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Nature-based insurance and investments - Guidance on performance and design criteria

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Ref. No.:CWA 18349:2026 E

Contents	Page
Foreword	3
Introduction	6
1 Scope	9
2 Normative references	9
3 Terms and definitions	9
4 Guiding Design Principles	10
4.1 General	10
4.2 Principle 1: Economic soundness	11
4.3 Principle 2: Financial viability	12
4.4 Principle 3: Environmental integrity	13
4.5 Principle 4: Social value and ethical practice	14
4.6 Principle 5: Governance, data, and assurance	15
5 Shared Metrics of Viable Nature-Based Insurance and Investment Solutions	16
5.1 General	16
5.2 How other frameworks and standards treat the shared metrics	16
5.3 Shared metrics rationale	17
5.4 Categories of metrics	18
Annex A (informative) Additional references and Case Studies	25
A.1 Relevant committee work referenced	25
A.2 Case studies	25
Bibliography	30

Foreword

This CEN Workshop Agreement (CWA 18349:2026) has been developed in accordance with the CEN-CENELEC Guide 29 “CEN/CENELEC Workshop Agreements – A rapid way to standardization” and with the relevant provisions of CEN/CENELEC Internal Regulations - Part 2. It was approved by the Workshop CEN/WS NATURANCE, the secretariat of which is held by “UNI” consisting of representatives of interested parties on 2026-02-09, the constitution of which was supported by CEN following the public call for participation made on 2025-07-29. However, this CEN Workshop Agreement does not necessarily include all relevant stakeholders.

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CWA 18349:2026 (E)

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Introduction

The climate, biodiversity, and pollution crises are inseparable and mutually reinforcing. Anthropogenic greenhouse-gas emissions drive global warming, intensify climate extremes, and shift hydrological and ecological regimes. At the same time, habitat loss, land and resource overexploitation, and invasive species erode the resilience that ecosystems need to buffer shocks. Human-induced pollution, including air, water, and soil contamination, plastics, excess nutrients, and toxic chemicals, degrades human and ecosystem health, weakens natural carbon sinks, and pushes planetary boundaries beyond the safe operating limits of Earth's systems. Each of these crises on its own, and even more so in combination, represents significant risks for people, the environment, and economies, disproportionately affecting vulnerable communities and groups who are least responsible and least prepared to cope. Yet solutions to each, especially when framed together, can create positive feedback and lay the groundwork for long-term resilience: restored wetlands store carbon and reduce flood risk; cleaner air improves health and productivity; and diverse ecosystems sustain food and water security.

The purpose of the Workshop is to establish shared design principles and performance metrics for nature-based insurance and investment solutions that enhance disaster risk reduction, environmental and social benefits, equity, and economic viability. The Workshop aims to fill a unique niche not currently addressed by previous efforts by targeting projects and activities that are material to insurance and financial actors. It supports equitably closing the Nature-based Solutions (NbS) financing gap, goals related to climate action, disaster risk reduction, and biodiversity, by providing transparent criteria and guiding principles for integrating NbS into nature-based insurance and investment solutions.

This CEN/WS builds upon the innovative outcomes of the *Nature for Insurance, Insurance for Nature* (NATURANCE) initiative (Grant Agreement No. 101060464). The NATURANCE project is a Coordination and Support Action funded under Horizon Europe, the EU's Research and Innovation Framework Programme for 2021–2027. It responds to the Horizon Europe Cluster "Food, Bioeconomy, Natural Resources, Agriculture and Environment," under the topic HORIZON-CL6-2021-BIODIV-01-06: *Nature-based solutions, prevention and reduction of risks, and the insurance sector*.

The objectives of the NATURANCE project are directly tied to the Workshop proposal:

1. Connecting major knowledge networks and fostering cross-domain knowledge;
2. Seeking to assess existing and explore new areas for equitable insurance and investment solutions;
3. Analysing policy and governance conditions that are conducive to sustainable, innovative and equitable green insurance;
4. Analysing models, methods, scenarios and metrics used for assessing risk-reduction performance of NbS;
5. Building awareness and capabilities for nature-positive financial innovations, thus creating conditions for inclusive, equitable and transformative change.

The project and the Workshop build on a commitment to analysis and network building to explore innovations that enable transformative change. Moreover, the Workshop builds on the work of the NATURANCE Knowledge Network, which is comprised of organizations such as the Institute for European Environmental Policy (IEEP), the International Groundwater Resources Assessment Centre (IGRAC), the Munich Climate Insurance Initiative (MCII) and the Stockholm Environment Institute (SEI), and Horizon Europe projects.

A broad consensus on what constitutes a sound "nature-based insurance and investment solution" is both needed and timely in order to make solutions decision-ready and defensible in a world where climate and nature risk reporting is increasingly no longer optional. Globally, frameworks such as the Task Force on Climate-related Financial Disclosures (TCFD), the Taskforce on Nature-related Financial Disclosures (TNFD), and the International Sustainability Standards Board (ISSB) standards, and in Europe the Corporate

Sustainability Reporting Directive (CSRD) with the European Sustainability Reporting Standards (ESRS), and the European Union (EU) Taxonomy and related disclosures, all require evidence that is comparable and material. For the scope of this CWA, “material” means significant enough to influence design, underwriting, investment or approval decisions; the CWA turns that idea into practice by setting out metrics and documentation that show when risk reduction and ecosystem benefits genuinely matter for underwriting and investment decisions.

NOTE This definition of materiality is slightly different from that of the International Sustainability Standards Board, which emphasizes the perspective of stakeholders.

The CWA applies double materiality: financial materiality (effects of nature degradation on businesses, e.g., costs, revenues, premiums and asset values) and impact materiality (the effects of business decisions on people and nature).

While the TNFD/SBTN operationalise NbS into investment and corporate decision-making, and the EU Taxonomy determines whether projects qualify as sustainable finance, i.e., whether they are sound, the core quality reference for assessing the environmental credibility of NbS projects is the IUCN Global Standard (8 criteria, 28 indicators). Although not formal standards, widely used EU frameworks include the EU Technical Guidance on NbS for Climate Adaptation, the MAES Framework (Mapping and Assessment of Ecosystem Services) and the EIB Natural Capital Financing Facility Guidelines. The Verified Carbon Standard (VCS) is used for carbon-oriented NbS certification markets.

These quality standards assure, among others:

- biodiversity and ecosystem integrity;
- social inclusion and governance;
- landscape-scale planning;
- restoration of degraded landscapes;
- long-term ecological sustainability; and
- climate and adaptation relevance.

In other words, existing quality standards determine the ‘soundness’ or ‘goodness’ of a project and are intended for certifying projects as environmentally credible. However, they do not cover many aspects that make NbS material for insurers and investors, and create a level playing field, including:

- quantified Risk Reduction Benefits (Core Insurance Requirement). Insurance underwriters need probabilistic hazard, exposure and vulnerability models with standardized metrics, e.g., on expected loss reduction, change in annual expected loss (AEL) and change in tail risk;
- quantified benefits to biodiversity and society with attention to enabling conditions for the private sector to exploit them, for example, through creating revenue streams;
- clearly defined performance obligations, e.g., who carries the performance risk and how to deal with time lags (e.g., forests take years to mature), and remediation mechanisms for ecological failure;
- risk-adjusted return models that include allowed revenue streams, monetization pathways (carbon, resilience credits, biodiversity credits, etc.), and cashflow waterfall or capital stack structure;
- monitoring, verification and data quality for financial use, including sensor density and ecological monitoring precision;

CWA 18349:2026 (E)

- liability, tenure, and maintenance including long-term maintenance contracts and liability allocation if damage still occurs.

