

# BEYOND DISCLOSURE: EMBEDDING CLIMATE TRANSITION RISK IN FINANCIAL SUPERVISION AND BANKING STRATEGY

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**Abstract:** *The paper explores the integration of climate transition risk into the financial supervision of banks, with a particular focus on regulatory evolution and strategic responses to an increasingly stringent sustainability policy environment. As governments advance commitments to net-zero transition pathways, banks face heightened exposure to risks arising from abrupt regulatory adjustments, the potential stranding of carbon-intensive assets, and rapidly shifting investor and client expectations.*

*The study examines how supervisory authorities, especially within the European Union, are moving beyond disclosure-based approaches to incorporate climate transition risk into prudential supervisory frameworks. It reviews key regulatory instruments, including the European Central Bank's Guide on Climate and Environmental Risks, the European Banking Authority's finalized Guidelines on the Management of Environmental, Social, and Governance Risks, and emerging practices in climate-related stress testing.*

*Special attention is devoted to the conceptual and methodological challenges associated with assessing transition risk, such as non-linear risk dynamics, scenario design, and the selection of appropriate time horizons. The paper also analyzes how banks are adapting their internal risk management and assessment frameworks in response to supervisory expectations. In addition, it provides insights into the heterogeneity of supervisory implementation across EU Member States and discusses the implications for banking strategy, particularly in the areas of capital planning, risk appetite, and portfolio alignment.*

*The paper concludes with policy-oriented recommendations aimed at strengthening supervisory convergence and embedding climate transition risk within prudential supervision in a proportionate, forward-looking, and effective manner.*

**Keywords:** *climate transition risk, prudential supervision, climate stress testing, NGFS scenarios, Climate-Policy Relevant Sectors, prudential transition plans, loan-pricing carbon premium*

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## Introduction

Climate transition risk refers to the financial consequences of the policy, technology, and market changes required to move the economy toward net-zero greenhouse-gas emissions. For banks, this means that some clients, especially those in carbon-intensive sectors such as energy, steel, or aviation, may face rising costs, declining demand, or asset stranding. Conversely, firms

investing in low-carbon technologies may gain competitive advantage. The transition is therefore both a risk and an opportunity, but it must be managed within prudential frameworks.

For the past decade, much attention has gone into climate-related financial disclosure frameworks (such as the Task Force on Climate-related Financial Disclosures and its successor, the IFRS International Sustainability Standards Board. These have improved transparency but have not guaranteed that banks' strategies or supervisors' assessments change accordingly. As the Basel Committee on Banking Supervision notes, climate change poses "unique and significant challenges to the banking system," and supervisors should ensure that risks are identified, measured, and managed, not merely disclosed [1].

The European Central Bank has led in practice: it issued its Guide on Climate-Related and Environmental Risks. Supervisory Expectations Relating to Risk Management and Disclosure and then it ran an economy-wide climate stress test in 2021 and a banking-sector stress test in 2022, both of which showed that early action reduces losses, but also that banks' capabilities were inadequate [2]. The European Banking Authority in 2025 published Final Guidelines on ESG risks under the Capital Requirements Directive VI, requiring banks to prepare prudential transition plans, that is, forward-looking, risk-based strategies for managing climate transition risks as part of their capital and governance processes [3].

We argue that supervisors and banks should build on disclosure and move "beyond" it by using Climate-Policy Relevant Sectors sector mapping and NGFS scenarios to systematically embed transition risk in their strategies, risk assessments, and supervisory dialogues. This article sheds light on the concepts in and demonstrates how they can be used without advanced quantitative modeling.

### Literature Review

The recognition that climate change poses systemic risks to finance began with The Green Swan report by the Bank for International Settlements and Banque de France, which described climate change as a "potential source of the next systemic financial crisis" because of its radical uncertainty and longtime horizons [4]. Early academic work such as Battiston et al. demonstrated that financial networks could amplify the impact of climate policy shocks, creating contagion effects through portfolios of carbon-intensive assets. Carney, in his "Tragedy of the Horizon" speech, similarly argued that short planning horizons in finance clash with the long-term nature of climate risks.

