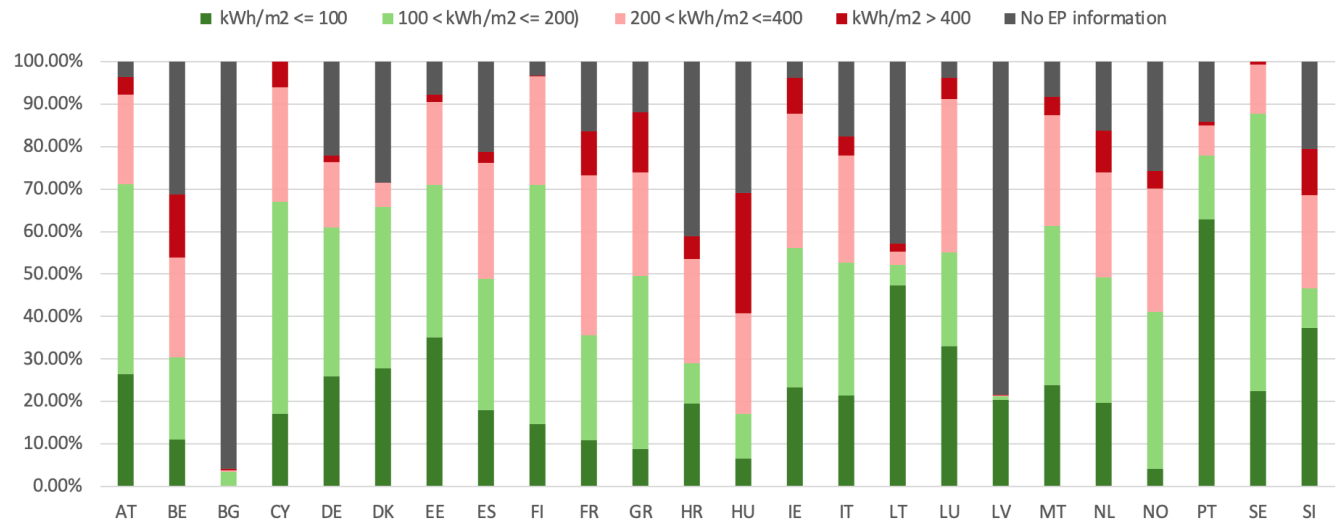
Significant challenges remain in the availability and comparability of data to create the underlying asset pool component. In the EU, EPC labels have two important limitations for mortgage-backed ABS:

- **Data availability:** although the ESMA disclosure templates used for EDW reporting include a field for EPC rating, it is often left blank.[27] According to EDW (2026a), only 40% of mortgage-backed securities currently have an EPC label. There is no EU-level repository of EPC labels. Some countries only maintain regional databases, further fragmenting data access. Spain, for instance, has 16 separate building EPC repositories (EDW, 2026a).

- **A lack of harmonised standards:** the energy consumption levels denoted by mortgage EPC ratings vary widely across countries. For instance, a consumption level of 50 kilowatt hours per square metre per year qualifies as an A++ rating in Austria but only a B rating in Spain (EDW, 2024). These fragmented standards led the EDW (2025b) to compare EPCs to the Tower of Babel. The Energy Performance of Buildings Directive, which should help address this problem, has still not been fully transposed by all Member States. This lack of harmonised standards may help explain the significant diversity in energy efficiency levels in the EU, as shown in Figure 3.5.

To address these gaps, the EDW developed a tool called Giuditta, which matches EPC data and other energy-efficiency indicators with loan-level mortgage data (EDW, 2025c). Where EPC information is missing, the system estimates likely ratings based on property characteristics such as year of construction and geographic location. So far, the tool has been implemented only in select Italian regions, but similar estimated approaches have been applied in the literature. For instance, Billio et al. (2022) combine EDW loan-level mortgage data with estimated EPC ratings using a comparable methodology.

Figure 3.5 Share of mortgage exposures to different energy efficiency buckets by kWh/m2 and country, December 2024



Source: European Banking Authority ESG Dashboard (2025).

For auto loan ABS, EPC labels are a less suitable metric because vehicle label standards vary significantly across countries in both criteria and number of categories (Badenhoop and Riedel, 2025). The French label, for instance, classifies vehicles by absolute CO_2 emissions, whereas the German label adjusts for vehicle weight. The European Commission aims to review the European Commission's Car Labelling Directive and to harmonise vehicle labels across Member States in 2026. Therefore, it would be more appropriate to use emissions-based approaches, which estimate CO_2 intensity directly based on vehicle characteristics. The EDW has developed a methodology along these lines and is constructing the GAS database, which maps existing ESMA disclosure fields onto information from the

[27] There are 11 securitisation templates in use for different underlying loans, as set out in more detail in ESMA (2026).

European Environment Agency (EDW, 2025a).[28] However, several limitations remain: GAS currently covers only Germany, France and Spain (EDW, 2024); certain GAS disclosure fields have been described as noisy, with lenders reporting that they feature the same information in different languages or levels of precision (Bena et al., 2024); and the diversity of vehicles within a typical ABS pool complicates estimates of average pool-level emissions. Simplifying disclosure data to cost-effective identifiers could still allow policymakers to obtain sustainability data (Hackmann et al., 2024).

These data gaps highlight the need to improve data quality and harmonise energy performance standards, but the ECB need not wait before extending the climate factor to ABS. The review of the Car Labelling Directive and the continuing implementation of the Energy Performance of Buildings Directive would simplify that extension. However, the interim solutions developed by the EDW and in the academic literature offer a basis for constructing the underlying asset pool component with currently available data. A phased approach that began with pools where data coverage is strongest would allow the climate factor to be extended to ABS without waiting for full data harmonisation.

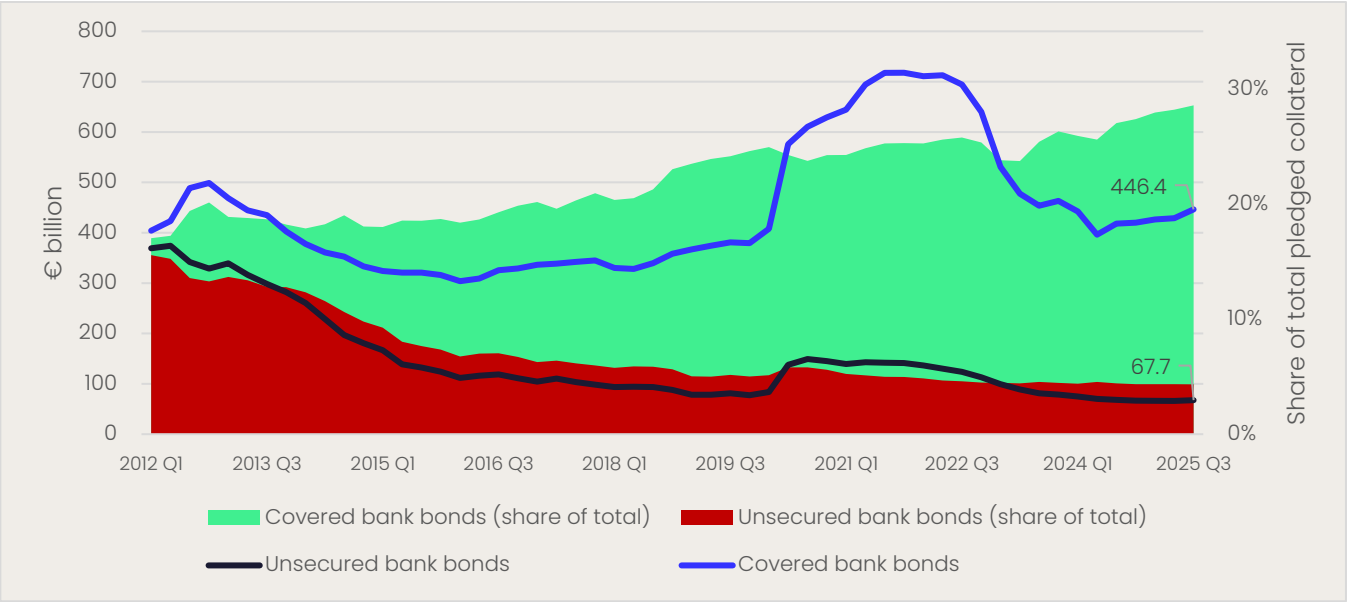
3.3. Covered bank bonds

Risk-based rationale for extending the climate factor to covered bank bonds

Covered bank bonds constitute around 29% of all pledged collateral in the Eurosystem, making them the second-largest asset class in the collateral pool. Although the Eurosystem accepts both covered and unsecured bank bonds as eligible collateral, unsecured bonds are subject to concentration limits that constrain their use. As a consequence, covered bonds play a far more prominent role in practice, and their share of pledged collateral has risen steadily in recent years (see Figure 3.6 below).

Covered bonds are debt securities whose financial obligations are backed by both the issuing bank and, in case of default, an underlying cover pool of assets – a guarantee known as dual recourse. **Unlike ABS, the cover pool assets are not transferred to a separate entity but remain on the balance sheet of the originating bank.** A financial institution that pledges its own covered bond or one from a closely linked institution is subject to additional haircuts in the Eurosystem (Adler et al., 2023). As of December 2024, cover pools were overwhelmingly composed of real estate assets (84%), with the remainder mostly loans to the public sector (EBA, 2025).