These gaps in the ‘playing field’ contribute importantly to the reluctance of insurers and investors to add NbS to their underwriting and investment portfolios. Indeed, insurers and other financial actors often treat NbS as unmodeled measures and classify them as high-risk/low-return or as non-revenue generating assets or activities. According to the EIB [13], nature-based solutions in the EU rely almost entirely on public funding, with a mere 3% receiving substantial financing from the private sector. As an important explanation, the EIB recognizes that NbS are largely public goods lacking revenue potential; still, incentives and innovative financing schemes along with increasing transparency and measurability can overcome many NbS barriers.

This CWA addresses barriers for nature-based insurance and investment solutions by setting out metrics and documentation that show when risk reduction and ecosystem benefits genuinely matter for underwriting and investment decisions (double materiality). Nature-based insurance and investment solutions are assessed against stated objectives and stakeholders, with material benefits demonstrated through quantitative indicators and uncertainty ranges, while non-material co-benefits can be reported qualitatively. By providing a clear, shared threshold for what counts, this CWA aligns methods with reporting obligations and reduces ambiguity in procurement, underwriting and investment.

The CWA is built on two complementary, inseparable components:

- Guiding principles that create a level playing field for procurers, developers, insurers, investors, and communities by defining what “good” or “sound” look like, and providing evidence that substantiates claims of materiality;
- A common set of shared metrics with proportionate monitoring, reporting, and verification (MRV) that support underwriting, investment and financing, and that are closely connected to, and substantiate, the guiding principles.

The target audience for this document is the private sector, including underwriters, asset managers, developers, and others who design and implement projects and financial products. The principles and shared metrics may also be useful for public decision makers, although investment objectives and NbS materiality can require separate considerations. The principles and metrics can be applied across all project scales, and economies of scale that seek aggregate solutions for maximized benefit are encouraged; yet the rigor in which they are applied may be proportional to the capabilities, data and resources available.

1 Scope

This CEN Workshop Agreement (CWA) gives guidance on a common ground for “nature-based insurance and investment solutions”, i.e. solutions which combine nature and ecosystem protection and restoration with disaster risk finance and harness the benefits of ecosystems to reduce the financial protection gap in the face of climate change and increasing damages and losses from extreme weather and climate events (climate extremes).

A main focus is on climate disaster risk reduction (DRR) through the protection, sustainable management and restoration of natural or modified ecosystems. DRR is especially material for insurance underwriters and financial investors. The CWA sets minimum expectations for these solutions in terms of economic and financial soundness and viability, environmental integrity, social value, ethical practice, and inclusive governance.

It aims to create the conditions for wider use of risk-financing mechanisms by harnessing the risk-reducing benefits of ecosystems. It sets out incentives and innovative financing instruments that serve two complementary goals:

- a) to promote nature-based solutions that have proven effective and efficient in protecting assets and communities from climate extremes;
- b) to restore and maintain valuable ecosystems and their multiple contributions to human welfare and resilience.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

Nature-based insurance and investment solutions

any arrangement designed to reduce climate-related risk and to enable financing for nature protection or restoration, or insurance-linked incentives to do so

Note 1 to entry: A solution may take the form of a nature-based solution (3.4) intervention (project) (3.2), a financial or insurance mechanism (product) (3.3), or a combination of both.

3.2

intervention (project)

place-based nature-based solution (3.4) that preserves, restores, or enhances ecosystem services material to the stated objectives of investors, underwriters, or other sponsors, and is designed, implemented, operated, and monitored to deliver measurable outcomes (i.e. risk reduction)

3.3

financial or insurance mechanism (product)

contractual arrangement between investors or underwriters and investees or issuers that prices, transfers, or rewards risk reduction arising from, or explicitly linked to, a nature-based solution (3.4)

CWA 18349:2026 (E)

Note 1 to entry: Examples include parametric covers, premium-credit arrangements, resilience bonds, and similar instruments.

3.4

Nature-based solution (NbS)

actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services, resilience and biodiversity benefits

Note 1 to entry: The approach aligns with the IUCN Global Standard for NbS [1] and the UNEA Resolution 5/5 (2022) and integrates NbS within a systemic, multi-benefit and financeable adaptation framework. [2]

[SOURCE: prEN 18140, modified – Note 1 to entry has been added]

3.5

Indigenous Peoples and Local Communities (IPLC)

individuals and groups who self-identify as indigenous or as members of distinct local communities [3]

3.6

metric

consistent measurement of a characteristic of an object, system, or activity that can be used to assess the condition or performance of a solution (both project and product)

3.7

shared metric

jointly defined and commonly adopted metrics (3.6) and derived indicators (3.8) that standardize measurement methods, units, and scales, emphasizing that how an indicator is measured is as important as what it represents

3.8

indicator

interpreted metric, that is a policy-relevant signal derived from one or more metrics to show progress toward a defined objective, target, or condition

4 Guiding Design Principles

4.1 General

This CWA builds on widely recognized frameworks that use guiding principles to protect integrity, enable comparison, and build market confidence in sustainable finance and the nature-based economy. The CWA draws on the IUCN Global Standard for Nature-based Solutions, which sets ecological and social quality. It uses the Green Bond Principles and Green Loan Principles of ICMA and LMA for financial transparency and accountability. It aligns with the IFC Performance Standards and the DFI Impact Principles for environmental and social risk management. It also reflects the UNEP FI Principles for Sustainable Insurance, which embed sustainability in underwriting and disclosure.

This same principle-based approach is applied to nature-based insurance and investment solutions. This creates a clear link between ecological performance and financial integrity. It connects risk reduction with returns and aligns private incentives with public value. The guiding principles in this CWA turn global frameworks into practical criteria for insurance, investment, and public procurement. We do not duplicate existing standards; we extend them.

Guiding principles establish a common basis and a level playing field for assessing “nature-based insurance and investment solutions” for reducing climate disaster risk. They set out what constitutes a well-designed solution,

the evidence required to demonstrate it, and the processes that lead to such solutions. This enables consistent interpretation across insurers, investors, investees, issuers, procurers, and developers, as well as the wider expert community, promoting comparability, reducing ambiguity in proposal evaluation, and supporting transparent decision-making. The principles also address efficiency and accountability. Clear expectations on risk materiality, risk-reduction performance, monitoring and verification, data quality, governance, and equity reduce transaction costs and facilitate due diligence, underwriting, investing and public reporting. This helps prevent double counting, improves the communication and understanding of uncertainty, reduces the risk of “greenwashing”, and ensures that benefits and responsibilities are appropriately allocated over the life of the solution.

4.2 Principle 1: Economic soundness

Solutions (projects and products) should address clearly defined hazards and risks and deliver a reduction in risk that is large enough to matter for investors and underwriters. Solutions should demonstrate risk materiality through a documented baseline risk assessment covering hazard frequency and severity, vulnerability of assets or populations, and critical functions that, if disrupted, may amplify impacts. Risk reduction should be demonstrated for the implemented-project scenario, quantified with appropriate metrics (e.g., before/after or with/without project), accompanied by relevant uncertainty assessment, and shown to be proportionate to the solution’s objectives and costs. Methods and assumptions used in both the baseline and project scenarios should be transparent, verifiable, and grounded in up-to-date scientific evidence.

