January 2026

Impact Valuation, Externalities and Transition Finance

Demonstrating Financial Relevance

Financial Markets Chapter

value balancing alliance

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Foreword

When the Value Balancing Alliance (VBA) was founded, our objective was clear but ambitious: make the true value of business visible and actionable. Today, this goal is no longer a vision on the horizon, it has become daily practice. Impact valuation and externalities accounting now enable boards, regulators, and investors to translate social and environmental effects into decision-useful monetary metrics. This research paper outlines the long history and science-based foundations of these methods and captures the industry shift with clarity and rigor.

For decades, externalities were treated as “outside the accounts”, important but ignored when determining enterprise value. These days have passed. Carbon prices, air-quality and health impacts, nature dependencies, and labor conditions increasingly shape earnings quality, funding costs, and valuations. Supervisors expect scenario-based management of transition and physical risks; market participants are building products, indices, and financing instruments that embed monetized impacts; and disclosure is converging around global baselines. The world is moving from narrative to numbers, to demonstrate financial relevance.

The VBA’s role, together with partners such as the International Foundation for Valuing Impacts (IFVI) and the Capitals Coalition, has been to build a robust, comparable methodology that organizations can trust. We have learned that credibility depends on three key factors: a transparent impact pathway from activity to monetary value, clear guardrails against double counting and misinterpretation, and alignment with reporting and prudential frameworks to influence real decisions. This paper shows how those elements come together, linking method to market, to improve capital allocation, strengthen resilience, and accelerate credible transition plans.

What stands out in these pages is the maturing and interconnectedness of the ecosystem: Corporates are institutionalizing internal prices and impact-adjusted KPIs; investors are designing portfolios and benchmarks that reflect monetized externalities; banks are integrating impact into credit analysis and risk appetite; and policymakers are establishing transition-finance guardrails. The result is a reinforcing loop: standards guide implementation; implementation generates reliable data; reliable data informs investment and policy; and those decisions, in turn, raise the bar for standards.

Our call to action is pragmatic. Start with the few externalities that matter most in your sector. Put credible prices and trajectories on them. Wire those prices into capex gates, procurement, product design, and financing terms. Align reporting with ISSB/CSRD so the same monetary inputs flow across disclosures, planning, and investor dialogue. And measure progress in real cash-flow effects, not only in documents.

Impact valuation is not a new layer of compliance, it is modern management - at entity and product level, across sectors and jurisdictions. It supports leaders to see the full opportunity set, avoid stranded choices, and allocate capital to strategies that create durable value for business and society. On behalf of the VBA, I am grateful to the authors and contributors of this paper for advancing the evidence base, sharing practical tools, and, above all, turning principle into use case practice.

Christian Heller
Chief Executive Officer, Value Balancing Alliance

Acknowledgements

We thank the authors and researchers whose work underpins this report and the wider field of externalities and impact valuation, including foundational contributions in Welfare Economics and market failure, the development of decision-useful disclosure and scenario practices, and the applied advancement of impact measurement, valuation and accounting, including the Value Balancing Alliance and collaborating practitioners.

We are also grateful to corporate and financial-market practitioners, data providers, and standard-setters whose pilots, disclosures, and methodologies continue to improve comparability, auditability and real-world adoption, enabling the investment value chain to move from sustainability narratives to quantified, finance-grade decision inputs.

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Executive Summary

Externalities are firms' uncompensated cost and benefits to society and the environment, a well-established concept in economics going back to Pigou (1920). Externalities are highly relevant for the efficiency of the economy, but also financially relevant for individual firms and investors. Factoring in externalities implies allocating capital more efficiently, generating more resilient cash flows, and improving risk-adjusted performance.

This whitepaper demonstrates the financial relevance of externalities and positions them as the foundation of impact valuation methods used to translate social and environmental effects into decision-useful monetary measures.

Once treated as "non-financial" spillovers, externalities are decision-useful metrics that improve assessments of firm and portfolio value, financial risk, investment returns, and capital-allocation quality.

The ultimate reason for the financial relevance of externalities is the "Coase Theorem" (Coase, 1960): strong socio-economic processes will make private and social values converge over time, i.e. externalities will be internalized, because there are efficiency and value gains from doing so.

After briefly reviewing the underlying economic theory, we will show financial relevance of externalities by documenting:

1. **Impact on market valuations and cost of capital:** Academic studies identify pricing of climate and environmental risks in cross-sectional returns and discount rates, including carbon premia and climate beta, and show that managing material sustainability issues relates to superior fundamentals and valuations. Most importantly, there is evidence that firms' market valuations indeed reflect externalities to some degree.

2. **Risk:** Empirical studies have estimated significant potential impacts, and large uncertainty around the magnitude, on GDP and growth at global economy level. Increasingly, information becomes available at firm level, which then feeds into scenario analyses from central-bank coalitions and supervisors mapping transition and physical risks into macro-financial outcomes, sectoral cash-flows and loss distributions. Incorporating externalities improves tail-risk recognition (liability, policy, and supply-chain risks) and reduces model error in long-lived assets.

3. **Adoption by market participants***:* Externalities and impact valuation are increasingly used by the private sector to report on, and manage, sustainability. Collaborative efforts, such as the VBA or IFVI, are laying the methodological foundations and work towards standardizing valuation models and parameters. Asset owners, financial institutions and investors have started to use these methods for managing portfolios and reporting purposes. Non-financial corporations are applying impact valuation for capital budgeting, regulatory reporting, corporate reporting and stakeholder communication.