The Basel Committee on Banking Supervision in 2022 codified this recognition by publishing 18 principles for banks and supervisors on climate risk management [5]. These principles emphasize governance, risk identification, scenario analysis, and supervisory review. The European Central Bank followed with an economy-wide climate stress test in 2021 and a dedicated supervisory stress test in 2022 [6], both of which showed that banks with more carbon-intensive portfolios face higher credit losses. The ECB's thematic review highlighted persistent gaps in data and methodologies, requiring remediation. The Bank of England's Climate Biennial Exploratory Scenario tested banks and insurers against orderly, disorderly, and "no additional action" scenarios, concluding that early, orderly transition reduces overall losses. The Federal Reserve's 2023–24 Pilot Climate Scenario Analysis marked the first US supervisory exercise, focused on learning about practices rather than setting capital requirements.

The Network for Greening the Financial System has become the global standard-setter for climate scenarios. Since 2018, NGFS has released iterative scenario sets, drawing on Integrated

Assessment Models such as REMIND-MAgPIE, MESSAGE-GLOBIOM, GCAM, and IMAGE [7]. The Phase V scenarios (2024/25) revised key parameters: orderly decarbonization requires a higher carbon price trajectory (around \$300 per ton of CO<sub>2</sub> by 2035) and chronic physical damages are projected at two to four times higher than earlier versions [8]. The short-term NGFS scenarios (2025–2030), released in May 2025, added narratives specifically designed for financial-stability planning horizons, including sudden policy tightening (“Sudden Wake-up Call”) and compound hazard events (“Disasters & Policy Stagnation”) [9]. These scenarios provide explicit GDP, unemployment, and carbon-price anchors for near-term prudential planning.

A challenge for banks is mapping financial exposures to scenario variables. Battiston et al. proposed the taxonomy of CPRS, later refined into granular mappings that connect NACE industrial codes to IAM variables [10]. This allows banks to identify which sectors, such as fossil fuels, utilities, transport, and heavy industry, are most exposed to transition policies, and to apply scenario shocks consistently. Supervisory bodies such as the ECB, EBA, and EIOPA have incorporated CPRS into pilots, emphasizing its comparability and reproducibility [11].

Empirical studies confirm that markets are beginning to internalize transition risks. Altavilla et al. find that euro-area banks charge higher loan spreads to high-emission firms and lower spreads to those with credible decarbonization commitments, consistent with a “climate risk-taking channel” in monetary policy transmission [12]. Delis et al. similarly show that syndicated loan markets penalize carbon-intensive borrowers [13]. Krueger, Sautner, & Starks report from surveys that institutional investors already incorporate climate risk into portfolio decisions. Bolton & Kacperczyk find that firms with higher carbon emissions face higher cost of capital, especially in countries with stronger climate policies.

The development of disclosure and alignment frameworks underpins supervisory and market action. The International Sustainability Standards Board issued IFRS S2 in June 2023, consolidating climate disclosure requirements around governance, risk management, metrics, and transition plans [14]. The Partnership for Carbon Accounting Financials provides a Global GHG Accounting and Reporting Standard for calculating financed emissions. The Paris Agreement Capital Transition Assessment offers a methodology for measuring whether portfolios align with Paris-compatible technology pathways [15]. These tools are increasingly referenced by supervisors, ensuring consistency between disclosure and prudential analysis.

A growing emphasis is placed on the credibility of firms’ transition plans. The Science Based Targets initiative validates whether corporate emission-reduction targets are consistent with 1.5 °C pathways [16]. SBTi validates corporate GHG-reduction targets against climate science. Companies commit to cut emissions by a specific percentage (often 30-50% by 2030) in line with a 1.5 °C pathway. For banks, SBTi-style commitments provide signals that can reduce risk assessments under transition scenarios [17]. Bolton et al. argue that credible transition plans are critical for capital allocation decisions and financial stability.

The literature converges on three points:

- climate transition risks are real and material for banks and financial stability,
- supervisors have established principles and are building tools (scenarios, CPRS, disclosure standards) to embed them,
- empirical evidence shows that markets are already differentiating firms by emissions intensity and transition credibility.

The challenge now is to integrate these insights into prudential supervision and banking strategy in a way that is practical, comparable, and decision-useful.