Economic soundness guiding principles should:

- specify the target hazards, exposed assets or populations, and the pathways by which the solution reduces risk;
- demonstrate that expected risk reduction is large enough to influence underwriting, pricing, or investment decisions;
- document a transparent baseline and a “with/without project” comparison using accepted catastrophe or risk models;
- report core risk metrics such as change in annual average/expected loss, probability of exceeding a loss threshold, avoided downtime, beneficiaries protected, and indicative premium effects and consider assessing benefits in terms of avoided loss of social welfare;
- disclose data sources, model choices, assumptions, and known limitations; assess and report uncertainty ranges;
- show that design choices match local climate, hydrology, geomorphology, and ecological conditions, including seasonal dynamics and maintenance needs;
- explain why the risk reduction would not occur without the solution and how risk shifting to other places is avoided;
- describe how performance evolves over time (establishment, maturation, potential degradation) and how this affects risk outcomes;
- outline proportionate monitoring and third-party checks at milestones to confirm delivery of risk reduction;
- show alignment with applicable policies and taxonomies, including Do-No-Significant-Harm screening where relevant.

4.3 Principle 2: Financial viability

Solutions (projects and products) should be presented in the form of a viable lifecycle business case with well-defined funding sources and revenue/repayment pathways, contingency management of risks, and sound plans for operation and maintenance. The lifecycle case should set out capital and operating costs, maintenance and monitoring, and, where relevant, decommissioning, for example, when the project is time-bound or when conditions for safe and beneficial operation are no longer met.

Solutions should specify who pays and who benefits, and how benefits are captured or shared (for example greeniums or avoided-loss savings). Co-benefits (collateral benefits) should be quantified and valued, with an explanation of how they contribute to private or social welfare. Where mechanisms exist to monetize or capture the value of these co-benefits, such mechanisms should be designed to ensure that the resulting revenues, fees, or savings are equitably shared and/or reinvested locally to directly support the maintenance of the NbS intervention and the sustained well-being of the communities and/or legitimate right holders.

Where a solution supports or is bundled with insurance, it should align with insurance practice and address basis risk (i.e. mismatch between insurance payouts and actual losses) by showing how the expected risk reduction and any co-benefits map to underwriting decisions, pricing, coverage terms, and any parametric triggers. The business case should be tested for resilience through sensitivity or scenario analysis of key drivers such as changing intensity/frequency of hazards, maintenance performance, discount rate, and price assumptions. Contingency plans should be outlined for performance shortfalls. All methods, assumptions, and sources should be transparent and verifiable.

Financial viability guiding principles should:

- summarise capital and operating costs, monitoring and maintenance, and end-of-life or renewal plans, all over the solution's expected or planned lifetime. Some standard references for financial planning can be found in the Annex A;
- identify confirmed funding sources and revenue or repayment pathways, including how avoided losses, "greenium," or public value are captured;
- provide benefit-cost ratio, net present value, payback period, leverage of private capital, and cost per unit of risk reduced;
- when leveraging private capital (i.e. PPP, blended finance, loans, philanthropy, equity investments), seek opportunities for financial stacking and bundling while avoiding double-county benefits so as to ensure high integrity investments;
- map expected risk reduction to underwriting logic, coverage terms, pricing, and (for parametric solutions) trigger design. Address basis risk explicitly;
- test the business case against adverse but plausible scenarios (hazard intensification, cost inflation...);
- identify relevant co-benefits (e.g., water security, heat reduction, biodiversity) and state how much is monetized, who benefits, and how it supports repayment. Quantify the material co-benefits, while non-material benefits can be reported qualitatively;
- clarify roles and responsibilities, performance guarantees, contingency reserves, and risk-sharing arrangements among sponsors, operators, and beneficiaries;
- commit to regular allocation and impact reporting consistent with market practice, with clear audit trails for proceeds and performance;
- specify delivery model, contract structure, O&M arrangements, and performance clauses that protect long-term functionality;

- note any enabling instruments (e.g., guarantees) that improve creditworthiness or crowd-in capital;
- acknowledge the specific role of parametric products in translating risk reduction into financeable outcomes, and provide guidance on aligning public-good objectives with private ROI (including invest-to-save logic), investor risk considerations (transition, reputational, liability), and the need for clear, predictable payment and repayment schemes.

4.4 Principle 3: Environmental integrity

Projects should deliver a net nature-positive outcome, supported by credible plans for maintenance and stewardship over lifetime, and should avoid unintended harm. Design choices should fit the local ecological and environmental context (e.g., species suitability, hydrological integrity, and land use) and anticipate ecological succession and potential performance decay, with sound provisions for upkeep, renewal, or handover. As climate change progresses and ecosystems evolve, it is essential to embrace an adaptive management approach:

- monitor appropriate indicators,
- define revision milestones/thresholds in advance,
- and be ready to adjust methods and assessments when results diverge from expectations.

In practical terms, evidence should include Do-No-Significant-Harm screening (DNSH, with reference to the EU Taxonomy), baseline and target habitat or condition metrics (and relevant hydro-morphological and water-quality indicators, among others), an operation and maintenance plan, and stewardship agreements. It should also document site diagnostics and the rationale for technical choices, sensitivity checks, a monitoring plan with milestones and thresholds for action, and anticipated revisions over time.

Environmental integrity principles should:

- ensure that each solution contributes to measurable net positive outcomes for nature and ecosystem services, avoiding significant harm to biodiversity or ecosystem functions;
- establish a clear ecological baseline and define measurable indicators of improvement such as habitat quality, connectivity, replicability, carbon storage, or ecosystem service delivery;
- design the solution in an ecologically appropriate way, taking into account local species, hydrology, soils, and landscape dynamics to avoid maladaptation or ecosystem simplification;
- integrate the project within the broader ecological context, aligning with catchment, coastal, or landscape-scale processes as well as other NbS projects and existing conservation or restoration strategies;
- develop a long-term maintenance and stewardship plan that includes responsibilities, financing, and capacity for adaptive management;
- apply the mitigation hierarchy—avoid, minimize, restore, offset—to any residual negative environmental impacts and disclose results transparently;
- use credible, peer-reviewed methodologies or recognized standards (e.g., IUCN Global Standard for NbS) to assess ecological outcomes;
- monitor ecological performance through regular field assessments or remote sensing, ensuring that monitoring data feed back into management and reporting cycles;
- promote nature-positive synergies, for example, linking flood protection with habitat creation, soil conservation, or carbon sequestration.

While the principles above may read as primarily targeted to the development of new projects, they are equally applicable to investment in existing NbS, where due diligence on costs, performance, risk reduction, governance, and revenue/repayment pathways remains essential for both investors and underwriters.

4.5 Principle 4: Social value and ethical practice

Solutions (projects and products) should demonstrate meaningful stakeholder engagement and a fair distribution of co-benefits and burdens (not only costs), with particular attention to vulnerable social groups, the preservation of local livelihoods, and cultural landscape practices. Engagement should recognise and integrate local and traditional knowledge, including customary practices and stewardship roles, and where relevant for community products, convey a sense of community ownership of the solutions. Solutions should make explicit and manage trade-offs between economic, social, and environmental outcomes, and foster equitable arrangements such as benefit-sharing, affordability, and access provisions. They should also assess and mitigate potential ecosystem disbenefits and anticipate social resistance to change, addressing concerns through dialogue and alternative designs or phasing. Engagement should be sound, timely, informed, and inclusive and accessible.

Claims should be transparent and accountable: methods and results should be traceable, reproducible, and explained in plain language, including limitations and uncertainty. In practice, the evidence should include engagement protocols; reports of who was consulted and how their inputs influenced design; benefit-sharing or community agreements; and accessibility considerations. It should also provide open method notes or summaries, uncertainty statements, and an agreed revision and correction policy.

