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# Emerging Risks in EU and U.S. Insurance Regulation with Insights from the Solvency II Review

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# Emerging Risks in EU and U.S. Insurance Regulation with Insights from the Solvency II Review

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## **ABSTRACT**

Since the introduction of Solvency II in 2016, the risk landscape for insurers has changed. Emerging risks, such as climate change, cyber threats, and pandemics, challenge business models and financial stability, yet were not fully addressed in the original regulatory framework. Therefore, we discuss the role of emerging risks in European Union (EU) and U.S. insurance regulation and use the Solvency II review process (2019–2025) to investigate how EU regulators adapted their framework to emerging risks. Our analysis shows that Own Risk and Solvency Assessments (ORSAs) and macroprudential supervision are key elements for regulating emerging risks, while capital standards require regular review and adjustment. The Solvency II review illustrates this by introducing more explicit requirements for considering emerging risks—particularly climate risks—in ORSA and risk management, and by strengthening macroprudential supervision. This paper provides insights for regulators on best practices and outstanding challenges in the regulation of emerging risks in insurance.

## **KEYWORDS**

emerging risks, insurance regulation, Solvency II Review

## **EXECUTIVE SUMMARY**

### **IMPORTANCE**

Emerging risks are characterized by high uncertainty, dynamic development, and systemic features, which make them difficult to capture within traditional risk frameworks. Historical events such as the 2008 financial crisis, Hurricane Andrew in 1992, or asbestos-related exposures between 1970 and 1990 demonstrate that unrecognized or poorly managed emerging risks can threaten insurers' financial stability. Agency frictions, in which managers focus on short-term performance or overlook the social impact of systemic spillovers, may further weaken incentives to adequately address emerging risks with uncertain and distant realization. Therefore, emerging risks warrant particular attention in insurance regulation.

### **OBJECTIVES**

Using a cross-jurisdictional comparison between the U.S. and the European Union (EU), we analyze how emerging risks are addressed in insurance regulation to identify key challenges and best practices for addressing them. Moreover, we review documents related to the Solvency II review from 2019 to 2025 to examine how EU regulators have adapted their insurance regulatory framework to emerging risks. We aim to inform supervisors on improvements made and outstanding questions about the effective treatment of emerging risks in insurance regulation.

### **FINDINGS**

Capital standards and investment restrictions are inherently limited in capturing emerging risks, as they rely on risk factors and scenarios calibrated on historical data. Principle-based approaches (e.g., internal models or the prudent person principle) can provide regulatory flexibility, but the Own Risk and Solvency Assessment (ORSA), as a forward-looking risk management tool, and macroprudential supervision appear to be key elements for addressing emerging risks in insurance regulation. However, some insurers may treat ORSA merely as a compliance exercise, and supervisors may currently lack sufficient powers to respond to emerging systemic risks. It remains unclear whether the EU's stronger requirements for public disclosure motivate insurers to also report on emerging risks and strengthen market discipline.

### **REGULATORY POLICY IMPLICATIONS**

Our analysis suggests that regulators should periodically review and, where necessary, update standard formulas to reflect emerging risks. Supervisors should ensure that insurers adequately consider emerging risks in their ORSA and translate the results into concrete management actions. Finally, supervisors need sufficient authority to both identify and respond to emerging systemic threats. The Solvency II review marks a step in this direction. The review includes provisions to review the standard formula for evolving climate risks and crypto-assets. Cyber risks have been formally incorporated into Solvency II's risk management requirements. The review also explicitly codifies inflation, climate change, and pandemics for consideration in ORSA, with even prescriptive rules for climate scenario analyses. Macroprudential supervision was strengthened through expanded supervisory powers, enabling intervention during exceptional, sector-wide shocks.

## 1. INTRODUCTION

Emerging risks are newly developing or continuously evolving risks characterized by high uncertainty (CRO Forum, 2024). Examples include economic risks (e.g., negative interest rates), technological risks (e.g., cyber threats), and environmental risks (e.g., climate change). These risks can impact insurers and financial market stability, yet they are difficult to anticipate and incorporate effectively into regulatory frameworks (Schiro, 2006). Research on the role of emerging risks in insurance regulation remains scarce. The Solvency II review process, culminating in the 2025 Solvency II Review Directive, provides a timely opportunity to examine how emerging risks have been integrated into the European Union's (EU's) insurance regulatory framework. Against this background, we provide a comprehensive overview of emerging risks in EU and U.S. insurance regulation, using the Solvency II Review as a case study to highlight areas of progress and remaining challenges, with the aim of informing supervisory practice and policy design to enhance the resilience of the insurance sector.

Our study bridges two strands of literature that have so far evolved largely in parallel: research on insurance regulation and research on emerging risks in insurance. Articles on insurance regulation cover specific instruments such as capital requirements (Cummins & Phillips, 2009; Holzmüller, 2009; Scherer & Stahl, 2021), macroprudential supervision (Bach & Nguyen, 2012; Gómez & Ponce, 2018), own risk and solvency assessments (ORSA) (Pooser & Walker, 2015; Santomil & González, 2020; Sirmans & McCullough, 2017), or provide an overview of regulatory concepts and principles (Klein, 2012; Schiro, 2006). Research related to Solvency II has examined the directive's anticipated benefits and limitations prior to its implementation in 2016 (e.g., Doff, 2016; Eling et al., 2007). Subsequent studies have evaluated the effectiveness of Solvency II in practice and identified drawbacks, including procyclicality, market consistency issues, complexity, and the costs of regulation (Eling, 2021; Rae et al., 2018). The ongoing Solvency II Review aims to address these and other shortcomings. Research on the review itself is limited, focusing on political drivers (Benoît, 2025) or group supervision (Siri & Böffel, 2022). An article investigating emerging risks in insurance regulation, either through a cross-jurisdictional comparison of the U.S. and the EU or in the context of the Solvency II Review, is currently lacking.

General literature on emerging risks in insurance is extensive and shows that several risks have intensified in recent years, which were either unknown or unforeseen in terms of their impact when Solvency II was originally adopted. Simulations indicate that climate risk (transitional or physical) impairs insurers' balance sheets with consequences for capital and solvency (Gatzert & Özdil, 2024; Oquendo-Torres & Segovia-Vagas, 2024). At the product and policy level, climate risk reshapes product design and motivates government interventions (Charpentier et al., 2022; Paudel et al., 2012). Firms respond by strengthening governance and disclosure (Berry-Stölzle et al., 2024; Gupta et al., 2024). The literature on cyber risks documents limits of insurability and a need for regulatory action (Biener et al., 2015; Cremer et al., 2024), differentiates operational from underwriting exposure,

and develops data, modeling, and organizational practices (Eling & Schnell, 2016). Capital standards are criticized for underestimating heavy tails and dependence of cyber risks (Eling & Schnell, 2020). Research on pandemic risk highlights issues of insurability (Gründl et al., 2021; Hartwig et al., 2020; He et al., 2023; Louaas & Picard, 2023) and underscores operational resilience (Richter & Wilson, 2020). COVID-19 affected insurers' investments (Liedtke, 2021) and covaried with equity markets and losses in other business lines (Qiu, 2020).

This paper contributes in four ways. First, we explain why emerging risks deserve particular attention in insurance regulation. Second, we conduct a cross-jurisdictional comparison between the EU and the U.S. to analyze how emerging risks can challenge key instruments of insurance regulation and how they are addressed in practice. Third, we outline the milestones of the Solvency II review process since 2019 and summarize the content of the final Solvency II Review Directive (EU) 2025/2. Finally, we analyze the treatment of emerging risks throughout the Solvency II review process. Our findings can inform supervisors on best practices and open questions related to the treatment of emerging risks in insurance regulation.

Our analysis shows that emerging risks warrant particular supervisory attention. Their high uncertainty, dynamic nature, and systemic character make them difficult to manage within traditional frameworks. Agency frictions and managerial myopia may further reduce insurers' incentives to adequately address these risks. Capital standards are inherently limited in capturing emerging risks, as they are designed to account for quantifiable risks and rely on risk factors or scenarios calibrated on historical data. Therefore, standard formulas should be regularly reviewed and adjusted, whereby the use of internal models, as under Solvency II, can provide some regulatory flexibility to address emerging risks. ORSA requirements present an important tool in U.S. and EU insurance regulation for addressing emerging risks, by requiring insurers to regularly assess all their material risks and prospective solvency. However, supervisors must ensure that insurers consider emerging risks in their ORSA and translate the results into concrete actions, rather than treating them as a mere compliance exercise. Macroprudential supervision can help identify systemic risks in insurance arising from emerging risks through sector-wide stress tests and risk dashboards, but supervisors must also be granted adequate intervention powers. Finally, future research could investigate whether the EU's stronger requirements for public disclosure motivate insurers to report on emerging risks and strengthen market discipline.

The Solvency II Review provides evidence that EU regulators used the process to adapt their insurance regulatory framework to emerging risks. Technical deficiencies revealed during the negative interest rate phase were addressed, and a legal mechanism was started to review and adjust the standard formula for evolving climate risks and crypto-assets. While insurers were always expected to account for emerging risks in the ORSA, the Solvency II Review now explicitly codifies the inclusion of inflation, climate change, and pandemics in the regulatory framework,

with even prescriptive rules for climate scenario analyses. Cyber risks have been formally incorporated into Solvency II's risk management requirements for insurers. Macroprudential supervision was strengthened through the requirement for liquidity risk management plans and the expansion of supervisory powers to intervene during exceptional sector-wide shocks.

The remainder of the paper is structured as follows. Section 2 provides an overview of emerging risks in insurance regulation, focusing on the U.S. and EU. In Section 3, we outline the Solvency II review process and analyze the role of emerging risks along the process. Section 4 concludes.

## **2. EMERGING RISKS IN INSURANCE REGULATION**

In this section, we introduce emerging risks, explain their relevance for insurance regulation, and discuss both the challenges they pose and how they are addressed in insurance regulation through a cross-jurisdictional comparison between the EU and the U.S.

### **2.1 DEFINITION AND CHARACTERISTICS OF EMERGING RISKS**

Emerging risk is characterized by high uncertainty and dynamic evolution. As outlined by the CRO Forum (2024), an emerging risk may refer to a risk that already exists but is undergoing significant change, or to a risk that is still emerging and whose nature, likelihood, and potential consequences remain unclear. Besides the dynamic nature and high degree of uncertainty, the International Risk Governance Council (2015) highlights the systemic character of emerging risk, often characterized by complex, nonlinear dependencies with other types of risks. One example is COVID-19, which the CRO Forum (2021) classified as an emerging infectious disease, illustrating how a generally known risk in a new and specific form can evolve into a global systemic event with cascading effects across health systems, supply chains, financial markets, and insurance exposures.

Academic perspectives on emerging risk lack consensus regarding its definition. Flage and Aven (2015) emphasize the importance of limited knowledge as a defining feature, noting that emerging risk is often associated with early signals of a potential novel event with significant societal implications. In their view, emerging risk should be seen as a relative concept, influenced by the available knowledge, which varies between individuals and evolves over time. Mazri (2017) offers a complementary perspective by describing emerging risk not through specific characteristics but as a phase in the development of a risk. According to this approach, emerging risk is a stage at which a risk has not yet matured sufficiently to be reliably addressed through conventional risk management practices. While the definition of Flage and Aven (2015) focuses on scientifically controversial risks, Mazri (2017) proposes a broader typology consisting of hidden risks, scientifically controversial risks, and societal emerging risks.