Figure 3.6. Use of covered bank bonds as Eurosystem collateral



Source: Authors' analysis based on ECB data.

[28] Data from the European Economic Area has similarly been used by Badenhoop and Riedel (2025) and Lindner and Riedel (2025) to estimate climate metrics based on vehicle features.

Due to their dual-recourse structure, covered bank bonds are affected by transition-related uncertainties through two channels: issuer risk and cover pool risk. On the issuer side, the creditworthiness of the issuing bank is the first line of recourse for bondholders. A 2024 report by ECB Banking Supervision[29] found that 90% of the 95 banks it analysed were misaligned with decarbonisation targets and were exposed to transition risks (ECB, 2024a). Yet the institutions were adopting a 'wait-and-see' approach instead of actively phasing out high-carbon activities (ibid.). Given doubts about the extent to which existing credit assessments adequately reflect climate-related risks, financial institutions' ratings may overestimate their creditworthiness. Although the climate factor is designed to capture market and liquidity risks, credit quality can have an influence on price volatility and is one of the determinants of the standard haircuts categories (ECB, 2015).

On the cover pool side, given that covered bonds are predominantly exposed to residential mortgage loans, these bonds are subject to transition risks similar to those affecting ABS linked to mortgages (as discussed in Section 3.2). Rising energy prices and the introduction or tightening of carbon pricing mechanisms may reduce households' disposable income, increasing default risk among mortgage borrowers. At the same time, the energy transition and the introduction of firmer regulatory standards may reduce the market value of energy-inefficient properties. This may erode the collateral that provides the second line of recourse and thereby increase loss-given-default. No dedicated climate risk measure currently addresses either channel.

Building an uncertainty score for covered bank bonds

The uncertainty score for covered bank bonds can be constructed from an issuer-specific component, an underlying asset pool component and the residual maturity of the bond. The first two components reflect the dual-recourse structure of covered bonds, capturing climate risk on both sides of the bondholder's claim. However, the availability of the data needed to construct the components varies: the issuer-specific component could draw on existing supervisory data and/or third-party assessment frameworks, while further disclosure requirements will be needed to address the more significant gaps in data for the underlying asset pool component.

Table 3.3. An uncertainty score for covered bank bonds

Uncertainty score component	Content	Information Source
Issuer-specific exposure (E)	Financed emissions Financial exposure Transition target/alignment Climate governance/disclosure	Supervisory data; regulatory reporting; climate reporting; third-party assessments
Underlying asset pool score (S) component	High risk (score of 3): Mortgages: EPC labels F and G	**To be phased in as data becomes available**
	Medium risk (score of 2): Mortgages: EPC labels C, D, E	
	Low risk (score of 1): Mortgages: EPC labels A and B	
Asset-specific vulnerability (V)	Residual maturity (with respect to extended maturity date)	Centralised Securities Database (CSDB)
$u_{i,j,s} = V_i \times E_j \times S_s$		

[29] Risks from misalignment of banks' financing with the EU climate objectives. Assessment of the alignment of the European banking sector (ECB, 2024a).

The issuer-specific component could follow the structure of the ECB's climate score for corporate bonds, adapted to financial institutions. As outlined in Section 2, the corporate score assesses non-financial issuers in three dimensions: backward-looking emissions, forward-looking decarbonisation targets and climate disclosures. An analogous score for banks could draw on the same structure: assessing financed/facilitated emissions and/or the sectoral exposure of the lending book; the ambition and credibility of transition targets and their alignment with low-carbon benchmarks; and the quality of climate governance and disclosure. The ECB's own supervisory data could be used for these purposes, as could data shared by other EU institutions such as the EBA, so long as this was permissible under the legislated separation between supervisory and monetary functions. Removing institutional siloes and improving data accessibility would help the ECB gain a more comprehensive view of banks' transition risk profile (Smoleńska et al., 2026).

Investors and other market participants increasingly analyse financial institutions through a growing ecosystem of assessment frameworks that help them compare between banks' transition exposures, financed emissions and strategy credibility. External stakeholders can evaluate both banks' operational emissions and banks' alignment of their investment portfolios with climate scenarios – usually transition pathway or temperature alignment scenarios - using tools such as the TPI Centre's Net Zero Banking Assessment Framework (NZBAF) and Carbon Performance for Banks, as well as the Institutional Investors Group on Climate Change's (IIGCC) Net Zero Standard for Banks; the Paris Agreement Capital Transition Assessment for Banks; the Partnership for Carbon Accounting Financials; the Science Based Targets Initiative's Financial Institutions Net-Zero Standard; ACT Finance; and Carbon Disclosure Project disclosures. Market participants are increasingly adopting these tools to make decisions based on forward-looking assessments of climate-related financial risks affecting banks' credit exposures, portfolio alignment, capital allocation, client engagement and transition-plan credibility. The TPI Centre's NZBAF and Carbon Performance for Banks tools, for instance, were designed from the outset as an investor tool, developed in consultation with the IIGCC and Ceres, and with contributions from more than 25 investors. Firms such as Robeco and Storebrand Asset Management explicitly cite the framework as central to their ongoing voting and engagement activities with financial institutions (TPI Centre, 2023). See Box 3.1 for an overview of the methodology used in this tool.

Box 3.1. Transition assessment frameworks for financial institutions

Ákos Hajagos-Tóth, Algirdas Brochard and Valentin Jahn (TPI Global Climate Transition Centre)

The TPI Centre assesses banks using two tools: the NZBAF and the Carbon Performance for Banks (TPI Centre, 2025). The NZBAF is a tool for evaluating banks' climate policies in ten areas using 77 binary sub-indicators. Each area focuses on a particular aspect of a bank's climate policy, including emissions disclosure, financed and facilitated emissions targets, decarbonisation strategy and climate governance. Together, these ten areas offer a roadmap for the disclosures, policies and initiatives banks need to establish to effectively manage low-carbon transition risks. The alignment of banks' sectoral decarbonisation targets with low-carbon scenarios is assessed using the Carbon Performance for Banks methodology.

Below, we explain how elements assessed by the NZBAF and the Carbon Performance for Banks could serve as building blocks for an uncertainty score and, in turn, the three proposed dimensions of an issuer-specific exposure score (E). To this end, we evaluate current market practices and data limitations.

(1) Assessing financed/facilitated emissions and/or the sectoral exposure of the lending book

Emissions and financial materiality are distinct but equally important concepts, which need to be considered jointly to understand a bank's baseline exposure to climate-related financial risks. In its 2026 assessment cycle, the TPI Centre found that the six large European banks it assessed had disclosed their credit exposure to all material high-emission sectors. (This financial reporting is limited to lending and some on-balance sheet activities, such as investments.)

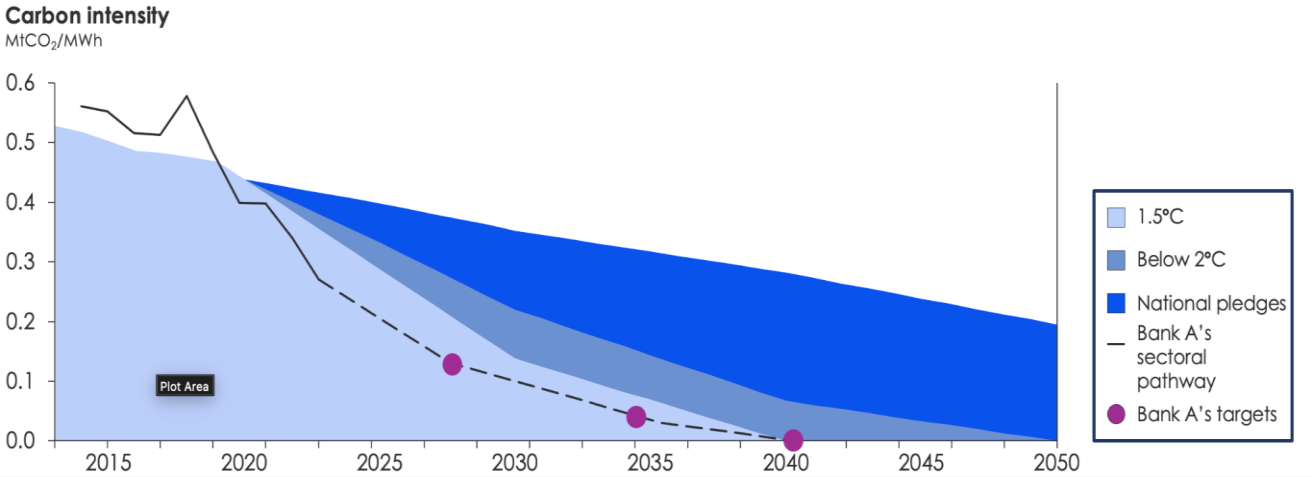
One difficulty in linking banks' emissions to an issuer-specific score is that banks only quantify and report emissions linked to some of the activities in which they are involved. For instance, three of the six assessed EU banks disclosed their absolute financed emissions to all material high-emissions sectors, but none of them disclosed absolute facilitated emissions.