Social value, equity and ethical practice guiding principles should:

- engage stakeholders early and continuously, ensuring that affected communities, local authorities, and other relevant actors are informed, consulted, and able to shape design and implementation, including what equity means within the context of the project and how it can be achieved;
- recognize and integrate knowledge systems from indigenous peoples and local communities alongside scientific expertise to strengthen social legitimacy, contextual relevance and sustained care for long-term effectiveness and legacy;
- ensure that benefits, such as risk reduction, livelihoods, or ecosystem services, are distributed equitably and fairly, also in terms of spatial equity and access, so that no group bears disproportionate costs or risks;
- conduct social and ethical risk assessments, including consideration of land tenure, gender equality, cultural heritage, and access to natural resources;
- respect the rights and priorities of Indigenous peoples and local communities, ensuring free, prior, and informed consent where applicable;
- communicate objectives, outcomes, and benefits in accessible, culturally appropriate, and evidence-based ways, including by reinforcing the replicability of projects;
- support capacity-building, employment, or training opportunities that enhance local resilience and social equity;
- align social and ethical practices with relevant international standards, including the IFC Performance Standards, UN Guiding Principles on Business and Human Rights, and UNEP FI PSI;
- define equity and fairness goals explicitly, including distributional and procedural fairness, and specify how trade-offs, burdens, and benefits should be assessed, managed, and monitored over time.

4.6 Principle 5: Governance, data, and assurance

Sound governance starts with clarity of roles and long-term “custodianship” (i.e. responsibility to care for, maintain, and safeguard solutions, both projects and products). Solutions (projects and products) should specify who is responsible for delivery, operation and maintenance, monitoring, reporting and verification (MRV), and remediation where performance fails to meet established targets. They should also align with applicable climate adaptation and disaster risk reduction policies, financial/prudential regulations, and with environmental protection and restoration requirements under internationally and nationally agreed programmes. This alignment should be explicit in approvals, permits and regulatory sandboxes (safe innovation paces), and reporting, so that project commitments are consistent with public objectives and compliance obligations over the solution’s life.

Data quality should be considered of equal importance. Methods and datasets should meet agreed quality criteria, with documented provenance, version control, and transparency about assumptions. Spatial attribution should be clear enough to trace where benefits arise and to avoid double counting across sponsors, hazards and risks, or jurisdictions. Results should be interoperable with insurance practice and public finance needs, for example, by stating normalisation choices, the reference price year, and how outputs map to catastrophe-model inputs, underwriting decisions, or budget reporting. Monitoring, Reporting and Verification (MRV) should be proportional to the scale and risk of the solution, tracking performance against stated outcomes with indicators that are “auditable” and reproducible. Higher-impact cases require independent review or third-party statements at key milestones.

In practical terms, evidence should include governance documents (contracts or memoranda of understanding), corrective-action procedures, performance guarantees where appropriate, data management and de-duplication protocols, geolocation rules, price-year and normalisation notes, and an MRV plan that sets out indicators, responsibilities, revision and compliance dates, and conditions for independent assurance.

Governance, data and assurance guiding principles should:

- establish clear and transparent governance structures that define decision-making authority, accountability, and oversight across all phases of the solution; from concept and financing to implementation and long-term management;
- clarify the roles, responsibilities, and mandates of all partners, including public institutions, private investors, insurers, community actors, and technical service providers;
- ensure that governance mechanisms promote transparency, inclusiveness, and responsiveness, enabling regular dialogue among stakeholders and access to relevant information;
- develop a data management framework that defines data ownership, access rights, quality control, and sharing protocols;
- commit to systematic monitoring, reporting, and verification (MRV) aligned with established standards and frameworks;
- integrate digital tools and geospatial information systems for data collection, analysis, and visualization to enhance transparency, replicability and upscaling, with data collection supporting inclusivity and vulnerability assessment;
- apply proportionate assurance mechanisms, ranging from internal audit and peer review to independent third-party verification, depending on the project’s scale and risk profile;
- include adaptive management procedures that allow for corrections and course adjustments when monitoring data indicate deviations from expected performance or risk thresholds.

5 Shared Metrics of Viable Nature-Based Insurance and Investment Solutions

5.1 General

Shared metrics translate the guiding principles into evidence that can be assessed, compared, and used to track performance, quality, and change. Metrics should show, in a consistent and transparent way, whether a nature-based insurance and investment solution is material to risk, delivers the intended outcomes, and represents good value across places and over time. In this CWA, shared metrics refer to a common set of qualitative and quantitative indicators, definitions, and evidence-gathering rules that support underwriting, investment, and public decision-making through an auditable and proportionate framework for Monitoring, Evaluation, and Learning (MEL).

5.2 How other frameworks and standards treat the shared metrics

The ISO family of standards on climate change adaptation provides a coherent and practical framework to help organizations, communities, and governments prepare for, respond to, and manage the impacts of a changing climate. The series is built around ISO 14090, the world's first International Standard on climate adaptation, which establishes the core principles, requirements, and guidelines for climate change adaptation. It is complemented by related standards that provide detailed guidance for specific dimensions of adaptation, such as vulnerability and risk assessment, local adaptation planning, and performance-based mechanisms for financing adaptation.

EN ISO 14090:2019 *Adaptation to climate change: Principles, requirements and guidelines* defines indicators as measurable variables, either quantitative or qualitative, used to monitor and evaluate the progress and effectiveness of climate change adaptation actions.

EN ISO 14091:2021 *Adaptation to climate change: Guidelines on vulnerability, impacts and risk assessment* defines indicators as quantitative, qualitative, or binary variables that can be measured or described in reference to specific criteria.

CEN ISO/TS 14092:2025 *Adaptation to climate change: Requirements and guidance on adaptation planning for local governments and communities* complements ISO 14090 and ISO 14091 by focusing specifically on the practical application of adaptation planning at the local level.

EN ISO 14093:2025 *Adaptation to climate change: Local mechanisms for financing adaptation through performance-based climate resilience grants* builds on the earlier ISO 14090–92 standards and focuses on mechanisms for channelling climate finance to subnational authorities through performance-based climate resilience grants (PBCRG).

The ISO 32210 and related standards are part of a broader ISO initiative to embed sustainability and climate resilience within financial and environmental management.

ISO 32210:2022 *Sustainable finance – Guidance on the application of sustainability principles for organizations in the financial sector* has created a comprehensive framework for sustainable finance, including how financial institutions and investors integrate environmental, social, and governance (ESG) considerations into decision-making and performance management using defined indicators and metrics.

ISO 14097 *Greenhouse gas management and related activities: Framework including principles and requirements for assessing and reporting investments and financing activities related to climate change* introduces a framework that extends the ISO environmental management standards into the financial domain, guiding how financial organisations assess and report the climate impact of their investments and lending.

ISO 17298:2025 *Biodiversity: Considering biodiversity in the strategy and operations of organizations, Requirements and guidelines* marks the first international guidance dedicated exclusively to biodiversity for organisations.

ISO 37123:2019 *Sustainable cities and communities: Indicators for resilient cities* provides a comprehensive framework for measuring and reporting the resilience of cities.

ISO 14030 *Environmental performance evaluation: Green debt instruments* series stands for a comprehensive framework for the environmental performance evaluation of green debt instruments.

EN ISO 14008:2020 *Monetary valuation of environmental impacts and related environmental aspects* provides a standardized framework for assigning economic values to environmental impacts, helping organizations quantify how their activities affect natural systems and ecosystem services.

5.3 Shared metrics rationale

5.3.1 General

In this CWA, the terms metrics and indicators are used in a way consistent with the relevant ISO standards and the IPCC Assessment Reports. By using the term “shared metrics”, emphasis is placed on both the metrics (i.e. the measurement methods, units, and scale) and the derived indicators, to underscore that how an indicator is measured is as important as what it represents.