4. **Alignment with public policy***:* Externalities have long and directly informed policy making, in particular with respect to public sector investments and the evaluation of legislative action. Pigouvian taxes, such as the CO_2 taxes, and cap & trade schemes, such as the European ETS, are direct implementations of policy actions to control externalities. More recently, central banks sovereign wealth funds have also begun to directly consider externalities. Where carbon pricing and product regulations tighten, monetised externalities become forward cash-flow adjustments rather than off-balance externalities.

T**ransition finance provides an ideal entry point:** *Mispriced externalities* (e.g., carbon, air quality, nature) are largest in transition-critical sectors, technologies and policies are evolving rapidly, and today's financing choices lock in cash-flow trajectories for decades. Impact valuation provides the analytical spine for credible transition plans and their financing (OECD, 2022), with forward-looking perspectives.

1. Introduction

1.1 Defining Externalities

The financial system's role is to allocate capital toward long-term value creation. In well-functioning markets, private financial value converges with social value. As Milton Friedman famously stated, *"There is one and only one social responsibility of business - to use its resources and engage in activities designed to increase its profits so long as it stays within the rules of the game"* (Friedman, 1970).

Externalities, uncompensated social and environmental costs or benefits, break that alignment, distort investment signals, and increase systemic risk (Pigou, 1920; Stiglitz, 1989). These misalignments can lead to capital misallocation and overexposure to systemic risks that threaten financial stability. Reconciling Friedman's "rules of the game" with modern market practice therefore requires systematic internalization of externalities through pricing, regulation, disclosure and assurance so that profit-seeking behavior and social value are re-aligned in financial analysis and capital allocation.

Impact valuation translates externalities into *monetary values for financial decisions*, such as cash-flow adjustments, hurdle rates, and risk premia, enabling more accurate capital allocation at level of firms, portfolios, bank balance sheets and the overall economy.

This is particularly critical in *transition finance*, which channels *investment into decarbonization* and other transformations in *hard-to-abate sectors* (LMA, APLMA and LSTA, 2025). The OECD emphasizes that credible transition finance depends on robust corporate transition plans, which must include quantified impacts, science-based milestones, and governance mechanisms to ensure accountability and transparency (OECD, 2022).

Climate and Nature Value at Risks (VaR) illustrate key implications for *transition finance*:

- Firms that offload the "*Social Cost of Carbon" (SCC)* may appear more profitable but embed transition and physical risks that impair asset values and cash flows (see Dietz et al., 2016; Stern, 2021). Transition risks arise from policy shifts, technological disruption, and changing consumer preferences, while physical risks stem from acute and chronic climate impacts (IPCC, 2022; NGFS, 2023a). Estimates of "*Climate Value at Risk" (CVaR)* suggest that global financial assets could face losses of up to US$2.5 trillion under warming scenarios, with tail risks reaching US$24 trillion, evidence that externalities eventually reprice into financial outcomes (Dietz et al., 2016). This underscores the need for forward-looking valuation models that incorporate climate-adjusted risk premia and stress-testing.
- Nature-related risks, captured as "*Nature Value at Risk*" *(NVaR)* are financially material, arising from firms' dependencies and impacts on ecosystems and transmitting via supply-chain disruption, regulatory tightening, reputational damage, and degraded ecosystem services (IPBES, 2019; NGFS, 2023b, FCA, 2024a)). Over half of global GDP depends on nature, with sectors like agriculture, fisheries, and construction especially exposed (see e.g., WEF, 2020 for further references).

- Central banks and supervisors are beginning to integrate *CVaR* and *NVaR* into macroprudential work using a phased approach covering "exposure" → "economic risk" → "systemic implications", aligned with global frameworks and protocols, such as the "*GHG Protocol"* (World Resources Institute and WBCSD, 2004) and the *"Kunming-Montreal Global Biodiversity Framework"* (Convention on Biological Diversity, 2022), and informed by emerging supervisory and scientific frameworks for nature-related financial risks (see e.g., NGFS, 2023a/b; IPBES, 2019; WEF, 2020; GFI, 2024 et al.).

Taken together, these developments point to a practical conclusion: *externalities* are not a parallel "sustainability" topic but a core driver of valuation, risk, and capital allocation, increasingly relevant to how investors price assets, how banks underwrite and manage credit risk, and how supervisors assess system resilience (see examples by Khan, Serafeim and Yoon, 2016; Dietz et al., 2016; Albuquerque, Koskinen and Zhang, 2017; as well as OECD, 2022; NGFS, 2023 etc. for further references).

1.2 Assessing Financial Relevance

In *financial reporting*, information is relevant if it is "capable of making a difference in the decisions made by users" and hence is classified as "predictive" or "confirmatory" value (IFRS Conceptual Framework [IFRS], 2018).

In *sustainability-related financial disclosures*, information is material if omitting, misstating or obscuring it "could reasonably be expected to influence decisions" of capital providers, specifically by affecting cash flows, access to finance, or *cost of capital* (IFRS, 2023). Under the EU's "European Sustainability Reporting Standards" (ESRS) (European Union, 2022; European Commission, 2023b), financial materiality sits alongside impact materiality in a double-materiality assessment that determines required disclosures (EFRAG, 2023, 2024).