(2) The ambition and credibility of transition targets and their alignment with low-carbon benchmarks

Similarly, unlike corporates, banks often set decarbonisation targets for only some of the business activities and high-emissions sectors in which they are involved. When building an uncertainty score for banks, it is important to understand that their sectoral decarbonisation targets currently only cover part of their business models.

Nonetheless, the TPI Centre's assessments of banks' emissions reduction targets reveal differing levels of ambition, which could help form the basis of a differentiated uncertainty score. While all six EU banks we assessed in 2025 have at least one 2030 sectoral decarbonisation target, only two have a 2050 target. Ten out of the 36 large global banks we assessed expanded the scope of their targets to capital market facilitation, but no EU bank has done so.

Finally, the TPI Centre's Carbon Performance for Banks tool details the timeframes of the climate targets banks have set for high-emission sectors and business activities. The tool also tracks whether these decarbonisation pathways are aligned with low-carbon benchmarks that we developed based on data from the International Energy Agency (IEA) and other sources. Carbon Performance for Banks provides an example of how to assess the ambition and credibility of transition targets, as well as their alignment with low-carbon benchmarks. Notably, it shows that less than one-third of all EU banks are aligned with the pathway to limiting warming to 2°C by 2030.



(3) The quality of climate governance and disclosure

Our assessments show that there is wide variation in the quality of banks' climate governance and disclosures, which could also help form the basis of a differentiated uncertainty score. All the EU banks we assessed have disclosed evidence that a board member has responsibility for oversight of climate risks. However, there are significant variations in banks' approaches to other areas, such as the comprehensiveness of their decarbonisation strategies. For example, while most EU banks have financing conditions that could support the transitions of clients in high-emission sectors, only one discloses how it enforces these conditions.

Taken together, these elements illustrate how existing third-party assessment frameworks could inform the creation of an issuer-specific exposure score for banks.

At this stage, a lack of available data on assets' climate characteristics makes it difficult to analyse individual covered bonds' underlying asset pools. Although the EU's 2019 covered bond package harmonised disclosures to a degree, the formats of these disclosures do not yet cover climate-

relevant data in sufficient detail – as the EBA (2025) reported in its review of the covered bond framework. EPC data is currently disclosed at the banking-book level, but the creation of the underlying asset pool component would require detailed information on the distribution of energy performance ratings between cover pool assets specifically (Tabakis, 2025).

Despite these challenges, ongoing institutional work suggests that assessments of underlying asset pools may become feasible in the future. As the ECB and the European Supervisory Authorities observed in 2023, the disclosure requirements already in place for mortgage ABS could serve as a model, given the structural similarities between securitisations and covered bonds. The EBA has recommended limiting the scope of any new disclosure requirements to the climate risk of immovable property (EBA, 2025). This may be sufficient to construct an underlying asset pool component for the uncertainty score, given that 84% of cover pools are real estate assets. Possible channels for such disclosure include the Pillar 3 ITS template 2 and supervisory reporting templates (Tabakis, 2025).

The Eurosystem could begin applying a climate factor for covered bank bonds built on the issuer-specific and residual maturity components, before implementing the underlying asset pool component as the relevant data becomes available. This phased approach mirrors the strategies proposed above for credit claims and ABS, whereby implementation could proceed on the basis of available data while the architecture is designed to accommodate future improvements in coverage. This would allow the ECB to begin addressing unpriced climate risk in covered bond collateral without waiting for comprehensive data disclosure.

3.4. Sovereign bonds

Risk rationale for extending the climate factor to sovereign bonds

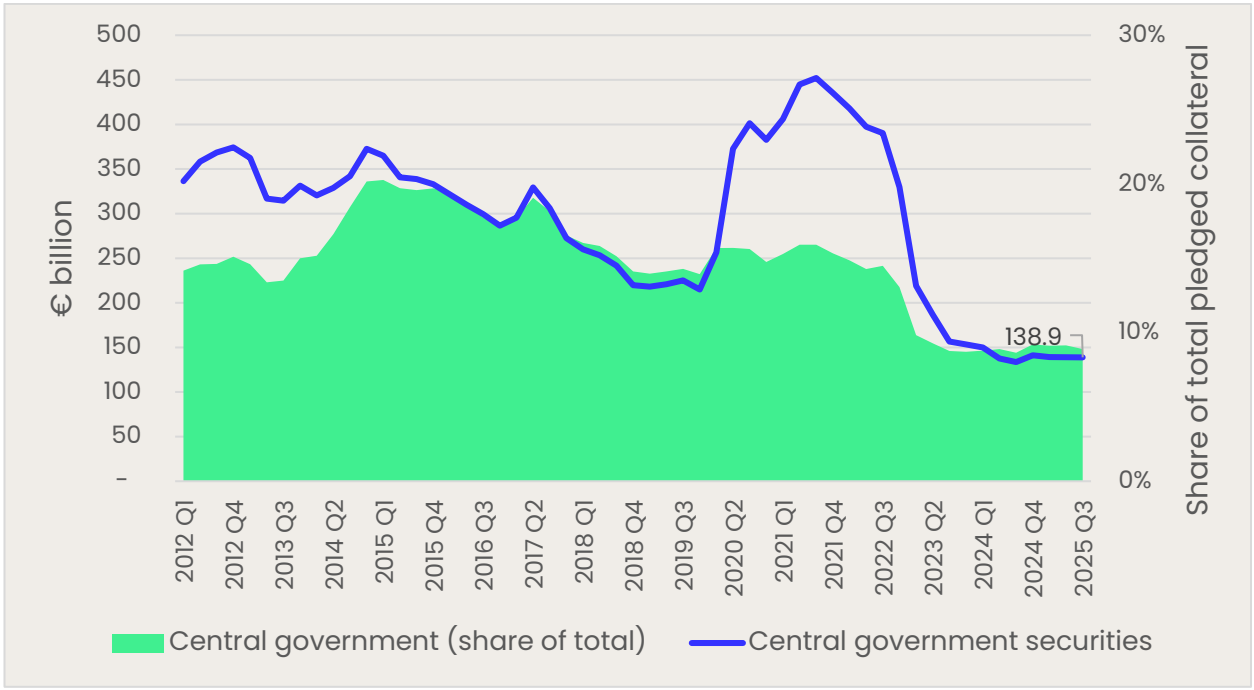
Debt securities issued by central governments constitute a significant share of the collateral pledged to the Eurosystem, but there are currently no metrics to account for climate risk in the valuation of these securities. There is growing evidence that the credit risk of sovereign bonds is linked to the climate resilience of countries (Anyfantaki et al., 2025; De Boyrie and Pavlova, 2020; Naifar, 2023; Yang and Hamori, 2023). However, there are doubts about the extent to which credit rating agencies are adjusting their assessments in response to climate risks. Moreover, the pricing of climate-related risks in sovereign bond markets remains partial and uneven, particularly in relation to physical risks. The pricing of climate risks varies according to countries' adaptation capacity and debt levels (Anyfantaki et al., 2026; Cevik and Jalles, 2022; Kling et al., 2025). There is a risk that market participants are underestimating the climate-related vulnerabilities of sovereign bonds, which account for 10% of the Eurosystem's collateral pool (see Figure 3.7 below).[30]

The global low-carbon transition could affect the fiscal position of national governments, particularly through the loss of fossil fuel rents in producer countries, which could reduce the value of their sovereign debt. The sources of transition risk discussed above could affect sovereign bond issuers' ability to repay their debts. However, sovereign credit ratings may partially account for ambitious climate targets and decarbonisation trends, but they do not appear to include metrics for exposure to transition risks such as national emissions and energy intensity(Cappiello et al., 2025). Credit rating agencies are developing new ways of measuring sovereign exposure to transition and physical risks,[31] but these are only starting to be integrated into their credit ratings. Similarly, current prices may not fully reflect climate risks and may be vulnerable to a sudden collapse of asset prices that could create market and liquidity risks (Miller and Dikau, 2022).

[30] For government debt, the probability of default depends to some extent on political factors that are relatively difficult to capture (Dafermos et al., 2022). Moreover, countries with monetary sovereignty may, in principle, respond to fiscal pressure with monetary expansion rather than outright default, implying that risks may materialise through inflation rather than outright default. Therefore, it is possible that government bond prices are less responsive to climate risks than private debt is.

[31] For instance, Moody's has started to integrate information from the IMF Climate Dashboard into estimates of countries' credit exposure to environmental risk (Moody's, 2024). Fitch Ratings developed Climate Vulnerability Signals to measure sovereign exposure to climate-related risks, but the tool is intended to be a screening device to flag sovereigns for additional analysis rather than a direct input into ratings (Fitch Ratings, 2023).