This paper uses the CRO Forum's (2024) definition, with particular emphasis on the central role of uncertainty. It further integrates the perspective of Flage and Aven (2015) by recognizing the importance of limited, evolving knowledge, as well as the relativity of risk perception over time and across stakeholders. In line with Mazri's (2017) framework, this study also considers the dynamic nature of emerging risk and the limitations of conventional risk management tools in addressing such phenomena. Finally, attention is given to the potentially systemic character of emerging risk, with interdependencies among other types of risk, as highlighted by the International Risk Governance Council (2015).

## **2.2 RELEVANCE OF EMERGING RISKS FOR INSURANCE REGULATION**

Historical events have illustrated how unmanaged emerging risks can disrupt the insurance industry, affecting both operations and financial stability. Examples include the 2008 financial crisis (Eling & Pankoke, 2016; Harrington, 2009), asbestos-related liability exposures between 1970 and 1990 (White, 2004), and natural catastrophes such as Hurricane Andrew in 1992 (Nicholson et al., 2018). Moreover, various emerging risks impact, or are expected to impact, the insurance industry in the near future. As an industry-recognized reference point for relevant emerging risks in insurance, Table A.1 in the Appendix lists all emerging risks identified in the CRO Forum's Emerging Risk Radar publications from 2019 to 2024, including their expected impact and estimated time horizon for materialization (CRO Forum, 2019a-2024). We grouped these risks into three categories: (1) environment and climate, (2) technological, and (3) social, economic, and health. Frequently cited emerging risks within these categories are climate change, cyber risks and AI, and pandemics.

Climate change affects insurers on both the liability and asset sides (Gatzert & Özdil, 2024). Physical risks (e.g., floods, wildfires, and storms) primarily increase the frequency and severity of claims, while transition risks (e.g., stranded assets in carbon-intensive portfolios) affect the asset side. Transitional risks are expected to intensify as governments, investors, and consumers accelerate the transition toward low-carbon economies (Gatzert & Özdil, 2024; NGFS, 2024).

Technological risks, particularly cyber threats, represent high-frequency, high-severity exposures. Examples include data breaches, ransomware, supply chain compromise, and correlated losses through cloud provider outages (Biener et al., 2015; Eling & Schnell, 2016). The scarcity of historical data and technological evolutions further complicate actuarial modeling (Eling, 2020). In response, insurers are offering modular cyber policies with dynamic underwriting tied to real-time telemetry and embedding incident response services. AI can reduce costs through process automation (e.g., in underwriting and claims settlement) and improve actuarial models (e.g., fraud detection), but introduces ethical, legal, and data privacy challenges, as well as new risks, such as those related to autonomous driving (Eling et al., 2022).

The COVID-19 pandemic represents an emerging health risk with further economic and social consequences. While the observed impact of COVID-19 deaths on life insurance was smaller than initially expected (Harris et al., 2021), the temporary market drawdown broadly affected insurers' investing (Liedtke, 2021). Pandemics challenge the principles of insurability: they are globally correlated, affect multiple sectors simultaneously, and generate tail risks that are difficult to quantify and diversify. Traditional risk pooling mechanisms proved inadequate during COVID-19, particularly in business interruption and event cancellation lines, where large-scale exclusions and litigation disputes emerged (Gründl et al., 2021; Richter & Wilson, 2020).

The examples discussed above show that emerging risks can challenge insurance business models and, in extreme cases, threaten financial stability. Although insurance companies are often assumed to pose less systemic risk than banks (Cummins & Weiss, 2014; Eling & Pankoke, 2016; Harrington, 2009), large-scale or highly correlated emerging risks could impact the entire insurance industry simultaneously with potential spillover effects for financial markets. The uncertainty and complexity of emerging risks make them difficult to anticipate and manage (Mazri, 2017), underscoring the importance of keeping them high on insurance regulators' agendas.

Another reason why emerging risks warrant particular supervisory attention is agency frictions. Managers may underinvest in costly, hard-to-verify preparedness (data, models, governance) for low-frequency, high-severity, long-horizon threats (Jensen & Meckling, 1976; Holmström, 1979). Short-term performance pressures and managerial myopia can reduce incentives to build long-horizon capabilities (Stein, 1989; Ladika & Sautner, 2020; Edmans et al., 2022). However, such capabilities are central for managing emerging risks, whose uncertain materialization lies (mostly) in the future. Moreover, emerging risks can generate high social costs due to their systemic character with correlated exposures and sector-wide spillovers. Insurers may not fully consider these costs when allocating their resources for risk management, providing a standard prudential rationale for regulatory intervention and explicit minimum expectations (Acharya, 2009; Cummins & Weiss, 2014).

### **2.3 CHALLENGES AND TREATMENT OF EMERGING RISKS IN INSURANCE REGULATION**

The goal of insurance regulation is to address market failures, thereby protecting customers and ensuring the stability of the financial system (Eling, 2021; Schiro, 2006). To reduce the likelihood of insurer insolvencies, regulators can employ a range of mechanisms designed to limit excessive risk-taking and mitigate systemic risk (Klein, 2012). Key regulatory elements are challenged by emerging risks but also specifically designed to address them. The following sections discuss the role of emerging risks for (1) capital standards and investment restrictions, (2) ORSA requirements, (3) macroprudential supervision, and (4) public disclosure obligations. The analysis focuses on a cross-jurisdictional comparison between the U.S. and the

EU. While insurance regulation in the EU is fully harmonized across member states through Solvency II, in the U.S., it is primarily a matter of state competence, with the National Association of Insurance Commissioners (NAIC) developing model laws and regulations that states may adopt to promote coordination. Together, the U.S. and EU represent the two largest insurance markets in the world, accounting for approximately 60% of total global premium volume (NAIC, 2025a).

### **2.3.1 CAPITAL STANDARDS AND INVESTMENT RESTRICTIONS**

Capital standards require insurance companies to maintain a minimum amount of capital to withstand adverse events. In the U.S., insurers must comply with the uniform risk-based capital standards set by the NAIC, which have been adopted by all states (Klein, 2012). For each business line (property/casualty, life, health), a factor-based formula exists to calculate capital requirements (Cummins & Phillips, 2009; Holzmüller, 2009). Each formula accounts for different risk categories, in which risk capital is calculated by multiplying a specific risk factor by a volume measure (e.g., asset volume, premiums written, or reserves).<sup>1</sup> The resulting capital requirements are then aggregated across risk categories under specific correlation assumptions to account for diversification.

The EU's approach under Solvency II follows a similar concept. Insurers must hold eligible own funds sufficient to cover their solvency capital requirements, which can be calculated using a standard formula composed of distinct risk modules aggregated through prescribed correlation matrices. Unlike the U.S. risk-based capital framework, the Solvency II standard formula is calibrated to a one-year 99.5% value-at-risk and largely follows a market-consistent and scenario-based rather than factor-based approach (Holzmüller, 2009; Scherer & Stahl, 2021). For example, to determine the capital requirements for life mortality risk, insurers must assess how their technical provisions would rise under the scenario of an instantaneous and permanent 15% increase in mortality rates (Commission Delegated Regulation [EU] 2015/35, Article 137). Another difference is that EU insurers may, subject to regulatory approval, use full or partial internal models to calculate their solvency capital requirements (Holzmüller, 2009).

Both capital standards are primarily designed to address quantifiable risks and rely on risk factors or scenarios calibrated on historical data. This makes the standards inherently limited in capturing emerging risks, which are new or evolving risks characterized by high uncertainty (refer to Section 2.1). For example, as of 2025, neither the risk-based capital formulas nor the Solvency II standard formula includes a risk module for cyber risks. While those risks are formally captured under operational or underwriting risk modules, they lack a dedicated calibration. Eling and Schnell (2020) note that the calculation of risk-based capital or solvency capital requirements tends to underestimate cyber risks, as their characteristic

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<sup>1</sup>While the risk-based capital formulas largely follow a factor-based approach, some exceptions exist. For example, the interest rate and market risk modules related to specific life insurance products (e.g., variable annuities) include model-based approaches (Society of Actuaries, 2023).

heavy-tailed loss distributions and dependency structures are not adequately reflected. This underestimation is particularly pronounced for small cyber insurance portfolios. Similarly, the one-year value-at-risk approach to calculate solvency capital requirements is seen as inadequate for capturing long-term climate risk dynamics (EIOPA, 2022b).

Against the background of emerging risks, standard formulas must be reviewed regularly to determine whether new risk modules should be added or whether existing risk factors and scenarios should be adjusted. In 2017, a new risk category for hurricanes and earthquakes was introduced within the risk-based capital formula for property/casualty insurers, reflecting the increased exposure to natural catastrophes (NAIC, 2021a). The growing popularity of crypto-assets prompted the European Insurance and Occupational Pensions Authority (EIOPA) (2025c) to propose a new risk category for them in the Solvency II standard formula. While crypto-assets are classified by insurers either as intangible assets, subject to an 80% undiversified stress, or as equity type 2, attracting a 49% shock with diversification benefits, EIOPA concludes that both treatments insufficiently reflect the extreme volatility and systemic risk of such assets. Instead, the EIOPA recommends a 100% undiversified capital requirement for crypto-assets, regardless of their balance sheet classification (EIOPA, 2025c).

Although regular adjustments to standard formulas are possible—and necessary—they address emerging risks only reactively and with a delay, since statutory amendment processes can take considerable time. Therefore, relying solely on (rule-based) standard formulas may leave insurers exposed to novel or rapidly evolving risks, highlighting the importance of (1) complementary forward-looking risk management tools and (2) regulatory flexibility. While the first point will be discussed in the following Section 2.3.2, a key distinction between the U.S. and EU frameworks regarding regulatory flexibility lies in their differing regulatory philosophies.

According to Holzmüller (2009), the U.S. risk-based capital system is largely rule-based and not fully risk-sensitive. The reliance on fixed risk factors and volume-based capital requirements provides comparability and regulatory simplicity, but does not accurately reflect the inherent risk and limits the framework's adaptability to evolving or poorly understood risks. Schiro (2006) emphasizes that principle-based regulation is essential for keeping up with insurers' changing risk landscape. Under Solvency II, capital standards follow a more pronounced principles-based philosophy, due to scenario-based capital requirements and the possibility to use internal models (Holzmüller, 2009). This approach enables insurers to integrate emerging risks into their internal models at an early stage, subject to supervisory approval.<sup>2</sup> Consequently, it can also increase supervisors' awareness of emerging risks and motivate adjustments to the standard formula.

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<sup>2</sup>Note that only 31 insurance groups and 148 solo insurers use an approved (partial) internal model to calculate their solvency capital requirements under Solvency II at year end 2023, but those insurers account for more than 50% written premiums of the European insurance market (International Monetary Fund, 2025).