## Methodology

Our methodological approach is intentionally simple and practice-oriented, focusing on steps that can be realistically implemented by banks and supervisory authorities. The analysis begins with mapping bank exposures using Climate Policy-Relevant Sectors (CPRS), which enables institutions to classify all portfolio exposures into transition-relevant categories. Compared with standard industry classifications, this approach provides greater granularity by recognizing that activities within the same broad sector are not equally exposed to transition risk. For example, carbon-intensive activities such as steel and cement production face substantially higher transition risks than less emission-intensive activities such as textiles. Applying the CPRS framework allows policy and technology scenarios developed by the Network for Greening the Financial System (NGFS) to be directly linked to specific portfolio segments, thereby providing a clear and transparent assessment of banks' exposure to transition-sensitive economic activities.

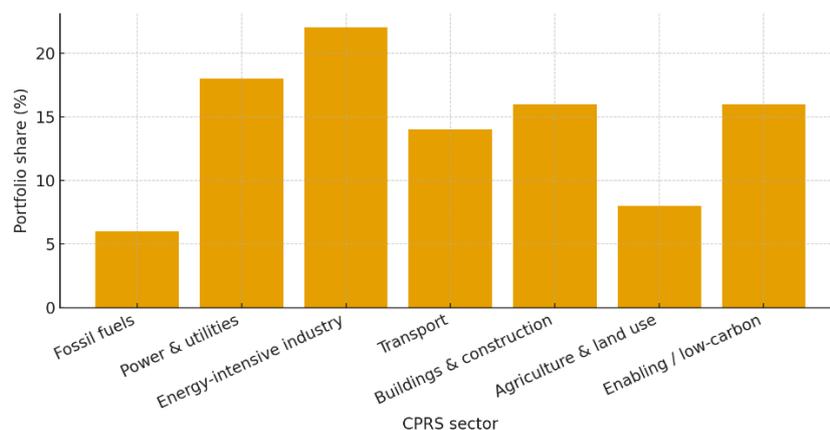
The second step involves the use of NGFS scenarios, combining short-term and long-term perspectives to capture different dimensions of climate-related risk. Short-term NGFS scenarios for the period 2025-2030 are used to assess banks' resilience to near-term economic and policy shocks, including scenarios characterized by compounding physical events and weak policy responses, orderly and gradual policy tightening, delayed but abrupt regulatory action, and divergent transition pathways across regions. These scenarios generate differentiated impacts on economic growth, employment, and sectoral performance that are directly relevant for credit risk assessment. In parallel, Phase V long-term NGFS scenarios, extending to 2050 and beyond, are employed to evaluate the cumulative effects of alternative transition pathways. These scenarios highlight that early and orderly transitions are less costly over time, whereas delayed action requires steeper carbon pricing and is associated with significantly higher physical damages.

To translate scenario narratives into actionable risk insights, the analysis relies on a structured qualitative interpretation focused on macroeconomic conditions, policy and price signals, and physical risk impacts. Scenarios with weaker growth or higher unemployment imply elevated credit risk in affected sectors, while sharp increases in carbon prices or regulatory stringency raise cost pressures for high-emission activities. Physical hazard scenarios are interpreted in terms of potential declines in collateral values, particularly in agriculture and real estate. These insights can be operationalized through qualitative risk classifications or simple adjustments to default probabilities, with the emphasis placed not on numerical precision, but on the internal consistency of the framework supporting risk appetite decisions and supervisory dialogue.

## Analysis

This section translates the methodological elements, Climate-Policy Relevant Sectors mapping and Network for Greening the Financial System scenarios, into portfolio-relevant insights. The discussion proceeds from exposure diagnostics (Figure 1), to the transmission of short-term scenario narratives into expected losses (Figure 2), and finally to the observed

differentiation in loan pricing by emissions intensity and transition-plan credibility (Figure 3). Throughout, the magnitudes used in the figures are illustrative but aligned with the NGFS anchors described earlier, so that the mechanics is evident without recourse to formal estimation. Figure 1 reports an illustrative CPRS decomposition of a universal bank’s corporate book (shares of total corporate exposure) [18][19][20]. The distribution highlights the concentration of transition-sensitive exposures in a small set of sectors.