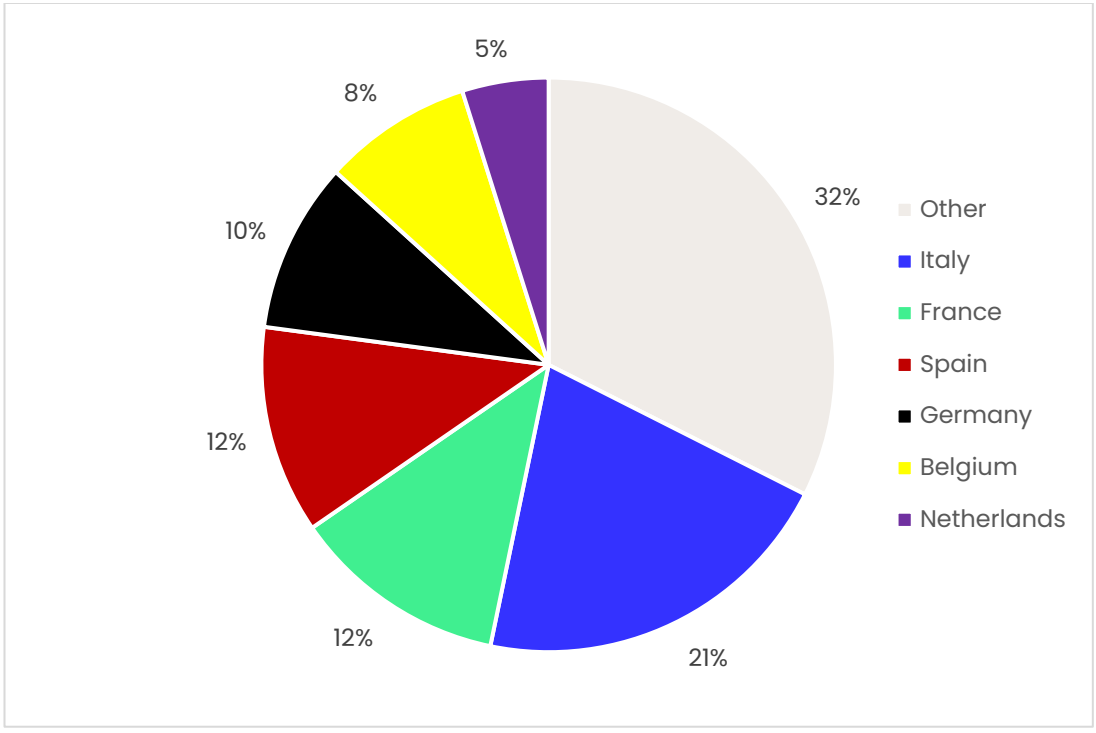
Figure 3.7. Use of sovereign bonds as Eurosystem collateral



Sources: ECB; authors.

Applying a climate factor to sovereign collateral could have implications for Member States' political economy and fiscal positions. Given that the ECB accepts sovereign bonds from Member States, any climate-based adjustment to the collateral value of the bonds could be perceived as the central bank treating these countries differently or evaluating national governments' policies. These are highly sensitive issues, as reducing the collateral value of sovereign bonds could increase borrowing costs for the countries that issued them. Given that this would make such an approach difficult to implement, such considerations would need to shape the design of a sovereign climate factor.

Figure 3.8. Major sovereign bonds in the Eurosystem's eligible collateral pool



Source: Authors' analysis based on ECB data.

Nonetheless, from a strictly risk-based perspective, the climate factor could, in principle, extend to sovereign bonds. While the political and institutional constraints outlined above are significant and would need to shape any policy design, they do not eliminate the underlying need to manage climate-related risks.

The BoE has also assessed sovereign bonds' exposure to climate risk, recognising that climate change can affect the determinants of sovereign yields. This exercise (BoE, 2024a) estimated yield curves following projected changes in policy interest rates and sovereign credit ratings in various climate scenarios, which it applied to two portfolios of differing average maturities. Losses occurred in both portfolios, particularly the one with longer maturities, in which deteriorating sovereign creditworthiness compounded the effect of rising interest rates.

Building an uncertainty score for sovereign bonds

A sovereign uncertainty score would need to depart from the approach developed for non-financial corporate bonds, since the factors that drive transition risk for sovereign issuers differ from those for corporates. The issuer- and sector-specific factors could be captured in a single component that assessed, for instance, a country's climate governance, the ambition and credibility of its emissions reduction targets, and the alignment of its policy and fiscal framework with the low-carbon transition. The asset-specific maturity component may be particularly important in this: the longer it takes for a sovereign bond to mature, the longer it will be exposed to transition risks.

Table 3.4. An uncertainty score for sovereign bonds

Uncertainty score component	Content	Information Source
Issuer-specific exposure (E)	Exposure of the sovereign to transition risk. Relevant metrics include: Backward-looking emissions trends Alignment of forward-looking emissions targets Climate governance, policies and disclosure	Third-party assessments, such as ASCOR
Asset-specific vulnerability (V)	Residual maturity	Centralised Securities Database (CSDB)
$$u_{i,j,s} = V_i \times E_j$$		

The issuer-specific component for sovereign bonds could draw on existing frameworks for assessing countries' climate performance. Such frameworks measure countries' progress in the low-carbon transition, thereby assessing their exposure to transition risks. Countries that set ambitious climate targets, steadily decarbonise and follow robust climate policies are more likely to manage and reduce their exposure to transition risks than those that do not do so – and may, therefore, face lower adjustment costs as the transition progresses. The complex landscape of countries' climate performance data comes from a range of tools that were developed for diverse purposes and audiences. These include:

- **Tools that track and evaluate the alignment of national emissions targets with global temperature goals**, such as Assessing Sovereign Climate-related Opportunities and Risks

(ASCOR; TPI Centre, 2026), the Climate Action Tracker (2026), the Net Zero Tracker (2026) and the 1.5°C National Pathways Explorer (2026).

- **Trackers that systematically evaluate specific climate policies**, such as ASCOR and the Oxford Climate Policy Monitor (2026).
- **Portals that enable users to explore relevant climate data**, such as Climate Watch (2026), the World Bank's Sovereign ESG Data Portal (2026) and the International Monetary Fund's (IMF) Macroeconomic Climate Indicators Dashboard (2026)
- **Indices that create aggregate rankings of countries' environmental performance**, such as the Climate Change Performance Index (2026) and the Environmental Performance Index (Yale Center for Environmental Law and Policy, 2026).
- **Dedicated indices for measuring sovereign exposure to physical risk**, such as the Notre Dame Global Adaptation Initiative (2026), GermanWatch's Climate Risk Index (Germanwatch e.V, 2026) and the European Commission's INFORM Climate Change Tool (European Commission Joint Research Centre, 2026).
- **Commercial datasets such as MSCI's Climate Change and Natural Hazards Risk Factor Score**, which measures exposure to physical and transition risks. This covers emissions, fossil fuel rents and fossil fuel subsidies. MSCI also provides a Sovereign Implied Temperature Rise metric and a Sovereign Climate Value-at-Risk metric.

The three subscores of the corporate climate score discussed in Section 2 could be adapted to create the issuer-specific component for sovereign bonds. Backward-looking climate metrics could include countries' historical greenhouse gas emissions (taking an absolute or intensity-based approach) and their rate of decarbonisation. Forward-looking metrics could include countries' NDCs and long-term net zero commitments. Countries with credible and ambitious targets could receive more favourable scores, especially if their targets were validated by one of the target alignment tools listed above. In the case of sovereigns, the third subscore for climate disclosures could focus on the robustness of climate governance and the transparency of reporting.

The ASCOR tool is already gaining traction in financial markets, providing a comprehensive, open-access and transparent breakdown of national climate performance. Since ASCOR was launched as an investor-led initiative, the development of the tool's analytical approach and methodology has been informed by the priorities of sovereign bondholders. Market participants have started incorporating this climate data into sovereign investment products. For example, Robeco recently launched an exchange-traded fund that tracks a climate index constructed by FTSE Russell (ING, Robeco and FTSE Russell, 2025).[32] The use of ASCOR data in the development of financial products demonstrates its support from investors and its market relevance, suggesting that it could also have value as a measure of transition risk for sovereign bonds in the ECB's collateral framework (see Box 3.2).

Box 3.2. ASCOR in assessments of sovereign climate

Antonina Scheer *(TPI Global Climate Transition Centre)*

The ASCOR tool is designed to be a comprehensive resource for investors and other stakeholders who seek to understand national climate performance. It comprises the pillars of Emissions Pathways, Climate Policies and Climate Finance, which are divided into 14 thematic areas that demonstrate whether and how a sovereign is managing climate risks and opportunities.

[32] The European Monetary Union-focused index uses ASCOR assessments to over-weight the sovereign bonds of countries that demonstrate strong climate commitments and progress. The index is designed to provide investors with exposure to sovereign debt that aligns with climate-conscious investment criteria, while preserving the standard relationship between risks and returns.

Figure 3.9. Overview of ASCOR framework

Overview of the ASCOR framework		
Pillar 1. Emission Pathways (EP)	Pillar 2. Climate Policies (CP)	Pillar 3. Climate Finance (CF)
EP 1. Emissions trends	CP 1. Climate legislation	CF 1. International climate finance
EP 2. 2030 targets	CP 2. Carbon pricing	CF 2. Transparency of climate costing
EP 3. 2035 targets	CP 3. Fossil fuels	CF 3. Transparency of climate spending
EP 4. Net zero targets	CP 4. Sectoral transitions	CF 4. Renewable energy opportunities
	CP 5. Adaptation	
	CP 6. Just transition	

Source: TPI Centre (2025).