The contrasting rule-based versus principle-based approaches in EU and U.S. insurance regulation are also evident in investment restrictions. Despite capital requirements depending on an insurer's investment portfolio, Solvency II relies on the prudent person principle (Directive (EU) 2009/138/EC, Article 132). Insurers are only allowed to invest in assets where proper risk management is possible, investments must be made in the best interests of policyholders, portfolios must be aligned with the nature and duration of liabilities, and ensure security, quality, liquidity, and profitability. Beyond these qualitative requirements, there are no prescriptive quantitative limits, and Article 133 of Solvency II grants insurers the freedom to select asset classes within these prudential constraints. In contrast, U.S. insurance regulation accounts for both principle- and rule-based investment requirements (Klein, 2012). Specifically, the NAIC's *Investments of Insurers Model Act (Defined Limits Version)* (#280) prescribes a list of permitted and prohibited investments and sets quantitative limits for certain asset classes. The lists and limits vary depending on how individual states adopted the model law.

Both rule-based and principle-based investment restrictions entail distinct benefits and drawbacks (Davis, 2002). Regarding emerging risks, the prudent person principle enables insurers to react more flexibly and swiftly to a changing risk landscape, whereas prescriptive investment lists and limits require reactive regulatory adjustments. Permitted investment lists prevent insurers from engaging in novel asset classes with uncertain or opaque risks (e.g., crypto assets), but they may also constrain diversification and investment opportunities. Prescriptive investment limits restrict insurers' risk-return profiles (Davis, 2002), but may also mitigate exposures to certain previously unforeseen risks, as observed for some insurers during the 2008 financial crisis (Klein, 2012). Effective reliance on the prudent person principle requires robust internal risk management and sound governance structures as well as a supervisory authority capable of interpreting and challenging insurers' risk assessments (Davis, 2002). Where these preconditions are met, a principle-based regime can provide a more efficient and flexible response to emerging risks by enabling insurers to assess, internalize, and manage novel risk exposures without waiting for regulatory reclassification or rule changes. A well-balanced combination of the prudent person principle and targeted prescriptive constraints may be preferable for emerging risks, as it preserves flexibility while containing potential downside risks.

### **2.3.2 OWN RISK AND SOLVENCY ASSESSMENT**

The International Association of Insurance Supervisors (2024) identifies enterprise risk management and the ORSA as key elements of forward-looking risk management and, consequently, of addressing emerging risks under its Insurance Core Principle 16. ORSA describes an internal process whereby an insurance company regularly assesses all material risks and its prospective solvency position under normal and stressed scenarios (Pooser & Walker, 2015; Santomil & González, 2020). The process accounts for both quantitative and qualitative risks (Pooser & Walker, 2015). The results of an ORSA are (1) used internally to strengthen enterprise

risk management and inform strategic, risk-informed decision making, and (2) are submitted to the supervisory authority in the form of an ORSA report (Pooser & Walker, 2015; Santomil & González, 2020).

Risk management and ORSA requirements in the U.S. are laid out by the NAIC's *Risk Management and Own Risk and Solvency Assessment Model Act* (#505) (Pooser & Walker, 2015; Sirmans & McCullough, 2017), which became effective in 2015 and has been (at least partially) adopted by all states since then (NAIC, 2021b). Additional details are provided in the NAIC ORSA Guidance Manual (NAIC, 2022b). Insurers are mandated to maintain a risk management framework and to conduct an ORSA at least annually to account for all material and relevant risks. An ORSA summary report with three parts must be prepared and submitted to the supervisory authority (Pooser & Walker, 2015). The first part describes the insurer's enterprise risk management framework, including how all material risks are identified. Part two contains the risk assessment, in which material risks are analyzed, and their potential impacts and outcomes are evaluated. Insurers are encouraged to use probabilistic models and stress tests, but they are not explicitly required to do so (Pooser & Walker, 2015). Part 3 includes an assessment of group capital adequacy (where applicable) and prospective solvency. The guidance manual explicitly states that the term "prospective" refers to "both existing risks likely to intensify and emerging risks with the potential to impact the insurer in the future" (NAIC, 2022b).

ORSA requirements for EU insurers are set out in Article 45 of Solvency II and are further specified in additional guidelines issued by EIOPA (2014). As in the U.S., EU insurers must conduct an ORSA at least annually and report the results to supervisory authorities. While smaller insurers with direct premiums below \$500 million at the individual level (\$1 billion at the group level) are exempt from ORSA requirements in the U.S. (Pooser & Walker, 2015), the EU requirements apply to all insurers under Solvency II, with the scope of ORSA following the principle of proportionality (Directive [EU] 2009/138/EC, Art. 29). In contrast to the more process and governance-oriented ORSA framework in the U.S., the Solvency II ORSA is more tightly integrated with the solvency regime. The solvency capital requirements are based on a one-year time horizon, and the ORSA extends the assessment to a forward-looking perspective by analyzing the insurer's solvency position over longer planning horizons and considering all material risks (Santomil & González, 2020). Insurers must document in detail the data, assumptions, and methodologies applied (scenario analyses, stress tests, reverse stress tests, sensitivity analyses) and justify any deviations from the Pillar 1 valuation framework, explaining both the nature and the purpose of such differences (EIOPA, 2014). EU insurers are also required to assess whether the underlying assumptions of the Solvency II Standard Formula or their internal model deviate from their own risk profile (Directive [EU] 2009/138/EC, Art. 45; Scherer & Stahl, 2021). While the ORSA is not intended to calculate regulatory capital requirements, the results are used in the supervisory process, where EU regulators can set capital add-ons for specific insurance companies whose solvency capital requirements do not adequately capture

the insurer's risk profile or where governance deficiencies are identified (Directive [EU] 2009/138/EC, Art. 37, 45).<sup>3</sup>

Across both jurisdictions (U.S. and EU), ORSA serves as a forward-looking mechanism for identifying, assessing, and managing risk. Regarding emerging risks, they serve two purposes: they enable insurers to anticipate and quantify them, integrate them into strategic decision-making and capital planning, and provide supervisors with insights into potential vulnerabilities. Pooser and Walker (2015) reference a 2015 survey in their paper, in which 60% of the consulted U.S. insurers believed that the introduction of ORSA requirements would improve the management of emerging risks and change corporate governance structures. A 2016 survey of 80 Spanish insurers under Solvency II indicated that 71.8% of the respondents saw great value in ORSA for supporting risk culture and decision-making (Santomil & González, 2020).<sup>4</sup>

ORSA requirements can serve as an effective tool for insurance regulation for addressing emerging risks, but limitations exist. A supervisory assessment by EIOPA (2017) noted that EU insurers do not adequately integrate ORSA results into their decision-making processes. A survey by the Casualty Actuarial Society (2015) found that regulatory compliance was the most frequently cited motivation among insurers for conducting an ORSA, with 77% of companies reporting that ORSA led to no or only minor changes in capital adequacy assessment processes, and 84% indicating little or no impact on internal capital allocations. These findings suggest that, in practice, ORSA could be treated by some insurers as a pure documentation or compliance exercise and not as a tool for substantive risk management or strategic capital planning.

Another problem noted by EIOPA (2017) is that insurers do not always consider all material risks or fail to align assessments with their specific risk profiles. For regulators, this implies that supervisory guidance and explicit expectations may be necessary to ensure that ORSA processes (results) are conducted (used) appropriately. For example, EIOPA (2022a) noted that only a small minority of insurers assessed climate change risks through scenario analyses in their ORSA and, consequently, published an application guidance on running climate change materiality assessments in the ORSA. Subsequent reassessment in 2024, following the publication of this guidance, found that the use, quality, and scope of climate scenario analyses in ORSA had improved significantly (EIOPA, 2025e). This demonstrates that more detailed guidance from supervisory authorities can effectively support the integration of emerging risks into ORSA.

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<sup>3</sup>For example, in 2023, the German Federal Financial Supervisory Authority (2023) stipulated the life insurer Signal Iduna with an additional capital add-on due to identified deficiencies related to cyber and IT security.

<sup>4</sup>The survey also included two Likert scale questions to assess whether "the ORSA [...] helps to understand all sources of risk and their future evolution" and whether "the ORSA [...] captures all significant risks (both quantifiable and not quantifiable), and not only those of the standard formula." Respondents strongly agreed with both statements, with an average value of 4.32 or 4.58 out of 5, respectively.

### **2.3.3 MACROPRUDENTIAL SUPERVISION**

As explained in Section 2.1, emerging risks are often characterized by systemic features, arising from non-linear dependencies and correlations with other risks. Therefore, emerging risks can pose systemic threats in the insurance sector. According to Insurance Core Principle 24 of the International Association of Insurance Supervisors (2024), macroprudential supervision aims to identify and mitigate vulnerabilities caused by market, financial, and environmental developments that could lead to inward systemic risk within the insurance sector or outward spillovers to the wider financial system. Key elements of macroprudential supervision include monitoring systemic risks and using tools such as cross-sectoral stress tests.

In response to the 2008 financial crisis, the U.S. adopted the Dodd-Frank Act and established the Financial Stability Oversight Council, which identifies and monitors systemically important financial institutions, including large insurers, to support financial stability (Gómez & Ponce, 2018). Insurance companies designated as posing a potential threat to U.S. financial stability are subject to enhanced regulatory oversight by the Federal Reserve and must comply with additional prudential standards (Financial Stability Oversight Council, 2023). While one objective of this framework is to identify and address emerging systemic risks, Aikman et al. (2019) argue that effective intervention may be constrained because the Financial Stability Oversight Council has limited direct regulatory authority and relies on other authorities with potentially opposing objectives.

To develop tools for macroprudential supervision of the insurance sector, the NAIC's Macroprudential Initiative was launched in 2017 (NAIC, 2026). As a result of this initiative, the NAIC began conducting an annual liquidity stress test for large life insurers in 2021 to assess their resilience to stressed market conditions and potential spillovers to financial markets (NAIC, 2022a). Participating insurers must project their cashflows over multiple time horizons (30 days, 90 days, one year) under a baseline scenario and predefined scenarios with stressed economic and financial variables (e.g., GDP, interest rates, asset values). In addition, the NAIC has developed a macroprudential risk assessment system that provides a biannually updated dashboard containing charts and indicators on key risk categories affecting the U.S. insurance sector (NAIC, 2020a). Further capital stress tests are under consideration but have not yet been formally implemented by 2025 (NAIC, 2026).

In the EU, Article 23 of Regulation No. 1094/2010 provides EIOPA the mandate to "develop criteria for the identification and measurement of systemic risk and an adequate stress testing regime" for the insurance sector in consultation with the European Systemic Risk Board. In this context, EIOPA regularly coordinates EU-wide stress tests for larger insurers, with the macroprudential objective of assessing the resilience of the insurance sector to adverse financial, economic, and insurance shocks, as well as potential spillovers to other financial markets (EIOPA, 2019d; Jakubik & Teleu, 2024). Unlike U.S. liquidity stress tests, EIOPA stress tests are not

conducted annually and often focus on recent and event-driven narratives from which scenarios are derived. For example, the EIOPA stress test 2021 described a prolonged COVID-19 scenario characterized by persistent low interest rates (EIOPA, 2021c), while the subsequent EIOPA stress test 2024 focused on geopolitical tensions leading to supply chain disruptions and inflation (EIOPA, 2024h). EIOPA stress tests account for both liquidity effects and the impact of adverse scenarios on solvency capital requirements to evaluate whether insurers would remain compliant with capital standards under stressed conditions (Jakubik & Teleu, 2024). In addition to stress testing, EIOPA (2026) publishes a quarterly risk dashboard that provides an overview of key risks affecting the EU insurance sector to support the early identification of emerging systemic threats.