The distinction between condition and performance is used to capture two complementary dimensions:

- Condition metrics assess whether the minimum conditions and enabling conditions are in place to support implementation of solutions exist (e.g. governance, financing, ecosystem integrity);
- Performance metrics assess how effectively the solutions operate or deliver on intended outcomes and impacts (e.g. risk reduction, investment return, biodiversity benefit).

In practice, many metrics in this framework focus on performance, while condition metrics relate to social acceptability and replicability (or scalability).

The common characteristic of all shared metrics is that they are both scientifically sound and policy meaningful. This means they should be specific, measurable, relevant, and time-related (in line with existing standards such as ISO 14093:2022), proportionate to the scope and scale of the solution, and sensitive to the changes induced by that solution. Metrics should be:

- specific, when they target a clearly defined area for improvement or performance assessment;
- measurable, when they are based on quantifiable or observable data, supported by documented methods, data sources, and assumptions that can be replicated and verified by an independent third party;
- relevant, when they capture aspects that are material for decision-making, investment, or policy evaluation, and directly reflect the objectives of the solution being assessed;
- time-related and sensitive to change, when they are linked to the timing of results or outcomes and capable of detecting meaningful variations in performance or conditions over time;
- proportionate, when the complexity and precision of measurement are aligned with the scale and purpose of the assessment, practical and not overburden the assessment.

5.3.2 Purpose and use context of the metrics

Each solution is assessed independently. This means that every solution represents its own unit of analysis and reporting, and the purpose of the assessment is to determine whether it is sound, credible, and appropriate for adoption or investment. For insurers, investors, and policymakers, it may be relevant to compare multiple solutions to select among them or to construct a portfolio of complementary solutions. This CWA focuses on individual solutions and is not designed to provide a full portfolio-level analysis. The metrics serve primarily ex-ante assessment, supporting decision-making before implementation or investment, and periodic ex-post assessment as a part of revisions to track performance and relevance over time. The revisions can lead to discontinuing a solution, suspending underwriting, or withdrawing invested capital if conditions or performance indicators no longer meet agreed levels.

5.3.3 Consistent conceptual framework

The metrics should be embedded in a clear conceptual framework, such as a pathway to impact/impact for action or a theory of change, that explains how a solution generates the intended impacts. This framework should describe the logical progression from inputs, for example financial investments, to outputs, such as the implementation of the nature-based project, then to outcomes, such as reduced exposure or avoided losses, and finally to impacts, such as broader and sustained improvements in resilience. For nature-based insurance and investment solutions, this pathway usually links financial inputs with activities that restore or protect nature, which in turn lead to risk reduction or resilience outcomes and ultimately to wider socio-economic, or corporate environmental benefits. A well-defined causal framework makes it possible to select and interpret metrics in specific cases. It clarifies what is being measured, why it matters, and how change is expected to occur. It also helps to demonstrate that different categories of metrics (economic, financial, environmental, social, and governance) are consistent with one another and together capture the full chain of value creation.

5.3.4 Categories of metrics and trade-offs between them

In this CWA, the metrics are organised into categories that reflect guiding principles and established practices. These categories include economic, financial, environmental, social, and governance dimensions. The categories are designed to be complementary rather than overlapping, although in some cases the attribution of specific metrics may not be unique to a single category. In many cases, trade-offs between categories are inevitable. For example, a solution may achieve a high financial return while delivering only modest ecological restoration, or vice versa. Such trade-offs should be explicitly acknowledged and transparently reflected in the purpose and design of the solution, to illustrate the value judgments and priorities that shape it. Positive and negative impacts should be reported separately for nature and for different socio-economic/societal groups.

5.3.5 Alignment with established frameworks

The metrics should be aligned with established international and European frameworks (such as EU Taxonomy for Sustainable Finance), standards (such as EN ISO 14093:2025 on adaptation finance), and the Sustainable Development Goals (SDGs). This alignment increases the comparability, interoperability, and policy relevance of the metrics, and reduces the reporting fatigue across broader regulatory, financial, and sustainability reporting systems.

5.4 Categories of metrics

5.4.1 Economic soundness

Economic soundness explains whether a solution “makes sense” within the broader social welfare system. It is not limited to the perspective of investors or insurers but considers the value of the solution to “society as a whole”. It assesses whether the solution is worth implementing once all site-specific and wider private and public benefits are taken into account.

The key measure of economic soundness is the extent to which the solution reduces risk, expressed in physical terms, such as reductions in peak flow levels in the case of floods, or in economic terms, such as reductions in annual expected damage and loss or in event-based damages and losses. The assessment should consider not only direct and site-specific benefits but also wider or induced effects, recognising that risks and their consequences often propagate across sectors and geographic boundaries.

Another important measure is the cumulative weight of co-benefits that are not directly linked to risk mitigation but result from restored or protected ecosystem services. These may include improved water quality, biodiversity conservation, carbon sequestration, recreational value, or cultural benefits. Although such co-benefits may be more difficult to quantify, they significantly enhance the overall societal value of the solution and should be acknowledged explicitly.

In practice, direct and verifiable benefits often take precedence in the evaluation, but the recognition and qualitative appraisal of wider and induced benefits are essential for a comprehensive understanding of the solution’s contribution to resilience and social welfare.

Table 1 — Categories and examples of metrics for economic soundness of a solution

Subcategory	Metric / Indicator	Description / Measurement Method
Risk reduction	Change in annual expected damage and loss (absolute and %)	Difference in expected annual damages or losses between the baseline and project scenarios. Derived from hazard, exposure, and vulnerability models.
	Change in event-based loss or damage	Avoided damage for defined hazard events (e.g., 1-in-100-year flood) compared with the baseline condition.
	Reduction in physical risk parameters	Physical improvements such as peak flow reduction, temperature moderation, erosion control, or flood extent reduction compared to the baseline scenario. [4]
	Beneficiaries protected or exposure reduced	Number of people, households, or assets benefiting from the intervention, or the total exposure reduced within the project area.
Co-benefits	Ecosystem service enhancement	Improvements in key cultural (i.e. recreation, tourism), supporting (i.e. nutrient cycling, habitat provision) and provisioning ecosystem services (e.g., water quality, carbon sequestration). Include biophysical or proxy indicators. [5]
	Social and cultural benefits	Non-market benefits such as improved wellbeing, community engagement, or cultural and recreational value associated with restored ecosystems.
	Cross-sectoral impact description	Qualitative or semi-quantitative assessment of induced positive effects in other sectors or regions (e.g., improved water retention benefiting agriculture or energy).
Economic materiality	Benefit–cost ratio (BCR)	Present value of avoided damages and co-benefits to the total cost of implementation and maintenance.
	Net Present Value (NPV)	Sum of present value of avoided damage and co-benefits minus sum of the present value of cost of implementation and maintenance.
	Loss avoided per euro invested	Measure of efficiency, showing how much loss is prevented for each euro invested.
	Indicative premium or capital requirement effect	Potential change in insurance premiums or capital costs due to the verified reduction in risk.
	Payback period	Time required for cumulative avoided losses and co-benefits to equal investment costs.
Robustness and credibility	Documentation of models, data, and assumptions	Transparency and reproducibility of methods and data sources used for baseline and project scenarios
	Uncertainty range or sensitivity analysis	Confidence interval or range of variability in key metrics under different plausible scenarios

	Third-party verification	Independent review and validation of risk and benefit assessments
	Compliance with relevant standards and frameworks	Alignment with applicable standards for adaptation and sustainable finance

5.4.2 Financial viability

Financial viability provides a detailed overview of the financial structure of a solution, including how it is funded, operated, and sustained over time. It sets out a comprehensive breakdown of the costs associated with implementing the project, in this case the nature-based intervention itself, and explains how these costs are recovered or repaid. It also identifies additional costs that may arise throughout the solution’s lifetime, such as operation, maintenance, monitoring, or end-of-life and decommissioning activities, together with the contingency management of financial and operational risks.