In adapting the three subscores of the corporate climate score discussed in Section 3, select components of the ASCOR tool could be used to create the issuer-specific component of the sovereign uncertainty score. In this way, the associated climate factor could draw on assessment data specifically designed to handle the distinctive uncertainties sovereigns face in evaluating net zero transition risks.

Backward-looking climate metrics are included in area EP 1 (emissions trends). A country's emissions trends are assessed in several ways to account for a variety of factors. This includes emissions in absolute terms and on the basis of intensity, as well as production-based and consumption-based emissions. Most emissions data are sourced from the PRIMAP-hist dataset hosted by Climate Resource.

Forward-looking climate metrics are included in EP 2-4 (2030, 2035 and net zero targets) and CF 4 (renewable energy opportunities). The alignment of medium-term NDC targets for 2030 and 2035 is evaluated against country-specific benchmarks, covering both least-cost optimisation models and fair-share considerations (EP 2-3). A clear disclosure on the intended reliance on carbon credits under NDC targets is also evaluated, which lends credibility to these commitments. Net zero commitments are benchmarked against 2045 and 2050 timelines (EP 4). The pipeline of prospective renewable energy capacity under construction in a country (CF 4) provides forward-looking information on the speed with which a country is decarbonising.

Relevant climate disclosures that communicate how a sovereign is managing transition risk are assessed across most areas in Climate Policies (CP 1-4 and 6) and Climate Finance (CF 2-3). A country is more likely to achieve its climate targets if it adopts a framework climate law (CP 1), sets a price on carbon (CP 2), initiates the phaseout of fossil fuel subsidies and production (CP 3), and establishes a variety of sectoral policies (CP 4). Just transition policies, such as those to manage the distributional impacts of carbon pricing (CP 6), can help build public trust and prevent costly delays in decarbonisation. Transparent reporting on the costs of meeting climate goals (CF 2), as well as the expenditures already allocated to these goals through practices such as climate budget tagging (CF 3), also build confidence in a country's ability to achieve its intended low-carbon goals and thereby manage climate risks.

Together, these areas provide a comprehensive and transparent set of building blocks that could be aggregated in the ECB's issuer-specific exposure score for sovereign bonds. The ASCOR assessment for each country is composed of binary yes/no indicators and quantitative (continuous) metrics organised into the areas shown in the table above. Rather than aggregating country assessment results into a single score, the ASCOR tool provides a transparent and granular picture of country performance. However, it would be possible to create an aggregate score for the purposes of the sovereign uncertainty score.

The TPI Centre developed a pillar score methodology to synthesise ASCOR results by normalising all binary indicators and metrics on a scale of 0 to 1, where all 'yes' results correspond to 1. Indicators and metrics in each area can be averaged to create an area score, which can be weighted equally or based on the judgements of the data user (see Box 3.1 in Scheer et al., 2024). By combining the two pillars on Climate Policies and Climate Finance into one pillar score, countries can be grouped by quartile to compare their relative performance against the ASCOR framework (see Table 3.5). This approach could be adapted to create a score for the ECB's collateral framework, aggregating results in the areas that are most relevant to its aims.

Table 3.5. ASCOR pillar scores for high-income countries, organised by quartile

Quartile	Emissions pathways			Climate policies and finance		
First	Austria	Germany	Slovenia	Austria	France	Norway
	Barbados	Norway	Sweden	Canada	Germany	South Korea
	Chile	Panama	Switzerland	Chile	Ireland	Spain
	Denmark	Portugal	UK	Denmark	Netherlands	Sweden
	Finland			Finland		
Second	Bulgaria	Ireland	Luxembourg	Australia	Latvia	Slovenia
	Cyprus	Japan	Netherlands	Bulgaria	Lithuania	Switzerland
	Estonia	Latvia	New Zealand	Greece	Luxembourg	UK
	Hungary	Lithuania	Slovakia	Japan	Portugal	Uruguay
Third	Australia	Hong Kong	Romania	Belgium	Hungary	New Zealand
	Belgium	Israel	Singapore	Croatia	Israel	Panama
	Croatia	Italy	Spain	Cyprus	Italy	Romania
	France	Malta	Uruguay	Czechia	Malta	Slovakia
	Greece			Estonia		
Fourth	Bahrain	Oman	Russia	Bahrain	Oman	Saudi Arabia
	Canada	Poland	Saudi Arabia	Barbados	Poland	Singapore
	Czechia	Qatar	UAE	Hong Kong	Qatar	UAE
	Kuwait	South Korea	United States	Kuwait	Russia	United States

Source: Hizliok et al. (2025).

4. Design of the climate factor

There is a strong case for calibrating several features of the climate factor's design, such as the multiplicative structure of the uncertainty score. This section explores avenues for further development of the ECB's climate-related collateral policy.

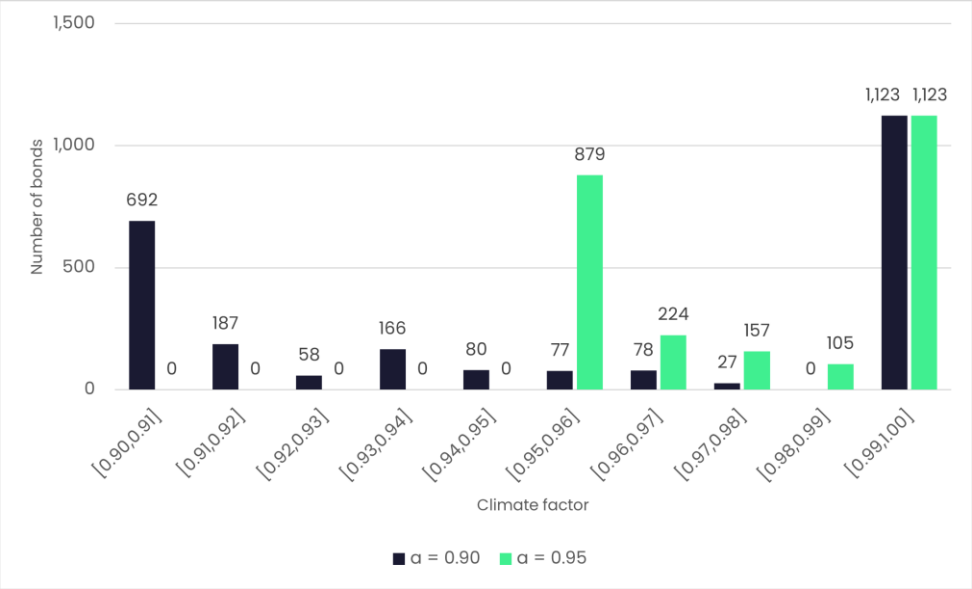
In refining the climate factor's methodology and scope, the ECB could draw on other central banks' experiences. These experiences are relevant to issues such as the calculation of the uncertainty score, the calibration of the climate factor, the treatment of residual maturity and its effect on green assets, and the absence of physical risk from the collateral framework. We draw on the BoE's experience of incorporating physical risk into collateral adjustments, the Hungarian National Bank's (MNB) haircut discounts for green securities, and the PBoC's preferential collateral treatment of green bonds.

4.1. Calibrating the climate factor and calculating uncertainty scores

The climate factor's methodology involves several design choices that are not derived from any formal theoretical model. Because the floor parameter and the multiplicative structure of the uncertainty score reflect policy judgements, there is no single theoretically correct configuration of the climate factor. A range of different choices in these areas could be equally defensible and produce materially different distributions of adjustments across assets. Therefore, it is worth exploring the potential of alternative configurations.

A key parameter in the calibration of the climate factor is α, which determines the lower bound (floor) of the climate factor and, accordingly, the upper bound of the adjustments. As discussed, we assume a value of 0.95. However, reducing this parameter would result in a wider distribution of adjustments to collateral values, while leaving the valuation of less exposed bonds largely unaffected (see Figure 4.1). As such, the parameter provides a flexible mechanism to modulate the intensity of the climate factor without altering its relative structure across assets.

Figure 4.1. Distribution of estimated climate scores with parameter *α* of 0.95 and 0.90



Sources: ECB; LSEG; authors. Note: In this example, the issuer-specific exposure is proxied by the LSEG Emission score for each company using the following scale: 83.33–100: 5, 66.67–83.33: 4, 50–66.67: 3, 33.33–50: 2, 16.67–33.33: 1, 0–16.67: 0. The sector-specific stressor is derived from the run-on-brown GVA sectoral shock of the 2024 Eurosystem climate stress test, using NACE categories. The asset-specific component is the square root of the residual maturity rounded up to the nearest year. Parameter α of the climate factor formula is set to 0.95, and parameter b is the median uncertainty score of the calculated sample (59% of eligible corporate bonds).

Like the floor parameter, the multiplicative structure of the uncertainty score has significant implications, as illustrated by three examples of the ECB's list of corporate bonds that are eligible as collateral (see Table 4.1). The three bonds are issued by companies in the real estate sector – which, in our assumed methodology, has a sectoral component of 0. Because of the multiplicative structure of the uncertainty score, these three securities would automatically receive climate factors of 1, despite having different residual maturities and issuer exposures. Differences in emissions at the firm level are effectively neutralised whenever the sectoral component has a minimal value.