In the academic literature, there is debate over whether insurance companies pose systemic risk. Several studies following the 2008 financial crisis find that, unlike banks, insurers generally contribute less to systemic risk and consequently argue against broad macroprudential regulation of insurers (Cummins & Weiss, 2014; Eling & Pankoke, 2016; Harrington, 2009). However, macroprudential supervision can help identify and address internal or sector-wide vulnerabilities, even if insurers are less likely to cause market spillovers (Bach & Nguyen, 2012). For example, stress tests and risk dashboards can inform national authorities and insurers about sector-wide vulnerabilities. Gómez and Ponce (2018) argue that insurers' contribution to systemic risk has likely increased since the 2008 financial crisis, for example, through non-traditional activities or cyber threats, and develop a model demonstrating that macroprudential regulation of systemically relevant insurers can be justified. Given this debate and the rising costs of regulatory oversight (Eling, 2021), a targeted macroprudential approach focusing primarily on larger, systemically relevant insurers appears appropriate. Irregular, event-driven stress tests, complemented by risk-monitoring tools such as dashboards, can enable early identification of sector-wide vulnerabilities and emerging risks without imposing the full burden of continuous regulation on smaller insurers. However, effective supervision requires both adequate mandates and intervention powers for supervisory authorities, ensuring that identified risks can be addressed promptly rather than remaining purely informational (Aikman et al., 2019).

### **2.3.4 PUBLIC DISCLOSURE**

According to Insurance Core Principle 20 of the International Association of Insurance Supervisors (2024), public disclosure requirements aim to provide market participants (e.g., investors, policyholders, intermediaries) with relevant information on insurers' risk profiles, business activities, and financial performance. The goal is to complement prudential regulation by promoting market discipline (Eling, 2012). While ORSA reports primarily serve as a confidential tool for internal risk management and supervisory review (refer to Section 2.3.2), insurers may also communicate information on emerging risks through public channels. The scope and nature of public disclosure requirements differ substantially between the U.S. and EU regulatory frameworks.

Under Solvency II, EU insurers are required to annually publish a solvency and financial condition report on their websites (Gatzert & Heidinger, 2020; Schwartz & Dobler, 2026). These reports follow a standardized structure and combine quantitative and qualitative information. Regarding emerging risks, two sections are relevant (Schwartz & Dobler, 2026): Section B.3 describes the insurer's risk management system and ORSA process, while Section C provides quantitative and qualitative information on the insurer's risk profile. There are five prescriptive risk categories (underwriting, market, credit, liquidity, and operational risk) and one open section C.6 for other material risks, where emerging risks could be reported.

In the U.S., there is no direct counterpart to the EU's Solvency and Financial Condition Report. State-licensed insurers are required to submit annual statement filings and risk-based capital reports in accordance with the NAIC *Annual Financial Reporting Model Regulation* (#205) and the *Risk-Based Capital (RBC) Model Act* (#312). However, these filings are primarily quantitative, follow (state-specific) standardized templates, are generally not publicly disclosed, and offer limited or no space for narrative discussions of emerging risks. Publicly traded U.S. insurers must additionally file an annual Form 10-K with the Securities and Exchange Commission, which includes a dedicated Section 1A on risk factors (Wang et al., 2019). Notably, the Securities and Exchange Commission (2023) has consistently emphasized cyber risks and introduced a separate item, "1C - Cybersecurity," for Form 10-K in 2023. Another mechanism that addresses a specific emerging risk in the U.S. insurance sector is the NAIC Climate Risk Disclosure Survey (NAIC, 2022c). Initially launched by the California Department of Insurance in 2009 and subsequently adopted by participating state regulators, the survey was revised in 2022 to align with the Task Force on Climate-Related Financial Disclosure framework (Lin et al., 2023). Insurers operating in participating states that exceed a state-specific premium threshold (typically \$100–500 million) are required to answer questions on their governance, strategy, risk management, metrics, and targets related to climate risks.

Public disclosure on emerging risks can supplement supervisory reporting and enhance resilience in the insurance industry through two primary channels. First, insurers can gain insights into peers' identified risks and risk measures, thereby increasing their awareness of previously unknown risks and motivating them to adapt their risk management standards. Second, the increased transparency toward investors and policyholders can strengthen market discipline (Eling, 2012). For example, empirical evidence suggests that mandatory disclosure of cyber incidents negatively impacts the affected firms' stock returns, whereby adverse market reactions are smaller for firms that reported (prior to the event) on IT governance or preventive cyber risk management strategies (Cao et al., 2025; Higgs et al., 2014). Consequently, insurers should be motivated to implement cyber risk management to prevent cyber incidents in the first place (Jung et al., 2025) and to increase investor trust.

While Wang et al. (2019) illustrate that U.S. insurers actively use Section 1A of the Form 10-K to report on their evolving risk landscapes, these disclosure requirements apply only to publicly listed insurers. In contrast, the Solvency and Financial Condition Reports in the EU are uniform across all insurers, which could foster market discipline compared with the U.S. Gatzert and Heideringer (2020) observed stock market reactions to the publication of the first Solvency and Financial Condition Reports for the fiscal year 2016, and Schwartze and Dobler (2026) found that insurers facing higher social or political pressure report significantly more on their risks and risk management in the narrative Sections B3 and C4. However, it remains unclear whether insurers use the narrative parts of the Solvency and Financial Condition Reports to provide information on emerging risks in the absence of specific requirements (such as those relating to cyber or climate risks in the U.S.), or whether they primarily focus on traditional risk categories.

### **3. SOLVENCY II REVIEW PROCESS**

After discussing the role of emerging risks in the EU and U.S. insurance regulatory frameworks in the previous section, we now focus on the Solvency II Review to analyze whether and how EU regulators adapted their regulatory framework regarding emerging risks. This section first provides a broad overview of the aims and timeline of the Solvency II Review, before examining the treatment of emerging risks within the review in detail.

#### **3.1 AIMS AND TIMELINE OF THE SOLVENCY II REVIEW**

The rules laid out by Solvency II have enhanced the stability and resilience of the European insurance sector since its introduction in 2016 (Directive [EU] 2025/2, Recital 1). However, these rules are subject to review clauses (e.g., Article 242 in Directive [EU] 2009/138/EC) and additional provisions introduced by the Omnibus II Directive 2014/51/EU (e.g., Articles 77f and 111[3]), and also leave some weaknesses unaddressed. This becomes especially apparent given the dynamic economic environment and emerging risks. To address these gaps, the Review Directive, formally Directive (EU) 2025/2, sets out specific adjustments and revisions to the Solvency II framework. It was officially adopted on November 27, 2024, and subsequently published in the Official Journal of the European Union on January 8, 2025; the directive must be implemented in the national legislation of all EU member states by January 29, 2027.

In this paper, we set the initiation of the review process to the European Commission's formal request to EIOPA for technical advice on the Solvency II review in February 2019 (European Commission, 2019). This marked the start of a series of consultations, feedback statements, and legislative proposals. Table A.2 in the Appendix summarizes the key documents published between the Commission's request in February 2019 and the adaptation of the Solvency II Review Directive in November 2024. The most relevant documents are EIOPA's Opinion on the 2020 Review of Solvency II and the proposal for a directive of the European Parliament

and of the Council amending Directive 2009/138/EC. The table also includes EIO-PA's consultation papers from 2024 that address Level 2 measures, i.e., Regulatory Technical Standards (RTS) and Implementing Technical Standards (ITS).

**TABLE 1**

Key elements of the Solvency II Review (Directive [EU] 2025/2) amending Solvency II (Directive [EU] 2009/138/EC)

Topic and subtopics		Directive (EU) 2025/2	Directive (EU) 2009/138/EC
<b>Technical modifications</b>	Long-term guarantee measures	Points of Article 1: 39-43, 51, 53  Recitals: 43, 44, 45, 46, 47, 48, 49, 57, 58, 98	Amended Articles: 77a, 77b, 77d, 77e, 86, 111, 122
	Long-term equity investments	Points of Article 1: 48, 84  Recitals: 3, 4, 53, 94	Added Articles: 105a, 233b
	Other technical aspects	Points of Article 1: 38, 44, 49, 102  Recitals: 41, 42, 51, 54, 105	Amended Articles: 77, 92, 106  Added Articles: 304d

	<p><b>Summary</b></p>
	<ul style="list-style-type: none"> <li>• Modifications to the extrapolation of the relevant risk-free interest rate term structure.</li> <li>• Improved volatility adjustments to risk-free interest rates, accounting for responsiveness to changes in spreads during times of market stress and pro-cyclicality.</li> <li>• Methods and assumptions for the interest rate risk sub-module shall reflect the risk that interest rates may further decrease even where they are low or negative.</li> </ul>
	<ul style="list-style-type: none"> <li>• Introduction of a distinct and enduring equity risk category for long-term equity investments with a stress factor of 22% in the standard formula, also accounting for long-term equities at the group level.</li> </ul>
	<ul style="list-style-type: none"> <li>• New method to reduce risk margin and cost-of-capital rate.</li> <li>• Commission shall adapt delegated acts for approaches to deductions from the basic own funds with material participation in credit and financial institutions.</li> <li>• Increased maximum symmetric adjustment from 10% to 13%.</li> <li>• EIOPA shall review whether the separation of life and non-life activities is still justified.</li> </ul>

Topic and subtopics		Directive (EU) 2025/2	Directive (EU) 2009/138/EC
<b>Macroprudential supervision</b>	Cross-border supervision and collaboration	Points of Article 1: 3, 6, 7, 9, 11, 35, 63, 64, 66, 67, 68, 76, 95  Recitals: 11, 12, 13, 29, 30, 61, 71-75, 77, 83, 85, 93	Amended Articles: 6, 18, 23, 25, 26, 68, 149, 152, 152b, 153, 226, 258  Added Articles: 152aa-ab
	Group supervision	Points of Article 1: 71, 72, 73, 74, 75, 76, 78, 79, 80, 81, 84, 85, 86, 87, 88, 89, 91, 92, 93, 94, 95, 96, 105  Recitals: 13, 21, 50, 76-93, 101	Amended Articles: 214, 220, 221, 222, 226, 228, 229, 230, 234, 244, 245, 246, 254, 256, 257, 258, 262, 308b  Added Articles: 213a-b, 229a, 233a, 246a-b, 256b-c
	Extended tools and responsibilities for supervisors and insurers	Points of Article 1: 17-23, 34, 47, 54, 56, 57, 58, 60, 61, 89, 96, 97, 98, 108  Recitals: 9, 16, 20, 21, 23-28, 39, 48, 49, 56, 59-70, 79, 100, 101	Amended Articles: 36, 37, 40, 41, 42, 44, 45, 64, 105, 132, 138, 139, 144, 262, 265, 267, 308  Added Articles: 136a, 144a-d, 246a-b
<b>Sustainability</b>	Integration of sustainability risks	Points of Article 1: 22, 25, 54, 102  Recitals: 6, 7, 8, 32, 95, 96	Amended Articles: 44, 51, 132  Added Articles: 304c
	Climate scenario analysis	Points of Article 1: 24  Recitals: 6, 7, 31, 95	Added Articles: 45a