Together, these definitions place *financial relevance* firmly within a *decision-usefulness* lens: information matters when it can reasonably be expected to influence the choices of investors and lenders - either by improving their predictions about future performance ("predictive value"), or by helping them confirm how past expectations and actions played out ("confirmatory value") (for definitions, see IFRS, 2018; FASB, 2018). This mapping *from sustainability issues to financial outcomes* is increasingly documented in practice and research, showing how ESG issues become financially material through cash-flow, risk and cost-of-capital channels (e.g., Freiberg, Rogers and Serafeim, 2020; for further examples and mapping of sustainable investing issues, see also OECD, 2020).

The following four key dimensions therefore serve as *operational tests of financial relevance for externalities and impact valuation*:

1) Market valuation and cost of capital: A key, and perhaps the ultimate, test of financial relevance is whether security prices in financial markets reflect externalities or impact valuation. This question is mainly addressed in academic finance and accounting literature, taking two strands: (i) analyses of expected returns, i.e. cost of capital, as reflected in historical time-series of returns and (ii) value relevance regressions in the cross-section of market valuations.

2) Risk management: In the financial industry, identifying and measuring risks attributable to a specific issue is often the first step in tackling the problem as well as a key element of prudential management and, in many cases, a fiduciary responsibility. Hence, externalities posing material risks is a strong indication of financial relevance.

3) Adoption by market participants: Relevance in the sense of usefulness for decision making is obviously and simply documented by market participants' actual use of the concept in question. Relevant market participants in this respect are asset owners, financial institutions, investors, and non-financial corporates.

4) Alignment with public policy: Independently of intrinsic relevance, a concept may be important for market participants because it determines the rules of the game. Thus, use by policymakers, standard setters, and the public sector in general is itself a major factor.

These *operational tests* matter for pricing, risk management, real-world adoption and, ultimately, the "Friedman's rules of the game" that shape market behavior (Friedman, 1970). In other words, *externalities* become financially relevant when they can be translated into decision-relevant signals about cash flows, earnings resilience, asset life and downside risk (see e.g., OECD, 2022; NGFS, 2023 for further references).

And that is increasingly what monetized externalities deliver in practice: translating impacts into decision-relevant signals that inform expectations about future cash flows, risk premia and performance outcomes (Dietz et al., 2016; Khan, Serafeim and Yoon, 2016).

2. Foundations of Impact Valuation

2.1. Economic Theory

A fundamental result in *economic theory*, i.e., the "first Welfare Theorem", is that competitive market outcomes, under certain conditions, are fully efficient (or *"pareto-optimal"),* meaning that it is impossible to improve upon the market outcome simply reallocating resources (Pareto 1927; Debreu 1959; Arrow and Debreu, 1954).

A central assumption underpinning the first "Welfare Theorem" is that private and social costs and benefits coincide, i.e., there are no externalities. *Welfare Economics* also shows that when a wedge opens up between private and social value, competitive market outcomes are no longer fully efficient, at least in the short run, and, in principle, can be improved through corrective interventions. This insight runs from Pigou's "foundational treatment of externalities" (Pigou, 1920) and Meade's analysis (Meade, 1952), through the general equilibrium formulation (Arrow and Hahn, 1971) and extends to settings with imperfect information where efficiency results weaken further (Greenwald and Stiglitz, 1986).

This implies that unpriced external costs, for example environmental pollution, can cause output to exceed the social optimum, generating deadweight loss, conversely, positive externalities, for example "knowledge spillovers", can lead to under-provision (Pigou, 1920; Baumol and Oates, 1988).

The solution to the problem of externalities is *internalization*, i.e., implementing mechanisms that equate private and social costs and benefits. *Internalizing externalities* restores efficiency by aligning private incentives with social welfare. Policy instruments include Pigouvian taxes and subsidies, standards, liability rules, and market-based mechanisms such as "tradable permits", the choice among them depends on information, enforcement and uncertainty (Pigou, 1920; for further references, see Baumol and Oates, 1988; Dales, 1968; Tietenberg, 2006).

The theory summarized above is a central part of the economic canon and treated in every standard textbook, see for example, Varian and Melitz (2024) or Mas-Colell et al. (1995).