Table 4.1. Examples of the ECB's eligible corporate bonds

ISIN	Issuer-specific component	Sector-specific component	Asset-specific component	Uncertainty score	Climate Factor
DE000A2R7JE1 (Vonovia SE)	1 (Score of 0)	0 (L - Real Estate)	3	0	1
FR001400SIL1 (UNIBAIL RODAMCO SE)	0.33 (Score of 3)	0 (L - Real Estate)	3	0	1
FR001400ZRC6 (ICADE)	0.2 (Score of 5)	0 (L - Real Estate)	3	0	1

Sources: ECB; LSEG Refinitiv; authors. Note: In these examples, the issuer-specific exposure is proxied by the LSEG Emission score for each company using the following scale: 83.33–100: 5, 66.67–83.33: 4, 50–66.67: 3, 33.33–50: 2, 16.67–33.33: 1, 0–16.67: 0. The sector-specific stressor is derived from the run-on-brown GVA sectoral shock of the 2024 Eurosystem climate stress test, using NACE categories. The asset-specific component is the square root of the residual maturity as of 5 March 2026, rounded to the nearest year. Parameter a of the climate factor formula is set to 0.95, and parameter b is the median uncertainty score of the calculated sample (59% of eligible corporate bonds).

This multiplicative structure makes the sector-specific stressor particularly important, as this stressor determines whether an entire sector receives any adjustment. A more granular categorisation of sectors could help address that issue, as current stress tests use broad sectoral categories that may mask significant differences within sectors. For instance, sectors such as utilities and manufacturing involve activities that have widely varying transition risk profiles. The choice of scenario is also consequential: recent delays in environmental regulation suggest that there is a distinct possibility of a more disorderly and delayed transition, resulting in more abrupt and severe economic shocks. Considerably larger GVA shocks featured in a disorderly transition scenario that the BoE (2022) explored using a more granular sectoral categorisation and a longer time horizon. There is also a possibility of transition and recession shocks that occur simultaneously, compounding risks (Hiebert and Monnin, 2025).

While this multiplicative structure has a clear risk rationale, alternative approaches could be equally defensible. The multiplicative approach ensures that there are no additional adjustments to assets in sectors that, in the stress test, were not exposed to transition-related risks. This concentrates adjustments in assets with the highest joint exposure, since each component amplifies the others. However, given the inherent limitations of any single stress test, issuer-level emissions exposure could warrant some adjustment even where the sector-level stressor is 0.

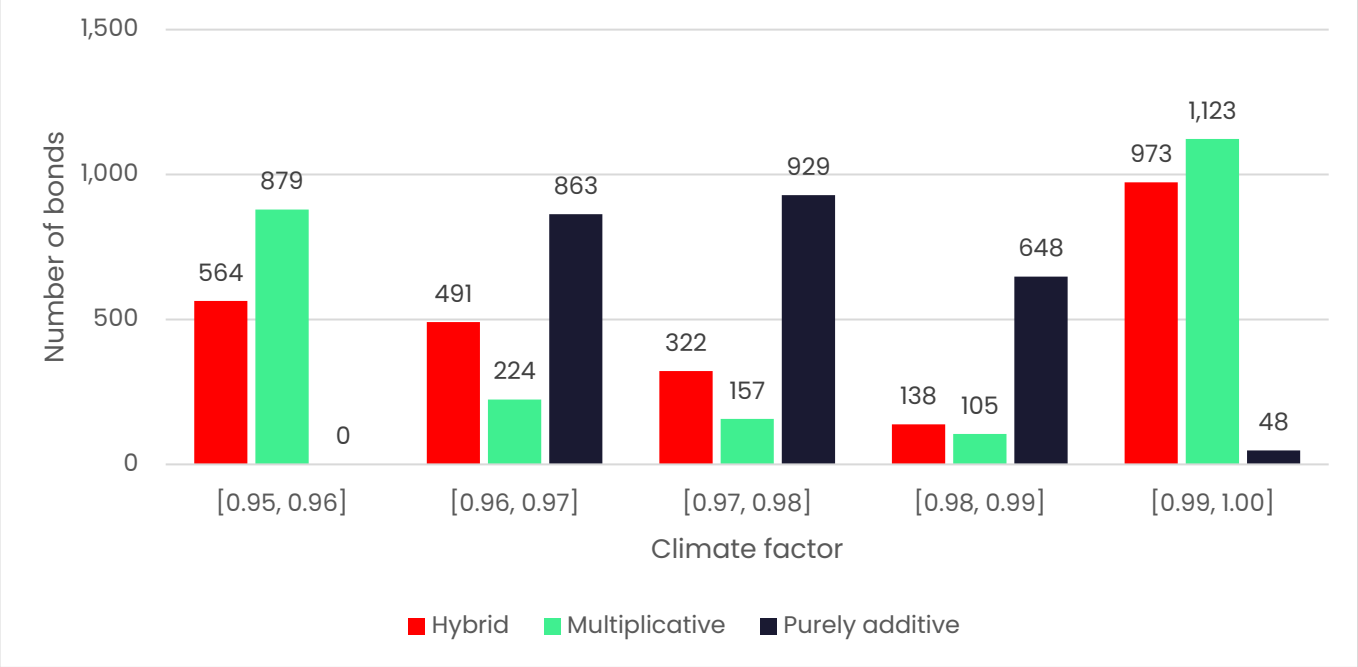
One alternative to the multiplicative uncertainty score could be an additive uncertainty score, or a hybrid of the two. In an additive formula, each component would contribute independently to the overall uncertainty score, preventing any one of them from nullifying the others. A possible middle ground would combine the issuer-specific and sector-specific components additively, while retaining the multiplicative relationship with residual maturity. The latter would reflect exposure to transition-related uncertainty that was specific to the asset. The results of the hybrid alternative formulation below are shown in Table 4.2. Figure 4.2 shows how different formulations may affect the distribution of factors.

$$u_{i,j,s} = V_i \times \left(E_j + S_s\right)$$

Table 4.2. Examples of the ECB's eligible corporate bonds, using a hybrid formula					
ISIN	Issuer-specific component	Sector-specific component	Asset-specific component	Uncertainty score	Climate Factor
DE000A2R7JE1 (Vonovia SE)	1 (Score of 0)	0 (L - Real Estate)	3	3	0.953
FR001400SIL1 (UNIBAIL RODAMCO SE)	0.33 (Score of 3)	0 (L - Real Estate)	3	1	0.971
FR001400ZRC6 (ICADE)	0.2 (Score of 5)	0 (L - Real Estate)	3	0.8	0.98

Sources: ECB; LSEG Workspace; authors. Note: In these examples, the issuer-specific exposure is proxied by the LSEG Emission score for each company using the following scale: 83.33–100: 5, 66.67–83.33: 4, 50–66.67: 3, 33.33–50: 2, 16.67–33.33: 1, 0–16.67: 0. The sector-specific stressor is derived from the GVA run-on-brown sectoral shock of the 2024 Eurosystem climate stress test. The asset-specific component is the square root of the residual maturity as of 5 March 2026, rounded to the nearest year. Parameter a of the climate factor formula is set to 0.95, and parameter b is the median uncertainty score of the calculated sample (59% of eligible corporate bonds).

Figure 4.2. Distribution of estimated climate factors with different uncertainty score methodologies