	<b>Summary</b>
	<ul style="list-style-type: none"> <li>• Exchange of information and collaboration between supervisory authorities when approving or refusing the authorization of undertakings operating in different countries.</li> <li>• Definition of cross-border activities and introduction of collaboration platforms to exchange information and actions on undertakings or groups operating in multiple countries.</li> </ul>
	<ul style="list-style-type: none"> <li>• Explicitly include insurance holding companies and mixed financial holding companies within group supervision.</li> <li>• Extended enforcement and macroprudential tools for supervisors at the group level, allowing for cross-border cooperation.</li> <li>• Clarifications regarding the calculation methodology for group solvency.</li> <li>• Streamlined solvency and financial condition reports and enhanced supervisory reporting templates, also accounting for the concept of proportionality.</li> </ul>
	<ul style="list-style-type: none"> <li>• Extended responsibilities and oversight for a company's body regarding fit and proper requirements and diversity.</li> <li>• Expanded supervisors' authority to assess and disclose relevant information about (group) insurers' risk position.</li> <li>• Expanded supervisors' authority to take measures in response to deterioration of solvency position.</li> <li>• Extended risk management rules regarding sustainability risks, long-term guarantee measures, and liquidity risk.</li> </ul>
	<ul style="list-style-type: none"> <li>• Extended requirements to account for sustainability factors in risk management and investment strategy.</li> <li>• Sustainability risks must be disclosed in solvency and financial condition reports.</li> <li>• EIOPA shall assess the need for prudential treatment of sustainability exposure and review the catastrophe risk submodule.</li> </ul>
	<ul style="list-style-type: none"> <li>• Introduction of regular climate change scenario analyses to assess the exposure to climate change risks in the ORSA process.</li> </ul>

Topic and subtopics		Directive (EU) 2025/2	Directive (EU) 2009/138/EC
<b>Simplifications</b>	Proportionality	Points of Article 1: 2, 12, 13, 15, 16, 20, 23, 25, 27, 38, 43, 50, 51, 71, 80  Recitals: 10, 14-19, 22, 31, 37, 38, 40, 52, 80, 81, 85	Amended Articles: 4, 35, 41, 45, 51, 52, 77, 86, 109, 111  Added Articles: 29a-e, 35a-b, 213a, 229a
	Reporting duties	Points of Article 1: 15, 102  Recitals: 18, 22, 23, 38	Amended Articles: 35  Added Articles: 304e
<b>Miscellaneous</b>	Modifications to the Solvency and Financial Condition Report	Points of Article 1: 25, 28, 29, 92, 93  Recitals: 36, 55	Amended Articles: 51, 53, 56, 256  Added Articles: 256b, 256c
	Deleted references to UK	Points of Article 1: 1, 3, 4, 5, 62, 103, 112  Recitals: - 103-104	Amended Articles: 2, 6, 8, 13, 145, 305  Deleted parts of Annex III: A (27), B (27), C (27)
	Updated references, timelines, and rewording	Points of Article 1: - 8, 10, 14, 30, 31, 32, 33, 36, 37, 45, 46, 54, 55, 59, 65, 69, 70, 73, 77, 82, 83, 90, 99, 100, 101, 104, 105, 110, 111  Recitals: - 5, 97, 99	Amended Articles: - 24, 25a, 30, 58, 61, 62, 63, 70, 72, 95, 96, 132, 133, 141, 152, 212, 213, 220, 227, 232, 233, 252, 268, 301a, 304, 308a, 308b, 309, 311

	<b>Summary</b>
	<ul style="list-style-type: none"> <li>• Definition of small and non-complex insurance or reinsurance undertakings as well as insurance groups with less or simplified obligations regarding risk measurement, risk management, and reporting.</li> <li>• Higher thresholds (gross written premiums, technical provisions) for undertakings where Solvency II shall not apply.</li> </ul>
	<ul style="list-style-type: none"> <li>• EIOPA shall submit a report to the Commission on potential measures for integrated data collection to reduce duplications between reporting frameworks and compliance costs.</li> <li>• Supervisory authorities can extend deadlines for reporting duties in exceptional circumstances affecting insurers.</li> </ul>
	<ul style="list-style-type: none"> <li>• The Solvency and Financial Condition Report will be split into two parts: one part specifically targeted at policyholders and one technical part for market professionals.</li> <li>• Specific audit requirements for Solvency and Financial Condition Reports are introduced with a separate audit report.</li> <li>• Solvency and Financial Condition Reports are extended to cover sustainability and liquidity risks, and rules are introduced to account for proportionality and group supervision.</li> </ul>
	<ul style="list-style-type: none"> <li>• Removal of references to the UK reflecting that the UK left the EU in January 2020 and is currently transitioning from the EU's Solvency II framework to a UK-specific insurance supervisory regime (also refer to Müller &amp; Reuse, 2023).</li> </ul>
	<ul style="list-style-type: none"> <li>• To ensure the internal consistency of the directive, several references to amended or added articles have been updated, as well as minor rewordings, also in regard to abbreviations.</li> <li>• To ensure consistency within the European legislation, several references to other regulations and directives have been updated, particularly in regard to definitions.</li> </ul>

The Solvency II Review Directive itself contains 106 recitals, six articles, and one annex. The directive's core lies in Article 1, which comprises 112 amendment points to Solvency II. The objectives behind these refinements of Solvency II are manifold (refer to Table 1): Technical modifications (e.g., to the extrapolation of the risk-free interest rate term structure curve) intend to remedy previously identified weaknesses during the period of low interest rates. Other modifications aim to release capital to support the economic recovery after the COVID-19 pandemic, e.g., by reducing the costs of capital or facilitating the treatment of long-term investments. To strengthen macroprudential supervision, the Solvency II Review Directive expands supervisory authorities' tools and responsibilities. This includes cross-border activities and the supervision of insurance groups. To contribute to the EU's Green Deal, insurers are required to regularly conduct climate scenario analyses and disclose their sustainability risks. Moreover, the revised framework introduces several simplifications and proportionality measures to reduce the regulatory burden on insurers. A central feature is a new category for small, non-complex insurers, which are subject to lower requirements regarding risk measurement, management, and reporting. The Solvency and Financial Condition Report is split into two parts to address policyholders and investors separately, with certain elements now being subject to mandatory audits. Finally, references and rules that relied on the UK's former EU membership have been removed, and references to other EU regulations and directives have been updated to improve the alignment across the EU financial regulatory landscape.

### **3.2 EMERGING RISKS IN THE SOLVENCY II REVIEW**

To investigate the role of emerging risks in the Solvency II review process, we examined the Solvency II Review Directive and all related publications since November 2019, as listed in Table A.2 in the Appendix. This approach allows us to examine the treatment of emerging risks throughout the review process and the regulatory adaptation in the final directive. Consistent with Solvency II's three-pillar structure, we analyzed the treatment of emerging risks in quantitative risk measurement (Pillar I), qualitative risk management (Pillar II), and risk disclosure (Pillar III). The subsections follow the categorization of emerging risks from Table A.1 in the Appendix: (1) environment and climate, (2) technological, and (3) social, economic, and health.

#### **3.2.1 ENVIRONMENT AND CLIMATE**

Solvency II did not originally include a dedicated approach to environmental and climate-related risks. However, the increasing recognition of climate change as a systemic financial risk and the integration of sustainability considerations into prudential frameworks have gained momentum. The 2025 review of Solvency II marks a major progression in this regard, aiming to more systematically embed climate risks into insurers' risk management and supervisory practices (EIOPA, 2024c). While no immediate changes to modify the Solvency II standard formula regarding environmental and climate risks were introduced under Pillar 1, specific requirements for integrating such risks into ORSA and public reporting were introduced under Pillars II and III. Table 2 summarizes the most important changes introduced by the Solvency II Review regarding environmental and climate risks.

**TABLE 2**

Comparison of the previous Solvency II framework and the post-review framework regarding environment and climate risk

<b>Regulatory pillar</b>	<b>Previous framework</b>	<b>2025 reforms</b>
Pillar I – capital requirements	Climate risks are not explicitly included in the Standard Formula; internal models may integrate them voluntarily.	No immediate change to capital formula; EIOPA to continue evaluating climate-sensitive parameters of the standard formula.
Pillar II – risk management & ORSA	Supervisory expectation to consider climate risks through scenario analyses. EIOPA recommending long-term climate scenario analysis.	<p>Mandatory long-term climate scenario analysis (<math>\geq 2</math> scenarios) for firms with material exposures (one where global temperature rise remains below 2°C, one scenario where global temperature rise significantly exceeds 2°C) and impact analysis across three time horizons:</p> <ul style="list-style-type: none"> <li>• Short-term: Identify immediate risks.</li> <li>• Medium term: Manage gradual sectoral transitions and adaptation.</li> <li>• Long-term: Assess structural market transformation.</li> </ul>
Pillar II – governance	Environmental risks are not explicitly required in governance systems	Integration of environmental risks into all core governance functions, including the actuarial function and underwriting.
Pillar III – disclosure	Limited and voluntary sustainability disclosures in Solvency and Financial Condition Reports	Enhanced and standardized disclosures aligned with the Corporate Sustainability Reporting Directive (transition plans and environmental risk metrics).

The regulatory shift to explicitly integrate environmental and climate risks into insurers' risk management and public disclosure is also reflected in the recitals of Directive (EU) 2025/2. Recitals 31 and 32 underline the importance of insurers disclosing their exposure to sustainability risks and their transition strategies in a more harmonized and transparent manner. Moreover, Recital 35 emphasizes that undertakings should consider sustainability-related factors in their governance and risk management systems, including the actuarial and underwriting functions. Recital 96 clarifies that ORSAs should explicitly include long-term climate scenarios and materiality assessments, also supporting the alignment of prudential regulation with the EU's climate goals. These provisions indicate a political and regulatory mandate for insurers to integrate ESG considerations more explicitly and systematically into their core supervisory processes—without compromising the risk-based foundations of the Solvency II framework (Directive (EU) 2025/2, Recital 11).

As explained in Section 2.3.2, EU insurers are expected to address all material risks in their annual ORSA, but EIOPA (2022a) noted that only a minority of insurers considered climate scenarios and subsequently issued a supporting document to provide guidance. The 2025 review seeks to address these shortcomings through a set of legislative and supervisory reforms. The most significant change is the introduction of mandatory climate-scenario analysis within the ORSA. All insurers with material exposure to climate-related risks will be explicitly required to perform at least two long-term climate scenarios as part of their ORSA process—typically including one physical risk and one transition risk scenario. These scenarios must extend beyond the standard ORSA planning horizon of three to five years and cover two distinct global warming pathways: a temperature increase of below 2°C and above 2°C. The analysis must account for three different time horizons: the short term, focusing on immediate risks to operations and portfolios; the medium term, addressing gradual sectoral transitions and adaptation needs; and the long term, assessing structural market transformation and transition dynamics (EIOPA, 2024c). These requirements are expected to align with internationally recognized frameworks such as those provided by the Network for Greening the Financial Systems (EIOPA, 2024a; Insurance Europe, 2025). The revised Article 45a of the Solvency II Directive formalizes this requirement and makes it an integral part of risk management (EIOPA, 2024c).

Next to the detailed requirements for ORSA, governance expectations regarding climate and environmental risks have been enhanced. EIOPA's proposal for RTS clarifies that sustainability risks must be integrated throughout the insurer's governance framework, including underwriting policies, investment strategies, and the actuarial function (EIOPA, 2025a). Moreover, supervisory authorities will evaluate how climate risks are identified, measured, and managed as part of the Supervisory Review Process (EIOPA, 2025a).