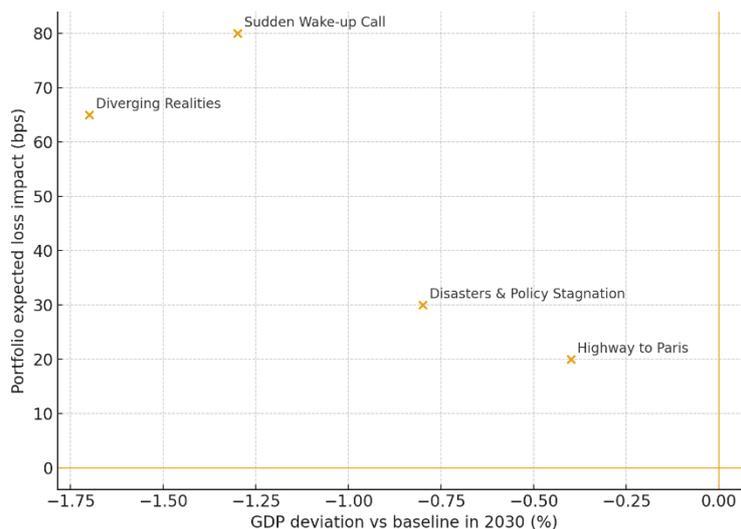


**Figure 1. Illustrative CPRS exposures by sector (%)**

“Energy-intensive industry” (e.g., steel, cement, basic chemicals, paper) and “power & utilities” generally constitute sizeable portions of corporate lending and are directly exposed to carbon-price trajectories, technology substitution (electrification, green hydrogen, CCS), and efficiency standards. “Fossil fuels,” although typically smaller in nominal share, can be disproportionately vulnerable because of stranding risk under abrupt policy tightening or accelerated demand shifts. “Transport” embeds multiple transition channels (fuel costs, fleet renewal, modal shifts, regulatory coverage), while “buildings & construction” reflects policy effects through building codes, embodied-carbon rules and, in some geographies, exposure to climate-policy-driven changes in planning and permitting. “Agriculture & land use” exhibits a dual sensitivity: transition exposures (methane, fertilizer standards, land-use rules) and physical-risk channels (heat, drought, floods) that can impair collateral and business continuity. Finally, the “enabling/low-carbon” slice (grid reinforcement, renewables, energy-efficiency retrofits) points to opportunities that counterbalance risks elsewhere.

The key analytical implication is that portfolio-level averages obscure heterogeneous risk. CPRS mapping offers a reproducible way to identify where transition forces are most likely to affect cash-flows, default risk, and collateral values. It also supports the setting of sector-specific risk-appetite limits and the monitoring of exposure migration over time, which is relevant for supervisory benchmarking under the European Central Bank and European Banking Authority frameworks discussed earlier.

Figure 2 links the short-term NGFS scenarios (2025–2030) to a single portfolio metric by plotting the 2030 GDP deviation against an illustrative expected-loss add-on (basis points). This representation condenses the scenario narratives into a tractable supervisory and managerial lens while remaining consistent with the NGFS macro anchors [21][22][23][24][25][26].