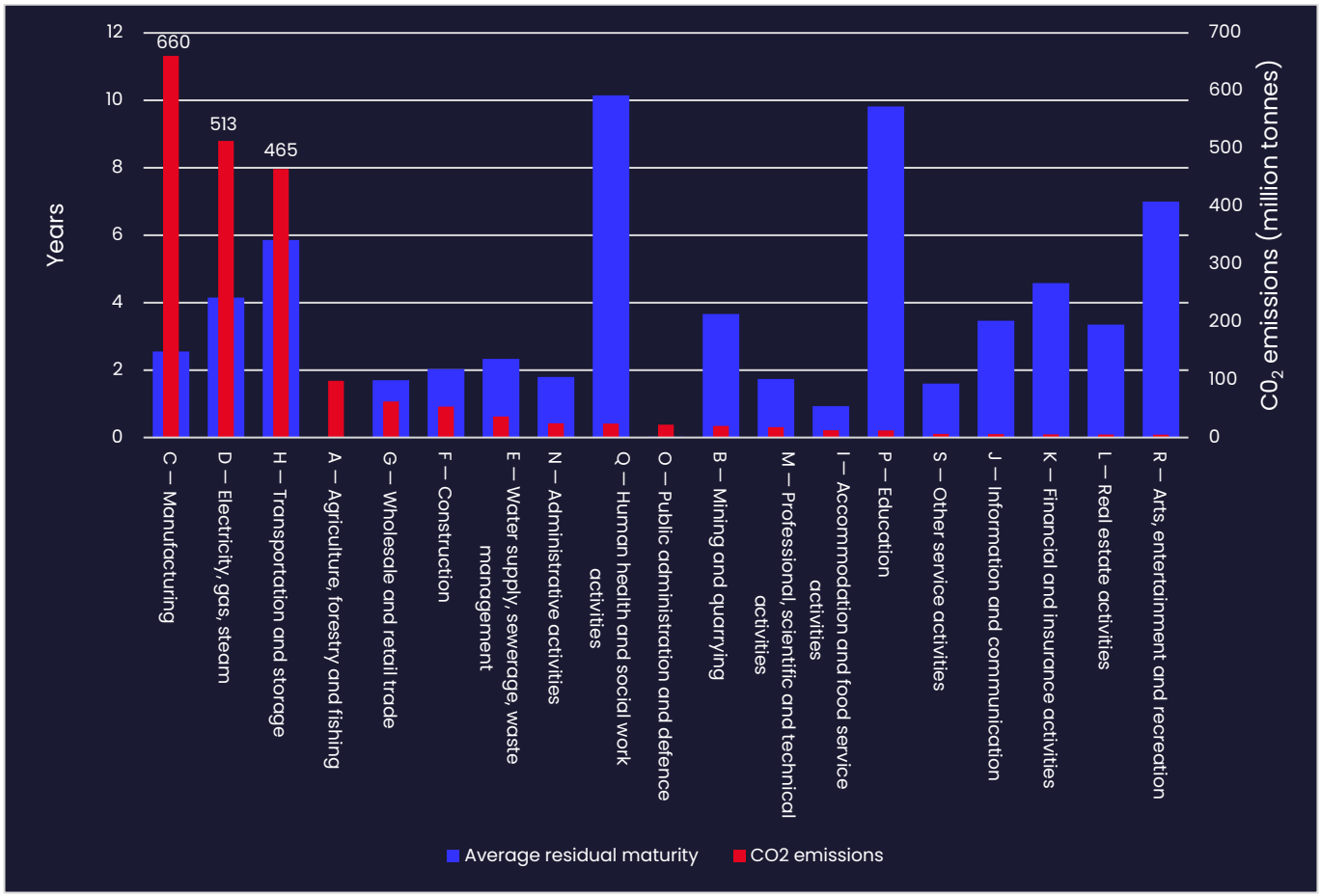
Sources: ECB; LSEG Workspace; authors. Note The issuer-specific exposure is proxied by the LSEG Emission intensity score for each company using the following scale: 83.33–100: 5, 66.67–83.33: 4, 50–66.67: 3, 33.33–50: 2, 16.67–33.33: 1, 0–16.67: 0. The sector-specific stressor is informed by the run-on-brown GVA sectoral shock in the first adverse scenario of the 2024 Eurosystem climate stress test. The asset-specific component is the square root of the residual maturity as of 5 March 2026. All components were normalised for the purely additive methodology. Parameter a of the climate factor formula is set to 0.95, and parameter b is the median uncertainty score of the calculated sample (59% of eligible corporate bonds).

The calibration of the climate factor depends on policymakers' risk appetite, requiring a balance between protecting the central bank's balance sheet from transition-related uncertainties and ensuring that adequate collateral is available. The ECB is legally required to ensure that adequate collateral is available and to provide access to its liquidity facilities. In practice, this places constraints on the extent of its adjustments. Within these constraints, however, the design choices discussed above may determine whether the climate factor produces adjustments that are large enough to reflect the underlying uncertainty, or whether they are too modest to substantively improve risk coverage of the collateral framework.

4.2. Residual maturity and the treatment of green assets

The treatment of residual maturity in the uncertainty score could also benefit from further discussion, given that it may have some counterintuitive effects. As discussed, longer maturities leave more time for transition-related shocks to materialise, justifying a higher uncertainty score. However, as Figure 4.3. shows, bonds in some of the most carbon-intensive sectors, particularly manufacturing, have shorter residual maturities on average, while less carbon-intensive sectors tend to issue longer-maturity bonds. Therefore, in practice, the maturity component can produce larger adjustments for lower-emitting assets than for some of the most carbon-intensive parts of the eligible collateral pool.

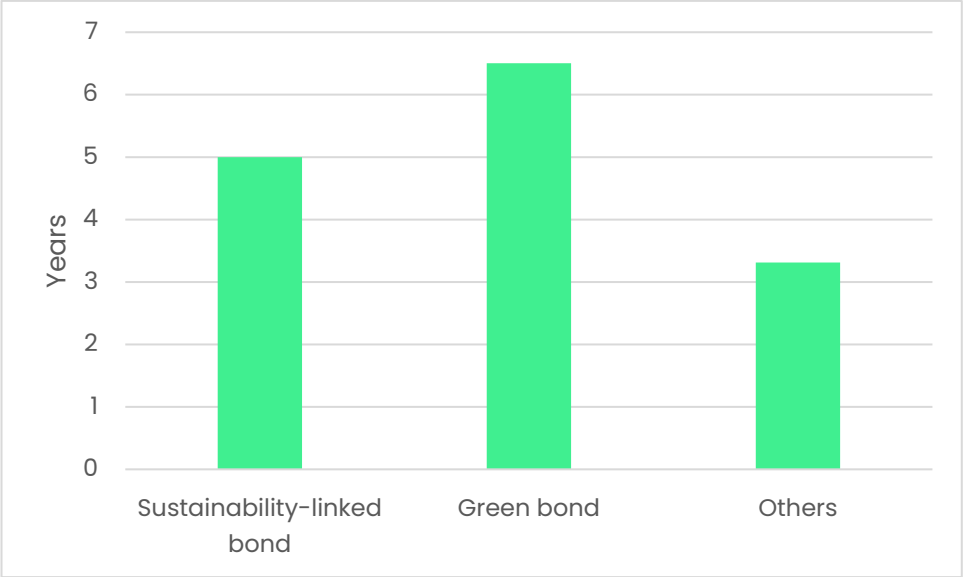
Figure 4.3. Average residual maturity and CO_2 emissions of eligible bonds, by NACE category



Source: Authors' analysis based on ECB and Eurostat data. CO_2 emissions data is as of 2024.

The same observation applies to green bonds, which tend to have longer maturities than conventional bonds (see Figure 4.4). This means that under the current methodology, green bonds may face larger collateral value adjustments than comparable conventional instruments. This can be illustrated with three eligible securities with similar characteristics issued by Electricité de France (see Table 4.2). All three receive near-identical climate factor values, but the green bond (aligned with Climate Bond Initiative standards) faces a marginally higher adjustment on account of its longer maturity.

Figure 4.4. Average residual maturity by type of bond



Source: Authors' analysis based on ECB, LSEG and EuroNext data.

Table 4.3 Three examples with Eligible Corporate Bonds

ISIN	Issuer-specific component	Sector-specific component	Asset-specific component	Uncertainty score	Climate Factor
FR0013213303 Electricite de France (EDF)	0.25 (Score of 4)	8 (D – Utilities)	3.3	6.63	0.95002
FR001400FDG9 EDF	0.25 (Score of 4)	8 (D – Utilities)	3	6	0.9501
FR001400D6O8 EDF CBI aligned *green bond*	0.25 (Score of 4)	8 (D – Utilities)	3	6	0.9501

Sources: ECB; LSEG Workspace; authors. Note: In these examples, the issuer-specific exposure is proxied by the LSEG Emission score for each company using the following scale: 83.33–100: 5, 66.67–83.33: 4, 50–66.67: 3, 33.33–50: 2, 16.67–33.33: 1, 0–16.67: 0. The sector-specific stressor is the GVA sectoral shock in the first adverse scenario of the 2024 Eurosystem climate stress test. The asset-specific component is the square root of the residual maturity as of 5 March 2026. Parameter a of the climate factor formula is set to 0.95, and parameter b is the median uncertainty score of the calculated sample (59% of eligible corporate bonds).

From a strictly risk-based perspective, a green bond and a conventional bond from the same issuer carry comparable risk. The bondholder's claim is against the issuer, not against the specific use of proceeds, and there is no conclusive evidence that green bonds are less volatile or more liquid than

conventional bonds (Fornari et al., 2026; Dziwok et al., 2026; Yan et al., 2025). This explains why the ECB's climate factor does not differentiate between green and conventional bonds.[33]

However, drawing on existing precedents, some favourable treatment could counterbalance the maturity bias discussed above. The MNB, for example, offers haircut discounts of up to 5 percentage points for green bonds and green mortgage bonds, conditional on issuers publishing allocation and impact reports (see Table 4.3). Notably, even non-green assets can qualify for smaller discounts if issuers provide climate risk reports. Furthermore, the PBoC has granted a 'first-among-equals' status to green bonds rated at least AA in its Medium-term Lending Facility, with the evidence suggesting this confers a yield advantage (Macaire and Naef, 2021; Fang et al., 2023).[34] The ECB has granted collateral eligibility to sustainability-linked bonds (ECB, 2020a) and increased primary market bidding of green bonds while tilting its corporate reinvestments (ECB, 2025b).

Table 4.4. Haircut treatment at the Hungarian National Bank

Security	Haircut Discount	Maximum value (cap)	Conditions (publications of reports)			
			Allocation	Impact	Transparency	Climate Risk Report (for non-green assets)[35]
Green bonds	20 %	5 pp	✓	✓	n/a	n/a
Green mortgage bonds	20 %	5 pp	✓	✓	✓	n/a
Non-green assets	10 %	2 pp	n/a	n/a	n/a	✓

Source: Authors' analysis based on MNB (2023). Note: 'pp' stands for percentage points; 'n/a' for not applicable.