In terms of quantitative capital requirements under Pillar I, the review does not immediately introduce changes to the Standard Formula. Proposals to implement

a “Green Supporting Factor” or a “Brown Penalizing Factor” (EIOPA, 2022c), which adjust capital requirements based on the environmental profile of assets (Thomä & Gibhardt, 2019), were not adopted. This outcome aligns with the position of European insurers: Solvency II should remain a risk-based framework, and any differentiated capital treatment for green or brown assets must be grounded in demonstrable differences in underlying risk exposure. Introducing non-risk-based incentives could distort investment signals and undermine the framework’s prudential integrity (Insurance Europe, 2022). However, EIOPA continues to explore how climate-sensitive risk drivers, particularly in natural catastrophe modules, could be incorporated into future calibrations of solvency capital requirements. Climate stress testing and scenario-based supervisory tools will provide empirical grounding for such future changes (Amundi, 2025; EIOPA, 2024c).

Pillar III is also subject to reforms. Insurers will need to report on their transition strategies and climate risk exposures, ESG-related governance, and ESG metrics in a structured and comparable manner.<sup>5</sup> The Solvency and Financial Condition Report (see Section 2.3.4) will likely evolve into a meaningful instrument for communicating climate risk management to regulators, investors, and the public (EIOPA, 2024g). The revised disclosure requirements are intended to harmonize with already existing EU regulations on sustainability disclosure (e.g., the Corporate Sustainability Reporting Directive and the European Sustainability Reporting Standards).

As discussed in Section 2.3.2, more specific and comparable disclosure requirements on climate and environmental risks harmonized across all EU insurers could strengthen market discipline, including relative to the situation in the U.S. However, insurers are concerned that redundant reporting obligations arising from the existing EU regulations on sustainability reporting, the ORSA, and Pillar 3 disclosure will cause operational inefficiencies (Insurance Europe, 2025). Additionally, insurers criticize the draft requirement by EIOPA (2024c) to prepare separate sustainability risk plans: these plans offer no added value and result in unnecessary duplication alongside the ORSA and existing reporting obligations (Insurance Europe, 2025). Against this background, research on the effectiveness of market discipline and an appropriate cost-benefit analysis for public disclosure requirements on climate and environmental risks in the insurance industry appears important.

While the Solvency II Review addresses climate-related risks across ORSA, governance, and public disclosure, it also broadens the environmental scope by explicitly including biodiversity risks (Directive (EU) 2025/2, Article 1[102]). EIOPA has been mandated to assess whether, and to what extent, the insurance industry considers its material exposure to biodiversity-related risks in its ORSA, and to identify necessary actions to ensure adequate risk integration. EIOPA (2025b) calls

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<sup>5</sup>Note that the Solvency II Review mostly focuses on the environmental dimension of ESG, but also explicitly mentions to consider socially harmful investments. Moreover, insurers must establish a policy to promote diversity and gender-balance in their management or supervisory body (Directive (EU) 2025/2, Article 1[20]).

for the systematic integration of both physical and transition risks linked to biodiversity loss into insurers' risk management frameworks under Solvency II, with a particular focus on the ORSA. Although Pillar I capital requirements remain formally unchanged, supervisors expect internal models to reflect material biodiversity exposures and to disclose them under Pillar III in line with existing EU regulations on sustainability disclosure. The implementation, however, is hindered by significant data gaps, the absence of standardized biodiversity metrics, and methodological uncertainty. Therefore, current assessments remain qualitative and fragmented, particularly in underwriting (EIOPA, 2025b).

### **3.2.2 TECHNOLOGICAL**

The Solvency II Review acknowledges both cyber and crypto-assets as examples of emerging technological risks. Similar to the environmental and climate risks (refer to Section 3.2.1), no immediate changes to the Solvency II standard formula under Pillar I are introduced, but modifications to risk management requirements under Pillar II. The scope and technical specificity of these modifications are less comprehensive than those for environmental and climate risks. An overview of the amendments for emerging technological risks is provided in Table 3.

Article 1(5) of the Solvency II Review Directive introduces a formal definition for crypto-assets in Solvency II by cross-referencing Regulation (EU) 2023/1114 on Markets in Crypto-Assets. Moreover, a new paragraph has been added to Article 105 of Solvency II that empowers the European Commission to adjust the market and counterparty default risk modules of the Solvency II standard formula through delegated acts in the future. EIOPA's proposal to address crypto-assets through a 100% undiversified capital requirement (refer to Section 2.3.1) has not yet been taken up in the Solvency II Review. Regarding cyber risks, the Solvency II Review does not account for any (future) changes to the Solvency II standard formula, although research indicates that the existing formula does not adequately reflect cyber risks (Eling & Schnell, 2020).

In the context of Pillar II, the 2025 Solvency II Review amends Article 44(2)(e) of Solvency II to explicitly require that insurers' operational risk management must include cybersecurity, referring to the definition in Article 2(1) of the Cybersecurity Act (Regulation (EU) 2019/881). This definition encompasses the preservation of the availability, authenticity, integrity, and confidentiality of network and information systems, including the data they process. The amendment formally embeds cybersecurity within the system of governance under Solvency II, reinforcing the supervisory mandate to address risks in the context of information communication technology. By referencing a horizontal EU regulation, the revised framework strengthens alignment with the Digital Operational Resilience Act (Regulation [EU] 2022/2554). This act entered into force on January 16, 2023, and became fully applicable as of January 17, 2025, introducing requirements on cyber risk management, incident reporting, and oversight of critical third-party providers in the EU financial sector.

**TABLE 3**

Comparison of the previous Solvency II framework and the post-review framework regarding technological risks

<b>Regulatory pillar</b>	<b>Previous framework</b>	<b>2025 reforms</b>
Pillar I – capital requirements	AI and cyber risks are included under operational risk; no explicit treatment in the Standard Formula.	No changes to the Standard Formula; internal models are expected to reflect material AI/cyber exposures. Supervisors will assess the adequacy of assumptions and internal quantifications where relevant.
Pillar II – risk management & ORSA	AI risks may be considered in ORSA, but practices are inconsistent; no formal scenario guidance.	Revised guidelines require ORSA to include scenarios for material AI or digital disruption risks (e.g., systemic cyberattack, AI model failure, cloud outage); governance must reflect risk sensitivity and proportionality.
Pillar II – governance	No specific governance standards for AI; general IT risk governance may apply.	Amendment to Art. 44(2)(e): cybersecurity (as defined in the Cybersecurity Act) must be part of operational risk management. AI governance requirements include explainability, fairness, oversight, and data quality safeguards.
Pillar III – disclosure	No harmonized disclosure on AI/cyber risks in Solvency and Financial Condition Reports; voluntary and qualitative	Enhanced transparency expected; disclosures should align with other EU regulations (DORA, NIS2, AI Act), including cyber risk exposures, governance frameworks, and customer communication standards for AI-based decision-making.

In U.S. insurance regulation, cybersecurity has already been addressed through the NAIC *Insurance Data Security Model Law* (#668) since 2017 (Kao, 2019; NAIC, 2025b). The law requires insurers to implement an information security program, conduct cyber risk assessments, designate a responsible officer, oversee third-party service providers, and meet specific disclosure and response obligations in the event of a cyber incident. However, Kao (2019) notes that the adoption and implementation of the NAIC model law have been highly inconsistent across states. By 2025, only 28 jurisdictions had adopted the model law, often with state-specific variations, while New York applies additional, stricter cybersecurity requirements (NAIC, 2025b). In contrast, the EU Digital Operational Resilience Act, together with the amendments introduced by the Solvency II Review, establishes harmonized cybersecurity and operational resilience requirements across all member states. Such harmonization simplifies compliance for insurers operating in multiple jurisdictions and enables more consistent supervision by regulators. Moreover, EIOPA (2023) published methodological principles, aligned with the Digital Operational Resilience Act, for sector-wide insurance stress testing to assess insurers' cyber underwriting risk and cyber resilience. While EIOPA has not yet conducted a cyber risk stress test by the end of 2025, these methodological principles can guide supervisory authorities and support insurers in assessing cyber risks within their ORSA processes.

AI is not mentioned in the Solvency II Review Directive, but EIOPA (2025d) recently issued supervisory guidance to address AI-related risks within the Solvency II framework. The focus lies within Pillar II, where insurers are expected to establish robust AI governance, ensure the explainability and fairness of AI systems, maintain high cybersecurity standards, and reflect material AI risks in their ORSA processes. Pillar I remains unchanged, but supervisors expect internal models to adequately consider material AI-related exposures. Under Pillar III, disclosure expectations are increasingly aligned with the EU's Digital Operational Resilience and AI Act, aiming to enhance transparency for both regulators and policyholders (EIOPA, 2025d). A similar regulatory approach can be observed in the U.S., where the NAIC *Model Bulletin on the Use of Algorithms, Predictive Models, and Artificial Intelligence Systems by Insurers* was adopted in 2023. The bulletin builds on NAIC's principles on AI, addressing ethical fairness, accountability, compliance, transparency, and security (NAIC, 2020b).

### **3.2.3 SOCIAL, ECONOMIC, AND HEALTH**

Emerging risks in the social, economic, and health domains have already affected, or are expected to affect, the insurance industry (Table A.1 in the Appendix). Table 4 provides an overview of how these risks were addressed in the Solvency II Review. The most detailed treatment concerns the low and negative interest rate environment observed in the EU prior to the onset of COVID-19 in 2020, whereas other emerging risks were addressed at a broader, more overarching level.

**TABLE 4**

Comparison of the previous Solvency II framework and the post-review framework regarding social, economic, and health risks

Regulatory pillar	Previous framework	2025 reforms
Pillar I – risk-free interest rate term structure curve	Interpolation of interest rates from the last liquid point toward the ultimate forward rate leads to sharp jumps during periods of low interest rates.	New approximation method to ensure a smooth transition from the last liquid point toward the ultimate forward rate during periods of low interest rates.
Pillar I – macroprudential measures	Lack of macroprudential tools for supervisory authorities to address systemic risks, particularly compared to the banking sector.	Supervisory authorities are empowered to restrict/ suspend capital outflows of insurance companies during exceptional sector-wide shocks.
Pillar II – liquidity risk management	Liquidity risk as part of the risk management system, but no explicit requirements to prepare liquidity risk management plans.	Formal requirements for liquidity risk management plans to identify and promptly respond to exceptional events.
Pillar II – ORSA	Insurance companies could and mostly did address macroeconomic developments in their ORSA, but this was not explicitly stated in the directive.	Formal requirement that ORSA must consider macroeconomic developments, including inflation, interest rate, climate change, pandemics, mass scale catastrophic events.
Pillar III – reporting deadlines	Lack of a clear mandate to extend reporting deadlines during periods of exceptional sector-wide shocks; supervisory authorities had to rely on “goodwill.”	Formal introduction of provisions that explicitly empower supervisory authorities to extend reporting deadlines in cases of exceptional sector-wide shocks.