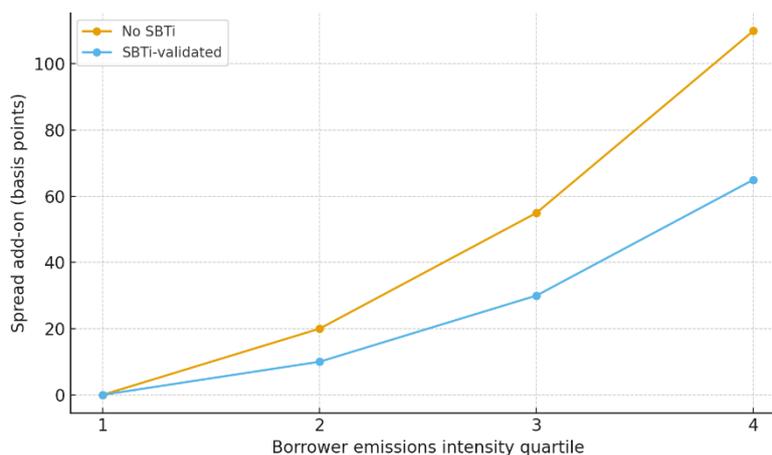


**Figure 2. Scenario GDP deviation (2030) vs expected loss impact (bps)**

Under Highway to Paris, policy tightens early and gradually; global activity is slightly below baseline by 2030 (around -0.4 percent). In such a path, aggregate losses are modest and largely concentrated in CPRS-high buckets where carbon-price pass-through is strongest, with the distribution further moderated by firm-level transition-plan credibility. In Sudden Wake-up Call, policy is delayed and then tightened abruptly in 2027; the one-year shock ( $\approx -1.2$  percent global GDP with higher unemployment) translates into the largest expected losses increment among the four cases, as both macro and cost channels intensify before firms have fully adapted. Disasters & Policy Stagnation combines compound physical hazards with policy inertia; although the 2030 macro gap is less pronounced than in a disorderly transition, EL rises because loss-given-default increases where collateral is damaged or rendered less productive, and because supply-chain disruptions transmit shocks across sectors and borders. Diverging Realities mixes transition in advanced economies with repeated hazards and supply frictions elsewhere; by 2030 the European Union gap (around -1.7 percent relative to baseline) implies a material EL add-on with geographically uneven incidence across the portfolio.

Expressing scenarios in EL space facilitates consistent translation into pricing add-ons, limit usage, and capital buffers using an institution’s internal conversion factors. The comparative positioning of the four points makes clear that orderly transition is manageable, abrupt policy yields the sharpest near-term impact, physical sequences elevate loss given default and introduce temporal lumpiness, and regional divergence complicates cross-border portfolio steering. Figure 3 presents an illustrative loan-spread add-on by borrower emissions-intensity quartile, separately for firms without and with SBTi-validated targets [28][29][30][31][32][33].

The spread increases with emissions intensity in both cases, but the slope is noticeably steeper for firms that lack validated transition plans. This pattern is consistent with loan-level evidence for the euro area and aligns with the growing supervisory emphasis on prudential transition planning. From a risk-management perspective, borrowers that combine high emissions with credible, time-bound, and capex-backed transition plans exhibit lower sensitivity to transition shocks. Consequently, they warrant a smaller pricing add-on than otherwise comparable borrowers that do not demonstrate such commitments.



**Figure 3. Illustrative loan pricing carbon premium (bps)**

Linking Figure 3 to the CPRS framework clarifies the interaction between sectoral exposure and borrower-level heterogeneity. In CPRS-high categories, such as fossil fuels, power and utilities, and energy-intensive industries, the pricing gradient with respect to emissions intensity is generally steeper, and the benefit associated with credible transition plans is more pronounced. In lower-exposure categories, the gradient is flatter, although firm-specific physical-risk profiles and positions within supply chains can still generate meaningful differentiation. This provides a coherent rationale for sector-specific pricing grids and client-engagement priorities that align origination capacity with credible transition trajectories. Taken together, the three figures convey a consistent message. CPRS mapping identifies where transition sensitivity is concentrated on bank balance sheets; short-term NGFS scenarios offer a disciplined way to translate macroeconomic, policy, and physical-risk narratives into expected losses over supervisory horizons; and market pricing already differentiates borrowers by emissions intensity and transition-plan credibility in a manner consistent with these narratives. Collectively, these elements support the supervisory shift toward prudential transition plans under Capital Requirements Directive VI and the incorporation of NGFS short-term scenarios into the Supervisory Review and Evaluation Process. They also provide banks with a transparent basis for setting sector limits, calibrating pricing add-ons, and prioritizing client engagement and transition-finance allocation.

Although the figures are primarily illustrative, the approach is generalizable. Institutions should clearly document how scenario variables, such as activity levels, unemployment, energy and commodity prices, shadow carbon prices, and hazard indicators, are mapped to credit-risk and valuation outcomes, and subject this mapping to robust model-risk governance, including conservative margins where parameter uncertainty is material. Data lineage from counterparties to NACE codes, CPRS categories, emissions metrics (e.g., PCAF), and transition-plan metadata should be auditable, particularly when results feed into the Internal Capital Adequacy Assessment Process and Pillar 3 disclosures. Where possible, qualitative scenario classifications (low/medium/high) can be complemented with interval estimates to reflect uncertainty and avoid spurious precision.