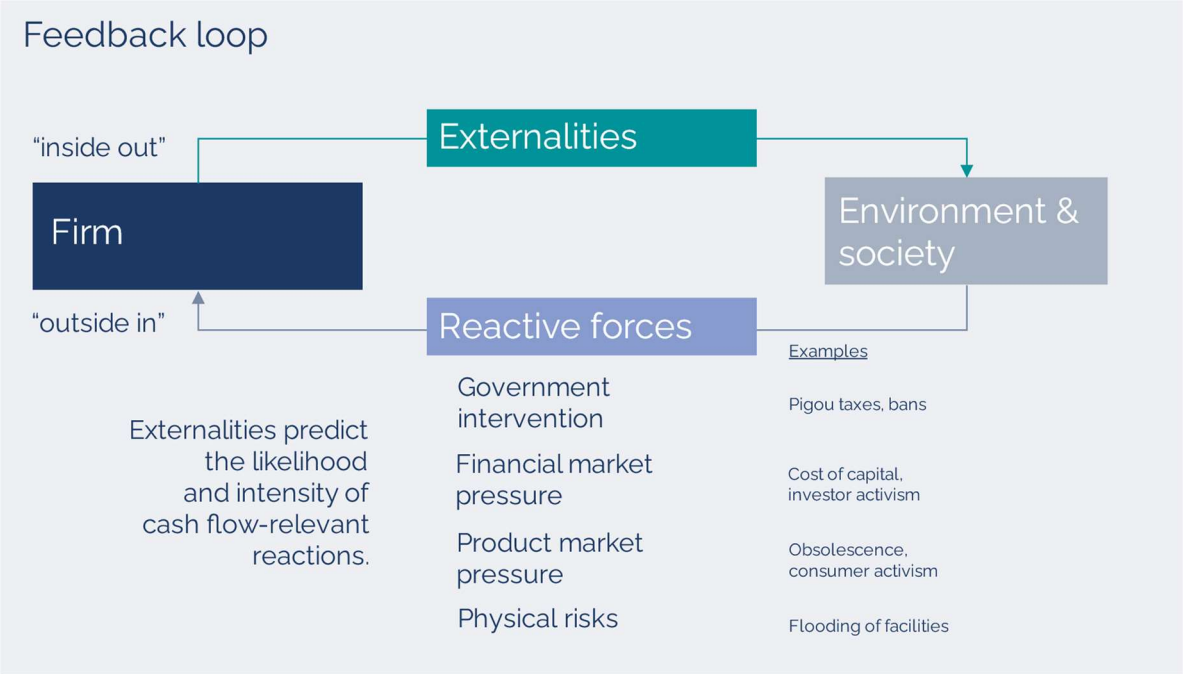
Beyond formal policy, there are powerful *institutional pathways to internalization:* With clearly defined property rights and low transaction costs, parties can bargain to efficient outcomes, following the "Coase Theorem", implying that legal frameworks and contracting institutions are pivotal (Coase, 1960). Where many users share common-pool resources, self-governance through norms and graduated sanctions can be effective, as documented in field studies of irrigation systems, fisheries and forests (Ostrom, 1990).

At the same time, the political economy of environmental policy shapes which instruments are feasible and how stringently they are applied; distributional effects, rent-seeking and institutional capacity all influence whether the potential *efficiency gains from internalization* are realized (Aidt, 1998; Baumol and Oates, 1988).

These perspectives collectively suggest that the *presence of externalities* implies a latent "efficiency dividend", i.e., a value gain available to societies, firms and investors that design credible institutions and instruments to realign private incentives with social welfare, whether through Pigouvian correction and market-based regulation (Pigou, 1920; Baumol and Oates, 1988; Weitzman, 1974), contracting and property-rights solutions (Coase, 1960), collective governance of common-pool resources (Ostrom, 1990), or policy designs that account for market failures and political-economy constraints (Stiglitz, 1989; Greenwald and Stiglitz, 1986; Aidt, 1998).

The following graph provides a summary of the *political economy of externalities*, highlighting the feedback loop from externalities to internalization:

Figure 1: Externalities: From "Inside-Out" Impacts to "Outside-In" Financial Effects



Source: Effectual, 2025. The chart illustrates an "inside-out / outside-in" feedback loop in which a firm's externalities affect the environment and society, triggering reactive forces, government intervention, financial and product-market pressure, and physical risks, that feed back into cash-flow-relevant impacts on the firm (Effectual, based on Aidt, 1998; Freiberg et al., 2020) For illustrative purposes.

2.2. Applied Economics

Environmental economics and *public economic*s, two important sub-disciplines of "Economic Science", are essentially built on the concept of externalities (see, for example, Laffont, 1988, and Field and Field, 2017).

For decades, *cost–benefit analysis* has been a core public-sector tool, assigning monetary values to externalities to inform investment and regulatory choices even where market prices are missing (see Boardman *et al.*, 2018; for applied public-sector examples, see e.g., EPA, 2023; Umweltbundesamt, 2024).

Estimating externalities is central to impact valuation and externalities accounting. It enables the translation of qualitative impacts into quantitative, decision-useful metrics that can be integrated into financial analysis, capital budgeting, and disclosure.

A selection of *impact valuation* methods and examples are summarized in the graph below:

Impact Valuation Methods in Brief

Multiple initiatives have translated the *scientific theory* and foundations into practical monetized "Accounting Methods for Impact Valuation" (IVM). Key methods include:

- ***Impact-Weighted Accounts (IWA)*** at Harvard Business School demonstrate how environmental and social impacts can be embedded alongside financial accounts to benchmark firms and sectors (Serafeim, Zochowski and Downing, 2020–2023).
- ***Integrated Value** approaches* (e.g., Impact Institute/RSM Erasmus) aggregate financial, social and environmental value to assess net value creation across capitals and entities (Impact Institute/RSM, 2022, and Schoenmaker, Schramade, and De Adelhart Toorop, 2023).
- ***The Value Balancing Alliance (VBA)*** and the ***International Foundation for Valuing Impacts (IFVI)*** have codified methods, such as "cost-", "market-", "revealed-" and "stated-" preferences and implementation guidance that align with ESRS and the ISSB baseline (VBA, 2021ff.; IFVI, 2024).
- ***PwC's Total Impact Measurement & Management*** **(2013)** and ***KPMG's True Value*** **(2014)** translate externalities into strategy and investor communications.
- ***Capitals Protocols*** standardize scope and data requirements: the Natural Capital Protocol and the Social & Human Capital Protocol define how to measure dependencies, impacts and valuation across sectors (Capitals Coalition, 2016; Capitals Coalition, 2018 ff.; 2025). The ***IIRC Framework*** embeds multiple capitals in value-creation narratives and governance (IIRC, 2013).

Based largely on these industry methods, several providers offer commercial data sets on externalities and impact values, e.g., Upright, 2020; GIST Impact, 2022; WifOR, 2025; and RGS, 2024.