Financial viability distinguishes who pays and how, while economic soundness considers whether the solution is worth it socially. Unlike economic soundness, which focuses on the overall value of the solution to society, financial viability examines how costs and liabilities are distributed among the actors involved. This is achieved within the framework of a viable lifecycle business case that shows how each participant contributes to financing, bears risks, and benefits from the returns or avoided losses generated by the solution.

Some categories of benefits, such as the value of ecosystem services, are also relevant for financial viability, and may appear as redundant. These benefits are included again, not for their contribution to social welfare, but to account for the portion of their value already internalised in the financial model, the revenue stream, or the repayment and investment decisions.

Table 2 — Categories and examples of metrics for financial viability of a solution

Dimension	Metric / Indicator	Description / Measurement Method
Cost structure and efficiency	Capital and operating cost breakdown	Total capital expenditure (CAPEX) and operational expenditure (OPEX), including monitoring, maintenance, and, where relevant, end-of-life or decommissioning costs
	Cost per unit of risk reduced	Total cost of implementation and operation divided by the quantified risk reduction (for example, avoided loss per year or per exposed asset)
	Lifecycle cost coverage ratio	Secured or projected revenues and repayments to total lifecycle costs, indicating whether the business case is financially sustainable
Funding and revenue structure	Confirmed funding sources and repayment pathways	Committed funding streams, revenue sources, or repayment mechanisms (for example, public grants, insurance savings, loans, or blended finance)
	Leverage of private and public capital	Proportion of private and public funding and the degree of financial leverage achieved through co-financing arrangements
	Greenium or avoided-loss savings captured	Reductions in financing costs or realised savings resulting from improved risk profile or sustainability value
	Sensitivity and scenario analysis	Financial performance changes under plausible variations in key assumptions such as hazard intensity, maintenance

Financial resilience and risk management		costs, or discount rate (discount rates in larger projects should also account for ecosystem processes)
	Contingency and reserve provisions	Adequacy of contingency funds, guarantees, or reserve mechanisms for unexpected costs or performance shortfalls
	Alignment with insurance and underwriting logic	Mapping of expected risk reduction to underwriting, coverage terms, and pricing, including treatment of basis risk in parametric solutions
Revenue and benefit distribution	Benefit allocation map (who pays and who benefits)	Distribution of costs, benefits, and liabilities among actors and beneficiaries, including public and private stakeholders
	Co-benefit monetization or value capture ratio	Proportion of measurable co-benefits (for example, ecosystem services or avoided losses) that are incorporated into the revenue or repayment model
Robustness and credibility	Transparency of financial assumptions and data	Cost estimates, discount rates, and financial assumptions clearly documented and verifiable
	Independent financial or technical review	Business case has been reviewed or audited by qualified external parties
	Compliance with relevant standards and taxonomies	Alignment with applicable standards for adaptation and sustainable finance

5.4.3 Environmental integrity

Evidence of environmental integrity should demonstrate that each solution contributes to positive ecological gains (such as improved habitat quality, increased biodiversity, enhanced ecosystem connectivity) within a larger landscape or catchment context and avoids harm.

The recommendation on the projects to deliver net nature-positive outcomes means that, over the lifetime of a project, the overall condition of nature and ecosystems is improved rather than degraded, once all positive and negative impacts are taken into account. Ecosystems affected by the project should be in better condition or provide higher levels of ecosystem services than before the intervention. In practice, this means that any negative environmental impacts resulting from the project's implementation, operation, or maintenance are avoided, minimised, or restored. In the context of this CWA, this principle means that financial and risk-reduction benefits should be achieved in synergy with ecological integrity.

Table 3 — Categories and examples of metrics for environmental integrity of a solution

Dimension	Metric / Indicator	Description / Measurement Method
Nature-positive outcome	Net change in habitat condition or area	Comparison of pre- and post-project habitat condition (quality, extent, or functionality) using recognised metrics such as habitat condition indices, species richness, or ecosystem integrity scores
	Biodiversity net gain (%)	Percentage increase in biodiversity or ecological value relative to the baseline, calculated through standardised biodiversity accounting methods (e.g., habitat hectares)
	Ecosystem service enhancement index	Changes in ecosystem service provision (e.g., water retention, carbon storage, soil fertility, pollination) based on modelling or biophysical assessments
Avoidance of harm	Do No Significant Harm (DNSH)	Project meets DNSH criteria under the EU Taxonomy; no significant harm occurs to other environmental objectives
	Residual impact and offset ratio	Remaining negative impacts and documents measures for restoration or offsetting to ensure a net positive outcome
Ecological design and contextual fit	Alignment with local ecological context	Design choices (species selection, hydrological design, landscape configuration) reflect local ecological, geomorphological, and climatic conditions
	Integration with landscape or catchment strategy	Project fits within broader ecological processes or regional restoration and conservation plans
Monitoring, maintenance, and adaptive management	Ecological monitoring plan and frequency	Ongoing monitoring programme is in place, with clearly defined indicators, data sources, and reporting intervals
	Adaptive management plan	Existence of a structured plan to revise practices or targets when monitoring results diverge from expectations
	Stewardship and governance arrangements	Long-term management and financing responsibilities, including community or institutional roles in stewardship
	Transparency and disclosure of results	Monitoring results and revisions are reported transparently and accessible to relevant stakeholders
	Compliance with relevant standards and taxonomies	Alignment with applicable standards for adaptation and sustainable finance

5.4.4 Social value and ethical practice

Social value and ethical practice metrics substantiate the guiding principle of fairness and inclusion, through status indicators that show whether the minimum conditions for equitable and ethical implementation have been met. These metrics complement the previous categories by verifying that the societal outcomes of a solution are fairly distributed and that the solution does not reinforce pre-existing structural inequalities. They

demonstrate to what extent benefits and burdens are shared appropriately, that local and traditional knowledge is respected, and that all stakeholders have a genuine opportunity to participate in shaping and benefiting from the solution.

Table 4 — Categories and examples of metrics for social value and ethical practice of a solution

Dimension	Metric / Indicator	Description / Measurement Method
Stakeholder engagement and participation	SH engagement plan and implementation	Existence of a documented and time-bound engagement plan, with identified SH, consultation methods, and how feedback is used in design and implementation
	Inclusiveness and representation index	Diversity and representativeness of SH engaged, including gender, age, vulnerable groups, and local communities
	Community ownership or participation level	Extent to which communities are involved in decision-making, management, or monitoring (for example, through local committees or stewardship agreements)
	Co-design and accountability	Assesses whether project was co-designed with stakeholder and citizens, and whether the process was communicated accessibly during all phases to stakeholders and citizens
Equity and benefit distribution	Benefit-sharing arrangements	Existence and fairness of benefit-sharing or compensation mechanisms that ensure equitable access to benefits and distribution of costs and risks
	Affordability and access provisions	Existence of provisions to ensure affordability or access for disadvantaged or vulnerable groups
	Distributional equity assessment	Extent to which benefits and burdens are distributed fairly and do not reinforce structural inequalities
Respect for rights and cultural values	Integration of local and traditional knowledge	Recognition and integration of indigenous, local, or traditional knowledge into design and management
	Cultural heritage and land tenure rights	Solution respect land tenure rights and protect cultural heritage sites and practices
Transparency, accountability, and ethical governance	Transparency of methods and results	Assesses whether consultation outcomes, design changes, and performance reports are publicly available and communicated in accessible language
	Social and ethical risk assessment	Potential social or ethical risks have been identified, assessed, and mitigated, including conflict potential or exclusion risks
	Compliance with relevant standards and taxonomies	Alignment with applicable standards for adaptation and sustainable finance

5.4.5 Governance, data and assurance

Governance, data and assurance metrics examine the processes through which solutions are designed, managed, and supported by evidence, rather than their performance outcomes. For that reason, they focus on the credibility, traceability, and consistency of results, assessing whether these processes are managed in a transparent, accountable, and verifiable manner throughout the entire life cycle of the solution. They complement the previous categories by evaluating how well a solution is monitored and verified, whether decisions are based on reliable information, and whether commitments made during design or investment stages are upheld during implementation and operation. This includes the clear specification of roles and responsibilities, the tracking and reporting of performance using recognised quality standards, and the existence of mechanisms for correction, learning, and independent assurance. In practical terms, governance, data and assurance metrics form the institutional backbone of the overall framework, ensuring that the evidence supporting each solution is both trustworthy and enduring.