In the original Solvency II framework, the risk-free interest rate term structure curve (e.g., used to calculate technical provisions) was directly extrapolated beyond the last liquid point of 20 years toward the ultimate forward rate. This led to sharp and unrealistic upward jumps when market rates were far below the assumed long-term rate. In response, the European Commission (2019) requested that EIOPA assess the appropriateness of using a last liquid point for calibration. EIOPA considered different options, including an increase of the last liquid point to 30 or 50 years, as well as an alternative approximation method to avoid the unrealistic upward jump (EIOPA, 2019a). The latter option was adopted in the final Solvency II Review Directive (Directive [EU] 2025/2, Article 1[37]). Moreover, Article 111 of Solvency II was amended to specify that “methods, assumptions and standard parameters for the interest rate risk sub-module [...] shall reflect the risk that interest rates may further decrease even where they are low or negative” (Directive [EU] 2025/2, Article 1[51]).

Next to the technical adjustments regarding low or negative interest rates under Pillar I of Solvency II, other emerging economic risks (e.g., trade conflicts), social risks (e.g., demographic change), or health risks (e.g., new diseases, medical advances) are not specifically addressed in the Solvency II Review, despite their timely and important role as emerging risks for the insurance industry. The impact of COVID-19 and pandemics is mentioned in the review, but mainly in the broader context of their macroprudential and macroeconomic consequences. The public consultation by the European Commission (2020) attracted limited feedback on lessons learned from the pandemic, with comments focusing on short-term market volatility, interest rates, and the lack of operational relief mechanisms during crises. In its opinion on the 2020 review of Solvency II, EIOPA (2020b) acknowledged potential implications for the Standard Formula’s lapse and health pandemic risk submodules but concluded that data were insufficient for recalibration at that point in time. This issue was not pursued further in later stages of the review, as attention shifted to other priorities, such as interest rate risk, long-term guarantees, and climate risks. Instead, EIOPA (2021b) addressed pandemic risk outside the Solvency II Review by issuing a Supervisory Statement on ORSA in the context of COVID-19.

Pandemics and other emerging risks in the area of economic, social, and health developments are indirectly addressed at a broader, more overarching level. New macroprudential measures are introduced to preserve insurers’ financial positions during exceptional sector-wide shocks (Directive [EU] 2025/2, Article 1[61]). The new Article 144c in Solvency II empowers supervisory authorities to restrict or suspend dividend distributions, share buy-backs, bonuses, and the repayment or redemption of own-fund items in these circumstances. A consultation carried out by the European Commission (2020) confirmed broad public support for granting supervisors such tools. EIOPA (2019e) emphasized that without macroprudential instruments, a triggering event could create systemic risk, whereas the banking sector already benefits from comparable safeguards in the EU. Aikman et al. (2019) emphasized that it is not enough to enable supervisors to identify emerging sys-

temic risks; they must also have the powers for intervention (also refer to Section 2.3.3). The Solvency II Review represents a clear step in this direction.

The definition of an exceptional sector-wide shock has not yet been finalized, but EIOPA (2024a) has submitted a draft RTS. These build primarily on qualitative rather than quantitative criteria (i.e., an event's potential to cause financial instability or defaults toward policyholders) to reflect the uncertainty around emerging risks (refer to Section 2.1). Additionally, the new Article 304e affects Pillar III of Solvency II and allows supervisory authorities to extend reporting deadlines during exceptional sector-wide shocks to ease the burden on insurance companies and help maintain their operational capabilities (Directive [EU] 2025/2, Article 1[102]).

Finally, the European Commission followed EIOPA's opinion on the 2020 review of Solvency II, placing greater emphasis on macroprudential risks (EIOPA, 2020b). Under Pillar II, the ORSA was explicitly expanded to cover the effects of macro-economic developments—in particular inflation, interest rates, climate change, pandemics, and other mass-scale events or catastrophes (Directive [EU] 2025/2, Article 1[23]). Additionally, the Solvency II Review requires insurance companies to prepare liquidity risk management plans and empowers supervisory authorities to remedy liquidity vulnerabilities in exceptional circumstances (Directive [EU] 2025/2, Article 1[61]). For the RTS, EIOPA (2024b) proposed a principle-based approach that balances market consistency with insurers' individual exposures. This implementation is grounded in liquidity risk indicators and monitoring periods drawn from the CRO Forum (2019b), which identified various emerging risks (e.g., natural catastrophes, pandemics, mass lapse) as potential drivers of liquidity threats.

## 4. CONCLUSION

This paper investigates the treatment of emerging risks in EU and U.S. insurance regulation, with additional insights from the Solvency II Review, which represents the largest revision of Solvency II since its introduction in 2016. Emerging risks (e.g., climate change, cyber threats, pandemics) are characterized by high uncertainty, dynamic evolution, and often systemic features. These characteristics make them difficult to manage using traditional risk frameworks. Historical events, including the 2008 financial crisis or the asbestos-related liability exposures between 1970 and 1990, illustrate the potential impact of emerging risks on business activities and financial stability in the insurance sector. Therefore, and in light of agency frictions, emerging risks warrant particular attention in insurance regulation.

The first part of the paper provides a cross-jurisdictional analysis of how EU and U.S. insurance regulation addresses emerging risks. The U.S. and EU are the world's two largest insurance markets, accounting for approximately 60% of total global premium volume. The analysis focuses on key regulatory elements that are either challenged by emerging risks or specifically designed to address them: (1) capital standards and investment restrictions, (2) ORSA requirements, (3) macroprudential

supervision, and (4) public disclosure obligations. The second part of the paper employs the Solvency II Review as a case study to analyze how EU regulators adapted their insurance regulatory framework to emerging risks. Initiated in 2019 and culminating in the 2025 Solvency II Review Directive, the review introduces amendments to Solvency II set to apply from 2027. We examined relevant documents from the review regarding the treatment of emerging risks, focusing on environmental and climate risks, technological risks, and social, economic, and health risks.

The cross-jurisdictional analysis shows that capital standards are inherently limited in capturing emerging risks, as they are designed to account for quantifiable risks and rely on risk factors or scenarios calibrated on historical data. Internal models, the prudent person principle for insurer investing, and the EU's more principle-based Solvency II standard formula can offer some regulatory flexibility for addressing emerging risks, particularly compared to the mostly rule-based approaches in the U.S. However, the need for regular reviews and reactive adjustments to quantitative requirements, as well as additional forward-looking, qualitative requirements, remains necessary. In this context, ORSA plays a central role in both the EU and the U.S., where insurers must regularly assess all their material risks and prospective solvency. To avoid some insurers viewing ORSA as a pure compliance exercise (i.e., overlooking emerging risks or strategic implications), as indicated by EIOPA, more prescriptive rules or guidelines might be necessary.

The systemic nature of emerging risks highlights the relevance of macroprudential supervision. In both the EU and the U.S., sector-wide stress tests and regularly updated risk dashboards for the insurance industry exist to monitor systemic risks. However, macroprudential supervision also requires providing authorities with the power for intervention, which is often missing. Regarding public disclosure obligations, major differences between EU and U.S. insurance regulation exist. While all EU insurers under Solvency II are required to publish a Solvency and Financial Condition Report with narrative sections on their risk management and assessment of material risks, public disclosure requirements in the U.S. are mostly limited to publicly traded companies. Future research should investigate to what extent EU insurers address emerging risks in their reports and whether this contributes to strengthening market discipline.

The Solvency II Review addressed several emerging risks. Environmental and climate risks received the most and far-reaching regulatory attention. The revised directive explicitly requires insurers to (1) conduct long-term climate scenario analyses in their ORSA, (2) integrate environmental risks into their governance functions, and (3) disclose sustainability risks in their Solvency and Financial Condition Reports. Pillar I capital requirements remain unchanged, but EIOPA is mandated to explore climate-sensitive refinements to the standard formula. In the area of technological risks, the review provides the regulatory foundation for future adjustments to capital requirements for crypto assets. Cyber risk is explicitly integrated

into operational risk management under Solvency II via cross-references to the Digital Operational Resilience Act, which is already applicable in the EU financial sector. Economic, social, and health risks were largely addressed through a principle-based approach. Insurers are explicitly mandated to consider macroeconomic developments in their ORSA and to establish liquidity risk management plans. Additionally, supervisory authorities are empowered to apply macroprudential measures and extend reporting deadlines during exceptional sector-wide shocks.

The amendments introduced by the Solvency II Review demonstrate that EU regulators are aware of emerging risks and are reviewing or planning to adjust their capital standards in response to them. While EIOPA has long issued guidelines and supervisory expectations for analyzing specific emerging risks in ORSA, the Solvency II Review marks a further step toward more prescriptive rules—particularly for environmental and climate risks—across ORSA, risk management, and public disclosure. Compared to the more governance- and process-oriented ORSA requirements in the US, this approach may reduce the risk that some insurers treat ORSA as a mere compliance exercise, relying on broadly worded statements (e.g., “all material risks”). The stronger focus on environmental and climate risks compared to other emerging risks in the Solvency II Review may partly reflect the EU’s ambitious Green Deal and current growth strategy (Benoît, 2025), although other factors may also play a role. Technological risks appear less prominent, possibly because they are already addressed under parallel regulations, such as the Digital Operational Resilience Act. As Schiro (2006) highlights, political pressure can hinder insurance regulation, while principle-based approaches are the key to adapting to market dynamics. In this regard, the flexible, principle-based approach to macroprudential risks in the Solvency II Review offers a promising model for addressing the uncertainty associated with emerging risks.

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**APPENDIX****TABLE A.1**

Emerging risks mentioned in the CRO Risk Radars from 2019 to 2024 (CRO Forum, 2019a-2024)

	<b>Emerging risk</b>	<b>Risk category</b>	<b>Last year mentioned</b>	<b>Time horizon</b>
<b>Environment and climate</b>	Climate Change Litigation	Medium	2021	Expected in 1-5 years
	Climate Change Transition Risk	High	2024	Expected in 1-5 years
	Climate Change Physical Risk/Climate Tipping Point	High	2024	Expected in 1-5 years
	Climate Change Engineering and Storage Techniques	Medium	2024	Expected in 1-5 years
	Energy Storage Systems	Low	2023	Expected in 1-5 years
	Environment and Pollution	Medium	2024	Expected in 1-5 years
	Extreme Weather	High	2021	Already seen
	Food and Water Supply	Medium	2021	Expected in 1-5 years
	Hazardous Chemicals and Small Particles	Medium	2024	Expected in 1-5 years
	Nature and Biodiversity Loss	Medium	2024	Expected in 1-5 years
	Plastic and Microplastics	Medium	2021	Expected in 1-5 years
<b>Technological</b>	3D Printing	Low	2020	Expected in 1-5 years
	Artificial Intelligence	High	2024	Expected in 1-5 years
	Autonomous Machines	Medium	2024	Expected in 1-5 years
	Blockchain Technology and Digital Currencies	Low	2023	Expected in 1-5 years
	Cyber Risk	High	2024	Already seen
	Data Privacy and Data Ethics	Medium	2024	Expected in 1-5 years
	Digital Misinformation and Information Reliability	Medium	2024	Expected in 1-5 years
	Genetic Engineering/Synthetic Biology	Medium	2024	Expected in 5-10 years
	Nanotechnology	Medium	2021	Expected in 1-5 years
	New Frontiers for Resource Extraction	Medium	2020	Expected in 1-5 years
	Predictive Genetic Testing	Medium	2019	Expected in 1-5 years
	Space Risk	Low	2024	Expected in 5-10 years
	Synthetic Biology	Low	2020	Expected in 5-10 years