For more details on IVM methods, and providers, please refer to the Annex.

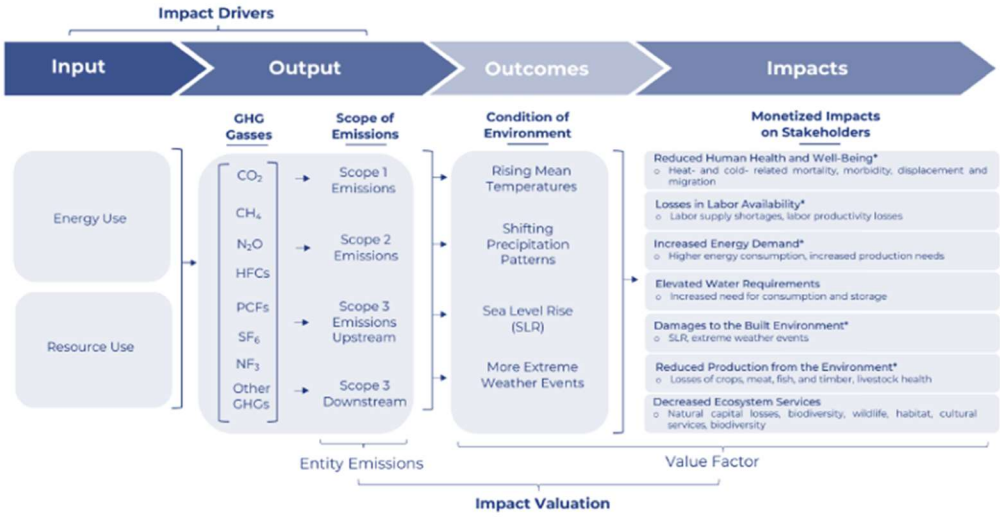
Applied economics has developed a range of *estimation techniques for cost–benefit analysis*, *impact valuation and impact accounting*, especially for corporate applications.

The general method is to identify (i) *impact drivers*, typically physical quantities such as tons of "CO_2e emitted", "cubic meters of water consumed", "hectares of land converted", "workplace injuries", or "wage gaps", (ii) *impact pathways* that translate those drivers into "biophysical" and "social outcomes", e.g., temperature change, health burdens, ecosystem degradation, lost productivity), and (iii) *monetary valuation* of the resulting welfare and economic effects on stakeholders, including healthcare costs, adaptation costs, productivity impacts, costs of inaction, and damages and losses, often with explicit assumptions about geography, time horizons, baselines, and uncertainty ranges.

The Value Balancing Alliance (VBA) takes this applied-economics logic and turns it into a standardized, decision-grade corporate methodology: it starts from company-reported activity data and operational metrics, maps them to defined impact pathways, and applies transparent valuation factors to monetize impacts in a way that is consistent across companies and comparable across impact categories (see e.g, VBA, 2021 ff.; 2024; 2025; and IFVI, 2024a/b).

In practice, the VBA approach emphasizes *(1) clear boundary-setting and allocation rules, (2) documented data hierarchies (reported data where available, modelled proxies where not), (3) repeatable calculation steps with audit trails, and (4) outputs that can be used directly in management and finance* – for example, to stress-test business cases, compare capex options, embed shadow prices, refine risk premia, and strengthen disclosure credibility (VBA, 2025).

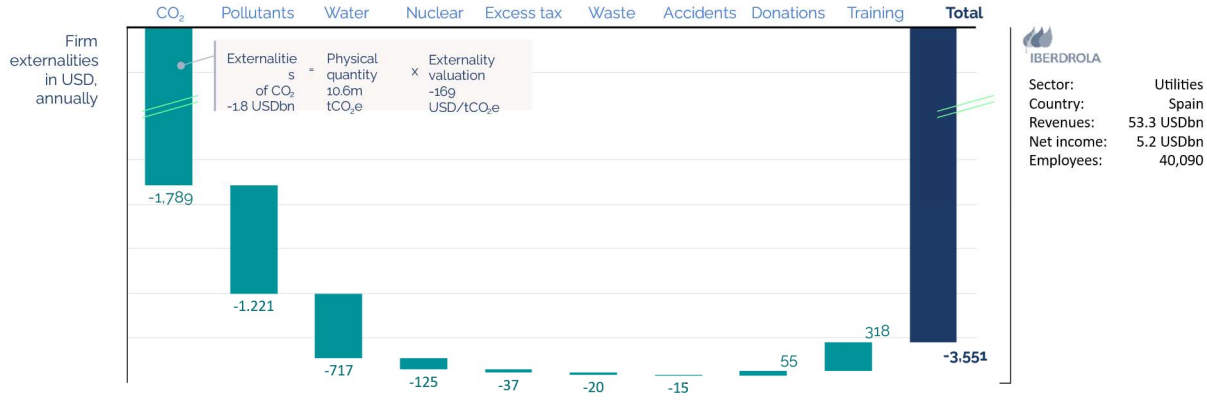
Figure 2: VBA and IVFI`s Method for Impact Valuation (Illustration)



Source: International Foundation for Valuing Impacts (IFVI) and Value Balancing Alliance (VBA) (VBA, 2024): "Environmental Methodology 1: Greenhouse Gas Emissions Topic Methodology". The chart illustrates an impact pathway describing entity "emissions → outcomes → monetized impacts" on stakeholders (further details on estimation techniques are included in the Annex, and in VBA methodology documents.)