Table 5 — Categories and examples of metrics for governance, data and assurance practice of a solution

Dimension	Metric / Indicator	Description / Measurement Method
Governance structure and accountability	Roles and responsibilities	Governance documents (contracts, mandates, or memoranda of understanding) clearly specify who is responsible for delivery, operation, maintenance, and corrective action
	Decision-making and oversight mechanisms	Existence of procedures for decision-making, approval, and oversight, including independent review or board-level supervision where relevant.
	Long-term management	Responsibilities for long-term stewardship and maintenance beyond the initial pilot period.
Policy and regulatory alignment	Alignment with policy and regulatory frameworks	Alignment with national and international adaptation, DRR, environmental, and financial regulations is explicitly documented
Data quality and management	Data quality assurance and documentation	Datasets meet defined quality criteria, including origin, version control, validation, and transparency of assumptions.
Monitoring, reporting, and verification (MRV)	Existence of MRV plan	Monitoring, reporting, and verification schemes exists, with specified indicators, frequency, responsibilities, and data sources
	Independent review or third-party assurance	Key results are independently verified, audited, or reviewed at critical milestones
Correction, learning, and adaptive management	Corrective-action procedures	Existence of procedures that specify how underperformance is addressed and by whom.
	Adaptive management framework	Mechanism for learning and iterative improvement, with adjustments based on monitoring outcomes.

Annex A (informative)

Additional references and Case Studies

A.1 Relevant committee work referenced

A.1.1 CEN/TC 465 – Sustainable and Smart Cities and Communities

CEN/TC 465 develops standards to support cities and communities in their quest for sustainability and sustainable development goals (SDGs). The committee focuses on requirements, frameworks, guidance, and supporting tools and techniques to support decision-making and implementation processes in urban and rural areas, aligned with the principles of urban sustainable development, including aspects such as resilience, attractiveness, well-being, social cohesion, environmental preservation and improvement, and responsible resource use. The Committee comprises working groups dedicated to Nature-based solutions (WG1), Services to Citizens (WG2) and Territorial Resilience Development (WG3). A draft European standard (prEN 18140:2025) focuses on common vocabulary and set of principles for NbS within the context of urban and community development. This FprEN is used as reference document for the terminology part.

A.1.2 ISO/TC 268 – Sustainable Cities and Communities

ISO/TC 268 develops standards that support the sustainable development of urban and rural areas, covering management systems, indicators, and guidance to improve quality of life, resilience, and environmental performance. The Committee has not addressed NbS directly but develops broader frameworks for sustainable infrastructure, urban resilience, and climate adaptation, such as ISO 37101 (Sustainable development in communities – Management system for sustainable development) and ISO 37123 (Indicators for resilient cities). These standards shape enabling environments where NbS can be effectively designed, implemented, and monitored—especially in the context of sustainable urban development and climate action.

A.1.3 ISO/TC 207 – Environmental Management

ISO/TC 207 develops standards that support environmental management practices across areas such as environmental management systems, auditing, environmental labelling, life cycle assessment, and greenhouse gas management. The Subcommittee 7 (SC 7) addresses both the climate mitigation and adaptation to the effects of climate change.

A.2 Case studies

A.2.1 Case Study on Wildfire Insurance Greeniums: Tahoe Donner

A.2.1.1 General

An insurance greenium refers to a pricing benefit - lower premiums and/or improved deductibles - offered to policyholders who implement risk-reducing green measures. In this way, insurance can function as an incentive for nature-based solutions (NbS) that reduce disaster risks, including wildfires. The concept derives from capital markets, where a “greenium” denotes the yield discount investors accept on green bonds relative to comparable conventional bonds.

In 2024, a first-of-its-kind wildfire insurance greenium was explicitly incorporated in a parametric wildfire insurance policy introduced in Tahoe Donner, California. The policy is priced to reward the policyholder, the Tahoe Donner Association (TDA), for carrying out a major forest treatment program to reduce wildfire risk. In

CWA 18349:2026 (E)

comparison with the premium without forest treatment, the parametric product is offered with a 39% premium reduction and an 84% deductible reduction.

The \$2.5 million wildfire resilience product covers 1,345 acres of Tahoe Donner's forested and recreation land owned by the TDA, including trails, ski slopes and forests adjacent to housing areas. The policy will provide financing for restoration activities following a major wildfire. The policy is not intended for private households since there are no immediate reductions in insurance costs for homeowners. Rather, it complements existing insurance policies, enhancing coverage for the Tahoe Donner community amid rising wildfire risks.

The product was developed by Willis/WTW in collaboration with the Nature Conservancy and the Center for Law, Energy and the Environment (CLEE) at UC Berkeley. This unique partnership not only combines public-private financing, but also assures that the process adheres to the Guiding Design Principles in Clause 4. As a major insurance brokerage firm, Willis/WTW has vast experience in designing products that are economically and financially sound; CLEE is highly qualified to assure legitimate social and governance practices; and the Nature Conservancy brings its competences to assure the environmental integrity of the product. Together, they ensured that pricing reflected actuarially justified risk reduction, environmental integrity, and governance safeguards, all important principles of this CEN Workshop Agreement.

NOTE The reference to specific organizations is provided for illustrative purposes as part of a case study and does not imply endorsement or recommendation by CEN or the participants of the Workshop.

A.2.1.2 Nature-based forest treatment

The forest treatment measures carried out by Tahoe Donner's Forest Health Management Program have focused on reducing hazardous wildfire fuels through various methods, including mechanical thinning, mastication, limbing, prescribed fire, and fuel breaks.

In accordance with the IUCN [1] and the European Commission [6], forest treatment - including selective thinning, prescribed burning and context-appropriate grazing - qualifies as a nature-based solution when it restores natural disturbance regimes, enhances biodiversity and ecosystem resilience, and reduces wildfire disaster risks [7]. While the Tahoe Donner project has by necessity focused strongly on reducing wildfire risk to households and assets - with potentially controversial measures like mechanical clearing - its advocates agree that the hybrid NbS is referred to the alternative of large-scale suppression.

WTW emphasizes that the product is a significant step toward acknowledging the value of proactive forest management in insurance underwriting, and a groundbreaking nature-based solution [9].

A.2.1.3 Greenium estimation

For insurance purposes, the risk of wildfire is translated into expected loss or average annual loss (AAL). The Tahoe Donner AAL was estimated with historical data and model results from similar risk contexts. The historical data showed the extent to which fuel reduction, regardless of the treatment measure, reduced the risk of wildfire. The assessors relied on three types of evidence:

- Two historical fires in the Lake Tahoe region, which showed the extent to which forest treatment reduced fire intensity;
- Models of fire behaviour and spread including an earlier study by WTW and TNC, which concluded that AAL could fall by approximately 40% due to fuel reduction from forest treatment.