<b>Social, economic, health</b>	Antimicrobial Resistance	Medium	2024	Expected in 1-5 years
	Collective Redress	Medium	2024	Expected in 1-5 years
	Critical Infrastructure Blackouts and Failures	High	2024	Already seen
	Economic Trade Conflicts and Sanctions	Medium	2024	Already seen
	Endocrine Disruptors	Medium	2022	Expected in 1-5 years
	Evolving Terrorism	Medium	2024	Expected in 1-5 years
	Geopolitical Tensions and Conflicts	High	2024	Already seen
	Growth of Leverage and Global Debt Crisis	Medium	2024	Expected in 1-5 years
	Legal & Regulatory Uncertainty	Medium	2024	Expected in 1-5 years
	Mass Migration	Low	2020	Expected in 1-5 years
	Medical Advances	Medium	2024	Expected in 1-5 years
	Mental Health	Medium	2024	Expected in 1-5 years
	Monetary Policies	High	2022	Already seen
	New Insurance Competition	Medium	2023	Expected in 1-5 years
	Obesity and Metabolic Syndrome	Medium	2024	Expected in 1-5 years
	Pandemics and Emerging Infectious Diseases	Medium	2024	Expected in 1-5 years
	Passive Investment	Medium	2022	Expected in 1-5 years
	Political Instability	Medium	2021	Already seen
	Protectionism	High	2021	Expected in 1-5 years
	Resource and Supply Management	Medium	2024	Expected in 1-5 years
	Sharing Economy	Low	2021	Expected in 1-5 years
	Shifting Range of Pathogens	Low	2021	Expected in 1-5 years
	Skills Shortage and Reskilling	Medium	2024	Expected in 1-5 years
Social Fragmentation	Medium	2024	Expected in 1-5 years	
Substance Abuse	Medium	2024	Expected in 1-5 years	
Supply Chain Complexity	Medium	2024	Expected in 1-5 years	

Notes: This table lists all emerging risks mentioned in the Emerging Risk Radar publications by the CRO Forum from 2019 to 2024 (CRO Forum, 2019a-2024). The risk category and time horizon correspond to the CRO publication in which the respective emerging risk was most recently cited.

**TABLE A.2**

Relevant steps along the Solvency II review process

Date	Document	Content
2/11/2019	Formal request to EIOPA for technical advice on the review of the Solvency II Directive <sup>a</sup>	<p>Review of long-term guarantee (LTG) measures and capital requirements measures:</p> <ul style="list-style-type: none"> <li>• Assess and improve LTG measures (e.g., volatility/matching adjustment) and equity risk sub-modules.</li> <li>• Evaluate methods and parameters for the calculation of Solvency Capital Requirements and Minimum Capital Requirements.</li> </ul> <p>Enhancement of supervisory framework:</p> <ul style="list-style-type: none"> <li>• Analyze group supervision practices, macro-prudential tools, and cross-border supervision effectiveness.</li> <li>• Explore harmonization needs for recovery, resolution, and insurance guarantee schemes.</li> </ul> <p>Proportionality and simplification:</p> <ul style="list-style-type: none"> <li>• Propose simplifications for small insurers and immaterial risks.</li> <li>• Assess proportionality in reporting, own funds tiering, and reliance on external ratings.</li> </ul>

Date	Document	Content
10/15/2019	Consultation paper on the opinion on the 2020 review of Solvency II <sup>b</sup>	<p>Adjustment of LTG measures and interest rate risk:</p> <ul style="list-style-type: none"> <li>• Reform of extrapolation and volatility adjustment methods to improve risk sensitivity and avoid underestimation of technical provisions.</li> <li>• Proposal to revise the interest rate risk sub-module calibration to better reflect empirical evidence.</li> </ul> <p>Inclusion of new regulatory tools:</p> <ul style="list-style-type: none"> <li>• Macroprudential tools, recovery and resolution frameworks, and harmonized insurance guarantee schemes.</li> <li>• Aim to enhance financial stability, policyholder protection, and cross-border coordination.</li> </ul> <p>Refinement of existing Solvency II provisions:</p> <ul style="list-style-type: none"> <li>• Enhancements to reporting, proportionality, group supervision, and freedom to provide services.</li> <li>• Clarifications and simplifications to improve consistency, reduce burden, and address supervisory experience.</li> </ul>

<b>Date</b>	<b>Document</b>	<b>Content</b>
7/1/2020 – 10/21/2020	Summary report of the public consultation on the review of prudential rules for Solvency II <sup>c</sup>	<p>Stakeholder priorities and diverging views:</p> <ul style="list-style-type: none"><li>• Support for Solvency II’s core objectives: policyholder protection, financial stability, and market fairness.</li><li>• Divergent views on review priorities: insurers emphasized long-term investments, while NGOs prioritized sustainability and systemic risk prevention.</li></ul> <p>Proportionality, transparency, and reporting simplification:</p> <ul style="list-style-type: none"><li>• Call from insurers to extend proportionality measures, reduce burdens for small firms, and simplify reporting.</li><li>• Views on public disclosure, internal model transparency, and differentiated treatment for mutual insurers.</li></ul> <p>Emerging risks and supervisory framework enhancements:</p> <ul style="list-style-type: none"><li>• Support for climate risk integration, macroprudential tools, and crisis response mechanisms.</li><li>• Disagreement over cyber risk treatment and cross-border supervisory powers; some stakeholders favor harmonized insurance guarantee schemes.</li></ul>

Date	Document	Content
12/17/2020	Feedback Statement on Consultation Papers 19/004, 19/005, and 19/006 (Opinion on the 2020 review of Solvency II) <sup>d</sup>	<p>General support for Solvency II objectives with a need for targeted reforms:</p> <ul style="list-style-type: none"> <li>• Consensus on maintaining core goals: policyholder protection, financial stability, and market integration.</li> <li>• Stakeholders support a risk-based approach, but call for improvements in sensitivity, consistency, and international competitiveness.</li> </ul> <p>Proportionality, reporting burden, and simplification:</p> <ul style="list-style-type: none"> <li>• Widespread support for increasing proportionality, especially for small and low-risk insurers.</li> <li>• Strong feedback to reduce complexity and frequency of reporting, and to simplify Solvency and Financial Condition Reports.</li> </ul> <p>Addressing emerging risks and enhancing resilience:</p> <ul style="list-style-type: none"> <li>• Stakeholders highlight the importance of integrating climate risk and enhancing macroprudential supervision.</li> <li>• Mixed views on supervisory powers and resolution tools; call for balanced, future-proof regulatory tools.</li> </ul>

<b>Date</b>	<b>Document</b>	<b>Content</b>
12/17/2020	Opinion on the 2020 review of Solvency II <sup>e</sup>	<p>Enhancement of risk sensitivity and prudential balance:</p> <ul style="list-style-type: none"><li>• Proposal to revise interest rate risk calibration and extrapolation method.</li><li>• Improvements to volatility adjustment and risk margin to better reflect actual risks and economic reality.</li></ul> <p>Strengthening the supervisory and macroeconomic framework:</p> <ul style="list-style-type: none"><li>• Recommendations for new macroprudential tools and a harmonized recovery and resolution regime.</li><li>• Emphasis on improved cross-border supervision and proportionality in supervisory practices.</li></ul> <p>Integration of sustainability and emerging risks:</p> <ul style="list-style-type: none"><li>• Inclusion of climate risk scenario analysis under Pillar 2 requirements.</li><li>• Suggestions to enhance resilience to digitalization and cyber risks.</li></ul>

Date	Document	Content
12/17/2020	Reporting and disclosure: quantitative reporting templates <sup>f</sup>	<p>Improving proportionality and reducing reporting burden:</p> <ul style="list-style-type: none"> <li>• Proposes reducing the number and frequency of templates for low-risk or small undertakings.</li> <li>• Suggests simplified templates and thresholds to avoid unnecessary complexity.</li> </ul> <p>Enhancing data quality and supervisory effectiveness:</p> <ul style="list-style-type: none"> <li>• Introduces clearer instructions, better definitions, and consistency across templates.</li> <li>• Aims to improve the usability of reported data for both supervisors and stakeholders.</li> </ul> <p>Streamlining the reporting framework and digitalization:</p> <ul style="list-style-type: none"> <li>• Supports digital transformation through standardized formats and machine-readability.</li> <li>• Encourages alignment with other reporting frameworks (e.g., ECB, ESRB) to avoid duplication.</li> </ul>

<b>Date</b>	<b>Document</b>	<b>Content</b>
9/22/2021	Proposal for a directive of the European Parliament and of the Council amending Directive 2009/138/EC <sup>9</sup>	<p>Improved proportionality and support for long-term investment:</p> <ul style="list-style-type: none"><li>• Introduces a more proportionate regime for small and non-complex insurers.</li><li>• Adjusts prudential rules to better support long-term investments and the EU's economic recovery.</li></ul> <p>Strengthened supervisory powers and crisis management:</p> <ul style="list-style-type: none"><li>• Establishes a harmonized recovery and resolution framework for (re)insurers.</li><li>• Enhances cross-border supervision and introduces new powers for early intervention.</li></ul> <p>Integration of sustainability and macroprudential tools:</p> <ul style="list-style-type: none"><li>• Embeds climate risk and environmental factors into risk management and reporting.</li><li>• Introduces tools to mitigate systemic risk and ensure financial stability in crises.</li></ul>

Date	Document	Content
10/1/2024	First series on consultation papers by EIOPA on RTS and ITS for the review process <sup>h</sup>	<p>Implementation of new supervisory tools post-Solvency II Review:</p> <ul style="list-style-type: none"> <li>• Consultation papers on cross-border supervision, liquidity risk management, and sector-wide shocks.</li> </ul> <p>Criteria for identifying exceptional sector-wide shocks:</p> <ul style="list-style-type: none"> <li>• The proposed RTS defines flexible, outcome-based criteria to assess financial instability and policyholder risk, avoiding rigid quantitative triggers to ensure applicability during unanticipated crises.</li> </ul> <p>Balance between harmonization and flexibility:</p> <ul style="list-style-type: none"> <li>• Preference for qualitative criteria to maintain supervisory discretion and reduce false negatives during crises, while ensuring coherent EU-wide application to preserve financial stability and policyholder protection.</li> </ul>
12/4/2024	Second series on consultation papers by EIOPA on topics for the review process <sup>i</sup>	<p>Mandatory integration of sustainability and biodiversity risks:</p> <ul style="list-style-type: none"> <li>• Insurers must identify, assess, and manage material ESG risks in their ORSA and strategic planning processes.</li> </ul> <p>Development of sustainability risk plans under Solvency II:</p> <ul style="list-style-type: none"> <li>• RTS for minimum standards, targets, timelines, and disclosure rules for sustainability risk plans.</li> </ul> <p>Proportional, data-driven, and aligned implementation:</p> <ul style="list-style-type: none"> <li>• Proportionate, principles-based approach for small firms, aligning with other EU frameworks.</li> </ul>

<sup>a</sup> European Commission (2019); <sup>b</sup> EIOPA (2019a); <sup>c</sup> European Commission (2020); <sup>d</sup> EIOPA (2020a); <sup>e</sup> EIOPA (2020b); <sup>f</sup> EIOPA (2020c); <sup>g</sup> European Commission (2021); <sup>h</sup> EIOPA (2024e); <sup>i</sup> EIOPA (2024f)