The following graph provides an example of *calculating the externalities* for a particular company and a particular year, based on the quantitative data reported by the company.

Figure 3: Company Externalities Waterfall: Annual Monetized Impacts by Category ($)



Source: Iberdrola, S.A., Fact Sheet, Annual Report 2023, Integrated Report 2023, Sustainability Report 2023. Effectual calculations for corporate externalities (example). The chart provides an illustrative annual breakdown of Iberdrola's monetized corporate externalities (USD) by impact category, showing the largest negative contributions from CO_2, other pollutants and water, smaller negatives from items such as waste, taxes and accidents, and offsetting positive contributions from donations and training, culminating in an overall net total. For illustrative purposes.

3. Evidence: The Financial Relevance of Externalities and Impact Valuation

This section summarizes evidence that *externalities and impact valuation* are *financially relevant* to investor and lender decisions through impacts on market valuation and *Value-at Risk (VaR),* and implications at economy and corporate level, within the *investment value chain.* All these developments are closely aligned with policy and standard setting. To establish *financial relevance*, the paper hence briefly assesses (1) effects on expected returns and *cost to capital*, then it evaluates (2) externalities as *drivers of risk*, at the economy-wide, and the corporate level, and summarizes implications at portfolio level.

The Annex includes a detailed overview on *externalities and impact valuation use cases* linked to (financial and corporate) market participants. It also details the European versus Asian uptake by policymakers, regulators and standard setters through *disclosure and supervisory expectations*.

3.1. Impact on Market Valuation and Cost of Capital

A growing body of empirical work shows that *externality exposures* are reflected in *market valuations and expected returns* that is, in the *cost of capital* from the firm's perspective (e.g., Chava, 2014; Bolton and Kacperczyk, 2021; Ilhan, Sautner and Vilkov, 2021).

This section therefore provides *evidence*, from both *value-relevance* studies linking environmental impacts to valuation discounts (Matsumura, Prakash and Vera-Muñoz, 2014; Freiberg et al., 2021) and *asset-pricing work* documenting externality-related premia and tail

risks (Bolton and Kacperczyk, 2021; Ilhan, Sautner and Vilkov, 2021; Pástor, Stambaugh and Taylor, 2024) that markets are increasingly pricing externality-related risks and internalization dynamics into valuations and required returns.

3.1.1. Expected returns and cost of capital

By now, a substantial body of academic research examines the relationship between corporate sustainability–related indicators, closely linked to externality exposures, and proxies for expected returns and firms' cost of capital.

The *theoretical foundation* is heterogenous preferences in general Equilibrium Models, where a sizeable fraction of investors is assumed to prefer owning firms that behave sustainably (an early example is Heinkel et al. (2001), a recent example is Pástor et al. (2021)).

The general prediction is that *sustainable firms* should have, in equilibrium, lower expected returns. However, during transition periods, in which, e.g., investor preferences change, or the fraction of sustainable investors grow, realized returns for sustainable firms may be higher.

The significant number of empirical papers on the *relation between sustainability indicators and time-series realized returns* as a proxy of expected returns are summarized by Eskildsen et al. (2025) as finding "… green outperformance, brown outperformance, and no significant difference." (see their footnotes 5,6, and 7, for a comprehensive list of references.)

Using cross-sectional asset-pricing tests, Bolton and Kacperczyk (2021) document significantly higher expected returns for more carbon-intensive firms, on the order of 2.5% annually per standard deviation of log emissions, suggesting that *transition risks are priced to a significant degree*.

However, much of the broader empirical and calibration-based evidence suggests that the *capital-market effect on firms' cost of capital is economically small*, often on the order of *less than a basis point to a few basis points* in typical divestment/ESG-capital calibrations (Berk and van Binsbergen, 2021; 2025), and that observed "pollution premia" would need to be substantially steeper for markets to replicate meaningful carbon-tax incentives (Chittaro, Piazzesi, Sena and Schneider, 2025).

As Eskildsen et al. 2025 point out, establishing tight links from sustainability indicators to expected return or cost of capital is complicated by *measurement error* and *method divergence*. And the wide dispersion among prominent ESG ratings illustrates why studies using different indicators can reach different inferences (see Berg, Kölbel and Rigobon, 2022).

Meanwhile, *measurement error* may well be responsible for the contradictory findings in time-series studies that attempt to link *various proxies for sustainability* to returns. A simple and direct way to reduce this problem is to use *monetized externalities and impact valuations*, in both academic research and industry practice, as consistent, comparable inputs for discounted cash-flow modelling, hurdle rates, impairment testing, and scenario analysis.

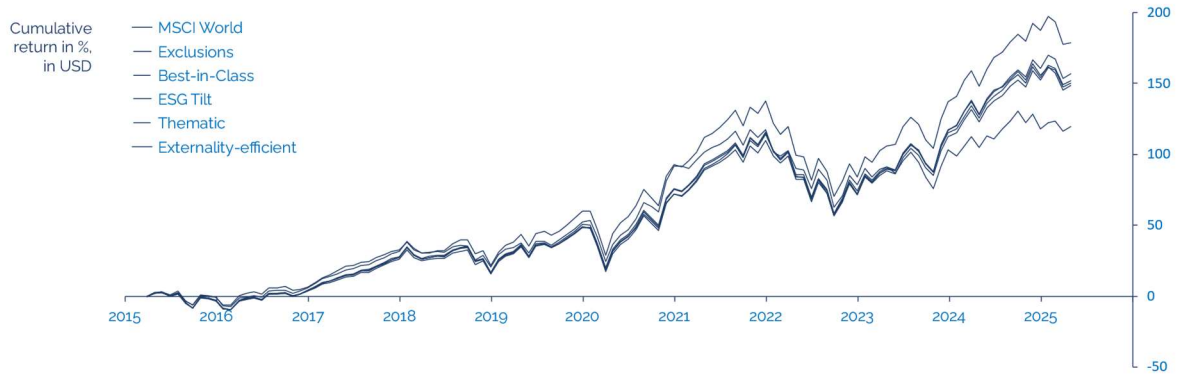
Pástor et al. (2025) estimate *the present value of future expected externalities* related to carbon emissions, which they call "carbon burden", for the year 2023 and show that it is significantly *correlated with implied cost of capital*: they estimate that firms in the top carbon burden decile have c. +1.7% higher cost of capital than firms in the bottom decile.