Site-specific fire history at Tahoe Donner, where firefighters and the local fire district confirmed that recent fires were stopped at ridgelines that had been treated, which showed that fuel reduction, not weather differences, likely explained the lower losses.

The greenium was based on the risk reduction or savings in AAL from the implemented fuel-reduction measures. As the above indicates, risks were not estimated with fire spread simulations as part of a probabilistic catastrophe model, but rather from a simplified, qualitative counterfactual. Annual average loss (AAL) without forest treatment measures was calculated on the basis of four historic fires, and the AAL with forest treatment

measures was estimated by experts, showing a 46 % reduction in AAL attributable to fuel reduction. WTW applied standard insurance pricing logic to estimate a net premium (actuarial premium excluding brokerage fees and other loads) based on a target net loss ratio of 40% and a policy limit of USD 2.5 million. The calculation showed a net premium of USD 96,000 without NbS and USD 52,000 with NbS, or an actuarial greenium of USD 44,000.

A.2.1.4 The insurance product

Willis placed the insurance with Globe Underwriting (Lloyd's market), which conducted an independent empirical analysis adding a 60 % loading factor. The final quoted terms differed only slightly from those estimated by WTW: a gross premium of USD 55,000 and a deductible of USD 10,000 with fuel reduction. The trigger for the parametric product is based on burn severity measured with satellite imagery. The pay-outs are based on per-acre amounts by severity class and insured value class. The advantage of the parametric product is the objective nature of the claims, but basis risk can incur from topographic shading and delayed tree mortality. Given these limitations, an alternative suggestion is to use CalFire fire perimeters for small insured areas [10].

A.2.1.5 Moving forward

According to WTW, Tahoe Donner is the first documented case where an insurer explicitly states that forest treatment reduces wildfire premiums and, thus, marks a significant step toward acknowledging the value of proactive forest treatment in insurance underwriting. Importantly, the case illustrates how forest treatment measures can be quantified into loss reduction using hybrid evidence, and it signals the feasibility of greeniums by incorporating wildfire risk reduction into insurance pricing to incentivize proactive nature-based forest treatment.

The question is whether the Tahoe Donner case will inspire broader adoption of similar insurance products that recognize the benefits of nature-based forest treatment. To address this question, it is important to recognize the motivating conditions for WTW to engage in this innovative process. As a start, wildfire insurance is becoming increasingly unaffordable as wildfire risks and claims costs continue to rise, a factor motivating insurers to support risk reduction measures. In California, residential wildfire policies have increased by 123% and commercial policies by 161% between September 2020 and September 2024 [11] [12]. With wildfire risk on the rise, many insurers are scaling back or refusing coverage in high-risk areas. Moreover, the measures, themselves, can be ill affordable. Indeed, modelled treatment costs are in the range of USD 1,000–4,500 per acre [13]. Funding support was provided by the US Endowment for Forestry and Communities, and the Nature Conservancy covered the cost of the insurance premium in the first year. Finally, in California, insurers are required to account for risk-reduction measures in their pricing (California Regulation 2644.9).

As wildfire risks continue to rise, insurance greeniums linked to ecological risk reduction are likely to become increasingly important instruments for scaling preventive investment in wildfire risk, especially where public budgets alone are insufficient. Conditions for replicating the innovative Tahoe Donner greenium can include the urgency of addressing rising insurance stress, supporting policy holders in financing treatment costs, and strengthening regulatory systems.

A.2.2 Case Study on Designing Equitable Community Insurance for Controlled Flooding

A.2.2.1 General

As part of the NATURANCE project, the consortium organized an Innovation Lab with local stakeholders the possibility of developing a community-based parametric insurance scheme tied to controlled flooding operations in Italy's Po river basin. The scheme would respond to increasing flood risk driven by climate change, and the growing recognition that traditional engineered flood defences are insufficient. Rather than compensating for damage after the fact, the proposal links insurance to proactive risk reduction through controlled flooding and NbS, diverting excess water into designated upstream areas to protect downstream communities. The scheme is currently in its design and testing phase, with a co-design process underway

involving water boards, regional authorities, insurers, and regulators. Further engagement with landowners and farmers directly affected by controlled flooding is planned for the next phase.

A.2.2.2 How equity is embedded into scheme design

The scheme surfaces equity considerations across multiple dimensions, which can be traced using the Schlosberg framework of equity:

- **Recognitional equity:** who is seen, whose circumstances/knowledge is acknowledged;
- **Procedural equity:** who participates in decision-making and design processes;
- **Distributional equity:** how costs, benefits, and burdens are allocated/distributed.

Recognitional equity appears in how the scheme acknowledges the differentiated circumstances of those across the basin, particularly the financial and non-financial burdens upstream landowners face when setting aside and converting land for the purpose of controlled flooding. The choice to pursue dialogue and partnership reflects recognition of their position as a stakeholder in flood resilience. Procedural equity is embedded in the co-design process, which has brought together water boards, regional government representatives, insurers, and financial regulators to shape the scheme's structure. The planned next phase, engaging landowners and farmers more directly, will extend the chance to shape the solution to a wider set of stakeholders. Distributional equity is addressed through mechanisms which calculate contributions based on benefits received from flood risk reduction, and through affordability provisions intended to keep costs manageable for more vulnerable populations with a lower ability to pay. Compensation strategies for upstream landowners, potentially supplemented by payments for ecosystem services, are also central to the design, ensuring burdens on landowners are supported.

Equity is also considered in the scheme through the characterisation of risk. The choice to have water boards act as policyholders on behalf of the community, rather than requiring individuals to purchase insurance separately, collectivises risk at the basin level. When risk is framed collectively, it opens the door to collective risk reduction. Upstream NbS interventions that reduce the flood hazard faced by those downstream become logical because the costs and benefits are shared across the basin rather than siloed by individual position. A downstream urban resident, otherwise facing high premiums and limited agency, can now contribute through their premiums to interventions further upstream that reduce their risk. This would be less likely to emerge from individualised insurance pricing, where each party optimises for their own position. Collective insurance allows for a landscape-level approach to risk reduction, with mechanisms for coordination and cross-subsidisation. The aggregator model also allows the water board to factor in ability to pay when determining contributions, a consideration that private insurers pricing individual policies would not typically incorporate. This points to a broader shift: insurance functioning not only as a financial instrument for transferring risk, but as a mechanism through which societies could organise around shared challenges [14].

A.2.2.3 Reflections

This case study does not offer a global blueprint. Equity in insurance design remains context-dependent, and there are no universal standards or settled metrics. The CMCC example makes equity explicit, surfacing the considerations and trade-offs involved. For practitioners, it raises questions worth carrying into other contexts:

On defining vulnerability: the scheme references affordability provisions for vulnerable areas. But vulnerability is not self-evident. The definition of vulnerability, including who defines it and the criteria used, as well as the thresholds at which provisions apply, are design choices with distributional consequences, and how they are made, and by whom, matters.

On institutional roles: the scheme positions water boards as potential stewards of broader landscape resilience, expanding their remit beyond water management to encompass land and ecosystem services. If institutions take on wider mandates, the main questions concern how accountability shifts and how communities influence bodies whose scope is growing and whose decisions increasingly shape their exposure to risk.

On the sequencing of engagement: institutional actors, including water boards, regulators, and insurers were engaged in an initial phase, followed by landowners and farmers. This raises a question relevant to any multi-stakeholder process regarding what gets shaped before affected communities enter the conversation, and what remains genuinely open for them to influence.

These questions do not have universal answers. Their resolution depends on the specific context, the objectives pursued, and the composition of the decision-making body. It is essential that these questions are addressed explicitly, rather than being determined by default.

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