A similar logic could be applied to sovereign bonds, given the sensitivities around downward adjustments in their collateral value. As discussed in Section 3.4, introducing climate-related adjustments to sovereign collateral could be interpreted as the ECB treating Member States differently or evaluating government policy. Haircut discounts would avoid the most acute version of this problem, and could operate on two levels: at the bond level, by offering preferential treatment to green-labelled sovereign bonds; at the issuer level, by linking discounts to a country's overall climate governance, policy framework and emissions trajectory, assessed through frameworks such as ASCOR (see Box 3.2). Discounts could reflect the lower risk exposure of countries that are actively managing

[33] Green bonds may benefit indirectly under the current methodology, to the extent that the transition-aligned activities they finance improve the issuer's emissions trajectory over time, which would be reflected in a more favourable climate score. However, this effect would be indirect and would depends on the issuer's overall emissions profile rather than the specific instrument.

[34] Both the MNB and the PBoC have explicit environmental objectives that may have facilitated the introduction of such measures.

[35] For non-green assets, haircut discounts may still be applied if climate risk reports align with international standards or legislative norms. These include (but are not limited to) EU Regulation 2019/2088 on sustainability-related disclosures in the financial services sector, the CSRD and the Task Force on Climate-related Financial Disclosures.

their transition and thereby reducing their vulnerability to climate-related uncertainties, while incentivising other sovereigns to strengthen their climate governance.[36]

A key challenge in favouring green assets is in identifying qualifying instruments and verifying their integrity, given that there remain significant concerns about greenwashing (EBA, 2023; ESMA, 2024). The credibility of preferential treatment would depend on robust standards for identifying genuinely green instruments that meaningfully support the transition. The European Green Bond Standard and the EU Taxonomy could, in principle, provide a basis for this at the ECB, but they are still in relatively early stages of development and adoption.

4.3. Physical risk

The ECB's climate factor currently addresses only transition-related uncertainties, but the Eurosystem's balance sheet is also exposed to uncertainties stemming from climate-related physical hazards. Climate change increases the frequency and severity of extreme weather events such as floods and wildfires, and will have long-term consequences for sea-level rise, declining land productivity and new patterns of drought and water scarcity. These hazards can affect the valuation of assets used as collateral, particularly ABS and covered bonds backed by real estate, through either direct damage or downward repricing of assets in affected areas. The absence of physical climate-related uncertainties in the climate factor could, therefore, be seen as a gap in the framework's risk coverage.[37]

The BoE has already introduced physical risk adjustments to the haircuts and eligibility of mortgages in its collateral framework. Over 75% of the Bank's collateral pool is made up of residential mortgage loans (BoE, 2025a), which are sensitive to physical hazards that erode property values, such as floods, and to transition policies that increase households' energy bills.[38] These measures, which the BoE describes as the first collateral adjustments to reflect a "quantitative assessment of climate risks" (BoE, 2025b, Box A), penalise flood-exposed properties and those with low EPCs, with haircuts calibrated according to different scenarios in the Climate Biennial Exploratory Scenario exercise. In terms of eligibility, mortgages that do not comply with the Domestic Minimum Energy Efficiency Standard, which requires a current EPC rating of at least 'E', are no longer accepted as collateral in the Bank's Sterling Monetary Framework operations (BoE, 2024c). While the adjustments are framed as risk management, they also create material incentives, steering demand away from energy-inefficient and flood-exposed properties, and encouraging retrofitting and flood-resilience improvements. In the medium term, this helps protect the mortgages the BoE holds as collateral.

For the ECB, the most natural entry point for physical climate-related uncertainties may be through the stress test scenarios that feed into the sector-specific stressor. The climate factor targets liquidation price risk during the period necessary to sell assets to third parties. While physical risk may operate on different timescales because chronic hazards unfold gradually, acute events such as floods can lead to sudden repricing. By incorporating physical risk into these stress test scenarios, the ECB would take a step towards ensuring that physical hazards were reflected in the architecture of the climate factor.

However, it is important to consider the distributional consequences of incorporating physical risk into collateral adjustments. Physical hazards disproportionately affect lower-income households and regions that tend to bear the least responsibility for climate change (Chaudhuri and Huaccha, 2023; Sayers et al., 2018). Downward adjustments to assets exposed to physical risk, such as mortgages in flood-prone areas, could increase borrowing costs for the most vulnerable communities without creating any corresponding incentive for adaptation investment. In the context of the BoE's reforms, complementary government policy would ideally ensure that climate-related collateral adjustments produced equitable outcomes (Claeys et al., 2024).

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[36] Nonetheless, even a reward-based approach would involve the ECB making judgements about climate performance across Member States, which would still be somewhat politically sensitive.

[37] This gap may become more consequential over time, particularly if the low-carbon transition proceeds more slowly than assumed in current baseline scenarios.

[38] Evidence on the effects of physical risks is discussed by Nguyen et al. (2022), Skouralis et al. (2024) and Fontana et al. (2025), whereas research on the effects of transition policies on mortgage credit risk has been conducted by Bell et al. (2023), Ferentinos et al. (2021) and Schütze (2020).

Central banks may also need to account for the interconnected challenges that nature-related risks present. The interaction between climate and nature is complex (Almeida et al., 2025). For example, climate change amplifies flood risks, while environmental degradation further compromises ecosystem services such as flood protection, an area that is highly relevant to more than 10% of euro area bank loans (Ceglar et al., 2025). Accordingly, it will be vital to understand how these compounding stressors could materialise as sources of risk for central balance sheets, and how collateral frameworks could better account for this.

5. Conclusion

The ECB's climate factor establishes a framework that, with further development, could significantly extend climate risk coverage across the Eurosystem's collateral pool. We have considered the case for extending the climate factor to credit claims, ABS, covered bank bonds, and sovereign bonds, which together represent approximately 88% of pledged collateral. We have proposed adapted uncertainty scores in each area, drawing on existing data infrastructure and third-party assessment frameworks to conclude that a phased approach to implementation would allow the ECB to act on the basis of available data while accommodating future improvements in coverage. We have also explored avenues for developing the methodology and scope of the climate factor, including its calibration, the treatment of green assets and the incorporation of physical risk.

Collateral rules shape not only the central bank's own risk exposure but also asset pricing and funding conditions in financial markets. Although the climate factor is designed as a risk management tool, any systematic climate-related adjustment to collateral valuations has the potential to generate market signals that favour assets with lower exposure to climate risks. The extent to which this positive side-effect may significantly depend on the transparency of the measure.[39] Other central banks' experiences[40] suggest that public disclosure can materially shape market pricing, whereas opaque or high-level signalling limits the impact of climate-related policies beyond the bank's balance sheet. If the ECB published climate factor values alongside standard haircuts in its list of eligible assets, this would allow banks and investors to identify which assets faced higher or lower collateral valuations and to adjust their portfolio choices accordingly.[41] By contrast, limited disclosure could weaken the market-based transmission channel. This occurred in the ECB's CSPP tilting, in which the bank did not publish individual corporate climate scores. Therefore, if the ECB wants to ensure that the climate factor influences financing conditions beyond its immediate risk management function, it will be important to maintain transparency around both the scores and their underlying methodology.

Effective transparency requires a supportive regulatory and data environment. The journey from the ECB's first climate plan in 2021 to the climate factor's scheduled implementation in 2026 illustrates how policy ambition can be constrained by shifts in the regulatory landscape, particularly the scaling back of the CSRD through the Omnibus simplification package. Policymakers face the challenge of minimising reporting burdens while improving the availability of climate-related data, including that on Scope 3 emissions and asset-level information relevant to structured finance. This can be achieved by harmonising data standards, pooling existing information, and reusing supervisory and public data sources.[42] Central banks can also play a signalling role by embedding transparency requirements in their own operations, as illustrated by the MNB's use of standardised reporting templates as conditions for eligibility. Such approaches can support disclosure practices over time while remaining compatible with phased implementation that reflects current data constraints.

Incorporating physical risks and nature-related financial risks into collateral frameworks is a potential avenue for comprehensive, robust risk coverage. The BoE's adjustments to mortgage haircuts based on flood exposure provided an early example of how physical risks could be integrated into these frameworks. However, this raises equity concerns, as adjusting the collateral value of assets on the basis of geographic exposure could disproportionately affect countries and regions that bear the least responsibility for climate change, where constrained financing will only make adaptation harder. Nature-related risks present a different challenge: while there is growing recognition of their potential to generate financial instability, the methodological tools and data infrastructure needed to translate them into collateral valuations remain at an early stage of development. Both dimensions will require

[39] For central banks with explicit environmental mandates, this may be an objective rather than a side-effect of climate-related collateral policies.

[40] See, for example, the differences between the impact of the BoE's Corporate Bond Purchase Scheme (CBPS) and its subsequent green tilting. The spreads of bonds eligible for CBPS decreased after the announcement of the scheme (Boneva et al., 2018), but the subsequent green tilting only produced minor differences on purchase days (Noss, 2026), possibly due to the lack of signals and other communication about which firms were considered stronger climate performers (BoE, 2025b).

[41] Moreover, climate factors could be recalculated daily rather than annually, as is the case with haircuts.

[42] See Smoleńska et al. (2026) for a more detailed discussion of increasing the efficiency of the EU's data architecture.

careful analytical and policy work before they can be meaningfully integrated into collateral frameworks.

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