Three conclusions emerge. First, transition risk is not diffuse but sectorally concentrated, making a CPRS lens essential for decision-useful measurement. Second, short-term climate scenarios already generate financially meaningful changes in expected losses, especially under

abrupt policy shifts or compound physical events, underscoring the prudential relevance of NGFS short-term narratives. Third, observed pricing differentials by emissions intensity and transition-plan credibility are aligned with supervisory expectations, providing market-based validation of the analytical framework. Integrating these components enables coherent supervisory dialogue and practical portfolio steering without reliance on opaque or excessively complex models.

### **Conclusions and Policy Implications**

Supervisory authorities should first establish a common data language to ensure comparability of climate-related risks across institutions. A practical approach is to anchor regulatory reporting in NACE activity codes and the Climate-Policy Relevant Sectors (CPRS) taxonomy, complemented by emissions metrics aligned with the Partnership for Carbon Accounting Financials (PCAF) standard. Each counterparty should be traceable through an auditable sequence from internal identifiers to NACE codes, CPRS categories, and, where available, financed-emissions indicators and transition-plan attributes. Simple data-quality flags explaining missing or estimated data can materially improve reliability without imposing excessive reporting burdens. This shared data infrastructure supports horizontal supervisory reviews, peer comparisons, and consistent feedback within the SREP framework.

Supervisors should then define a scenario policy that combines short-term and long-term NGFS scenarios. Short-term scenarios for 2025-2030 are well suited for near-horizon solvency and liquidity assessments, as they capture policy shocks and physical hazards likely to materialize within supervisory timeframes. Long-term NGFS Phase V scenarios should inform business-model assessment and strategic planning by illustrating the cumulative costs of delayed versus orderly transitions. To enhance transparency and limit model risk, supervisors may publish a concise scenario package specifying a minimum set of macro-financial variables, such as economic activity, unemployment, energy prices, carbon-price proxies, and physical hazard indicators, and require banks to document their transmission into credit risk, asset valuation, and capital adequacy. A key step beyond disclosure is the prudential transition plan required under the Capital Requirements Directive VI and the EBA's ESG risk management guidelines. Supervisors should emphasize that these plans are risk-management tools rather than communication exercises. Each plan should set out baseline exposures by CPRS category and geography, define time-bound steering targets for high-risk segments, and explain how financing strategies support transition objectives. Plans should also specify contingent management actions under adverse short-term NGFS scenarios, including pricing adjustments, exposure limits, and capital-preservation measures. Introducing an evidence-of-use requirement can strengthen effectiveness by demonstrating how transition-risk analysis influences pricing and portfolio decisions.

In Pillar 2 supervision, authorities should prioritize capability- and risk-based measures rather than automatic capital add-ons. Where banks show robust data traceability, consistent scenario use, and clear links between analysis and decisions, qualitative measures and remediation timelines may suffice. Where deficiencies persist, such as missing CPRS mapping or weak governance over assumptions, supervisors should define explicit remediation milestones and escalate if needed. The objective is not to penalize carbon-intensive activities per se, but to ensure that foreseeable risks are managed with the same rigor as other material financial risks.

Given the reliance on new data and judgment-based assumptions, model-risk management is essential. Banks should document key assumptions and margins of conservatism, while avoiding spurious precision. Supervisory reviews may include sensitivity analyses or

challenger assessments, particularly where third-party tools are used. Proportionality remains central. Smaller banks should apply the same principles using simplified tools. Supervisors can support this by facilitating shared utilities, standardized CPRS mappings, common hazard indicators, and clear guidance on the use of NGFS scenarios. Banks should embed transition risk firmly within governance frameworks. Boards should approve a clear transition-risk appetite aligned with the business model, while management should ensure that scenario analysis informs pricing, exposure limits, and capital planning. A pragmatic data strategy, mapping counterparties to NACE and CPRS categories and progressively calculating financed emissions, should be complemented by qualitative assessments of counterparties' transition plans.

Overall, coherence across data, scenarios, governance, and supervisory processes is critical. A structured and transparent approach to transition-risk integration can enhance supervisory dialogue, improve portfolio steering, and support an orderly transition of the real economy.

### Conflict of Interest

The author declares no conflicts of interest.

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