Herzog and Mellert (2026) estimate the *present value of expected future externalities*, generalizing the carbon burden metric to a range of environmental and social externalities, and construct externalities-efficient portfolios by adjusting market values for the externalities' present value. They report *outperformance of these portfolios relative to cap-weighted*

benchmarks and ESG-score portfolios, consistent with markets gradually recognizing externalities and internalization dynamics.

The following graph summarizes the results:

Figure 4: Externalities Internalization in Asset Prices: Evidence from Externalities-Adjusted Portfolios



Source: Bloomberg, Effectual, as at 30.03.25. Past performance does not predict future returns. Exclusion, Best-in-Class and ESG Tilt are calculated as a blend of the USD net-return member of the respective index family with the MSCI World as the underlying universe. Thematic is calculated as a blend of 8 thematic indices, capturing investment themes like water, plastics, circular economy, climate change, renewable energy, energy infrastructure or social development goals. The underlying universe is defined either by the MSCE World of by MSCI World ACWI IMI and 4 out of 8 underlying thematic indices start in November 2016. The externality-efficient index is calculated based on the Bloomberg Developed Market Equity Index (DM Index). The market capitalization of the equity index is corrected for the present value of the measured externalities of the constituent companies. Companies with negative adjusted market capitalization receive a zero weight in the index. For illustrative purposes.

3.1.2. Market valuations

While academic finance research has largely relied on *time-series returns* to infer expected returns (and, equivalently, firms' cost of capital), accounting research has long used cross-sectional "value relevance" regressions, grounded in standard valuation frameworks linking market value to accounting fundamentals (e.g., Ohlson, 1995; Feltham and Ohlson, 1995) to examine the *determinants of firms' market values*, including financial performance and investment in intangibles such as R&D and marketing (see for example Collins, Maydew and Weiss, 1997; Barth, Beaver and Landsman, 2001; Barth et al., 2023 for further references).

These models primarily capture firm characteristics associated with expected cash flows and profitability (or the ability to generate future cash flows), rather than isolating discount-rate effects (i.e., the cost of capital).

An early *application of this method to environmental issues* is Matsumura et al. (2014), who estimates that firms' market values are impounding a discount of c. USD 200 per ton of CO_2 emitted p.a. for the firms in the S&P 500 in the period 2006 to 2008.

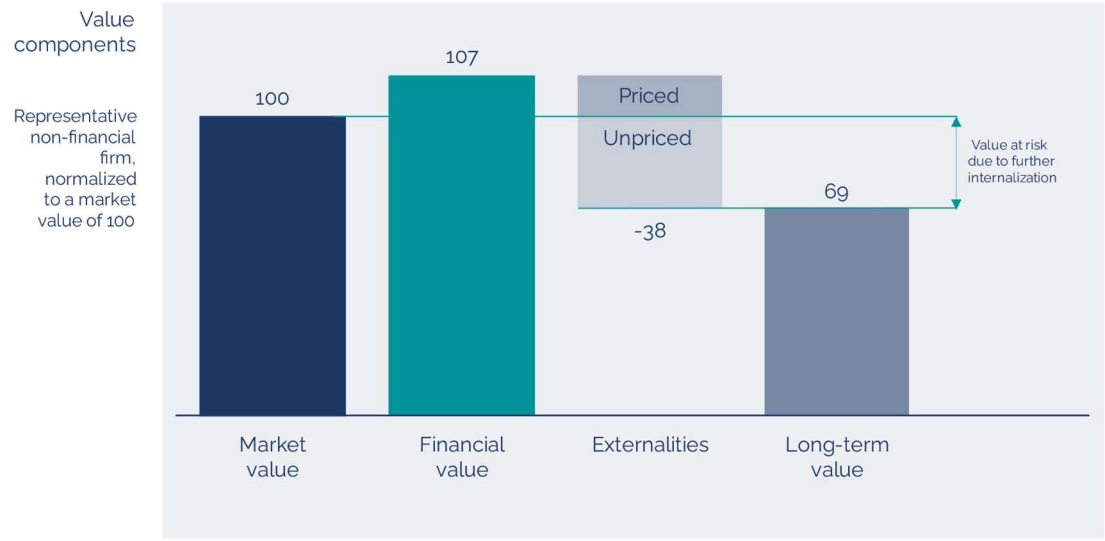
Following that tradition, Freiberg, Park, Serafeim, and Zochowski (2021) compute firm-period impact valuations for a large sample of firms and show that *contemporaneous environmental externalities* are significantly associated with market value, with large negative externalities implying valuation discounts. They report that a doubling of the environmental externality intensity detracts c. 2.5 to 5 percentage points from market value. The regression coefficients

in their regressions can be interpreted as valuation multiples for a flow metric, equivalent to a price-earnings ratio. If instead a stock metric is used as an independent variable, e.g., book value, the regression coefficient indicates the extent to which the value of that stock is reflected in the market value (the "dependent variable").

Using that logic and the present value of *expected future externalities*, Wilkens et al. (2025) show that approximately 20% of externalities appear already capitalized in firms' market values, consistent with investors anticipating progressive internalization.

The graph below shows the *impact of priced and unpriced externalities* on firm value for the average firm:

Figure 5: Externalities as Value at Risk and Average Firm Valuation Impact



Source: Effectual, 2025, based on the descriptive statistics and parameter estimates in Wilkens et al. (2024). The chart illustrates a stylized decomposition of enterprise value for a representative non-financial firm, normalized to a market value of 100. The chart shows (i) "Market value" = 100, (ii) "Financial value" = 107, (iii) "Externalities" = −38, split into a "Priced" and "Unpriced" component, and (iv) "Long-term value" = 69 (i.e., 107 minus 38). A right-hand bracket labelled "Value at Risk (VaR) due to further internalization" highlights the potential reduction in long-term value if currently unpriced externalities become internalized through regulation, pricing, or liability. For illustrative purposes.

3.2 Risk: Externalities Impact Volatility and Value-at-Risk

A growing academic literature shows that *transition and physical risks* linked to unpriced *externalities* pose significant *financial risks* (see e.g., BIS, 2020; Giglio, Kelly and Stroebel, 2021; Dietz et al., 2016; Lamperti et al., 2019; Rebonato, Kaith and Melin, 2025).

Correspondingly, empirical evidence increasingly links *externality-intensive business models* to (i) higher return volatility, (ii) greater sensitivity to policy and climate shocks, (iii) fatter left tails in return distributions, and (iv) abrupt repricing around news that signals externality internalization for example through regulation, litigation, or extreme events.

This section evaluates how these effects are observable both at the *economy level,* through systemic spillovers to growth, inflation, sovereign and financial stability, and at the *company level*, where exposure profiles translate into idiosyncratic earnings risk, asset impairment, and financing constraints.

3.2.1. Economy-Level Evidence

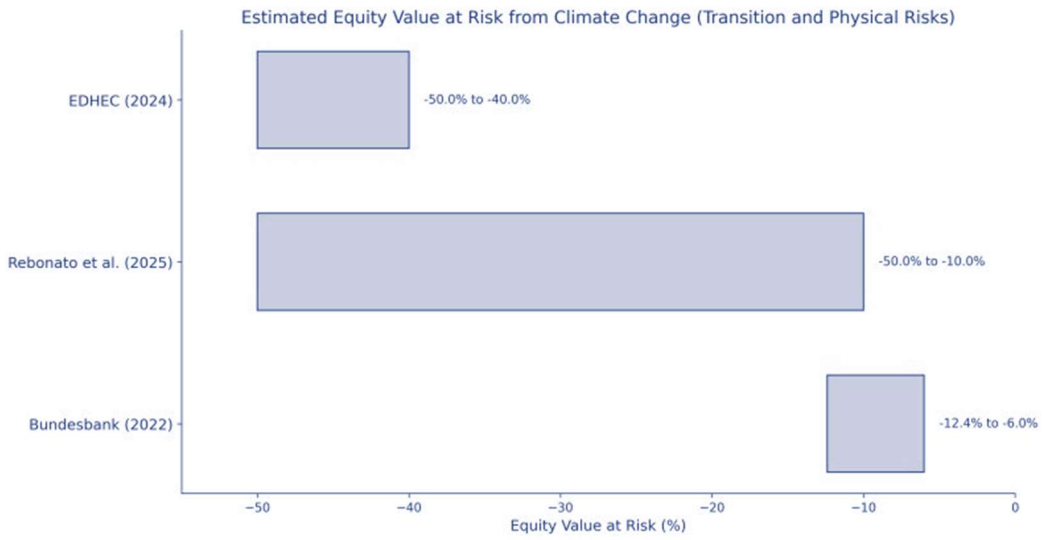
Early economy-wide estimates, for example by Dietz et al. (2016), quantify "Climate VaR" for global financial assets under plausible policy and damage assumptions, *illustrating system-wide exposure*. Dietz et al. estimate that a 2.5-degree Celsius change translates into a c. 2% present value loss of global financial assets. There is, however, significant tail risk of a 5% loss for the 95th percentile and 17% loss for the 99th percentile.

More recently, probabilistic *Valuation Models* that incorporate non-linear feedbacks and "tipping" dynamics point to substantially wider downside intervals. As illustrated in Figure 6, estimates of equity value at risk vary markedly across studies: the EDHEC-Risk Climate Institute (2024) indicates losses in the order of ~40–50%, while Rebonato, Kaith and Melin (2025) report ranges extending to ~50% and, in adverse "tipping-point" settings, potentially beyond.

By contrast, the Deutsche Bundesbank (2022) range is material but smaller in magnitude including single-digit to low-double-digit losses, consistent with differences in scenario design, modelling scope, time horizons, assumed policy responses, and the treatment of amplification mechanisms, such as macro-financial feedbacks, capital reallocation frictions, and non-linear physical damages.

Taken together, the next figure underscores two core conclusions: (i) climate-related valuation impacts are highly model- and scenario-dependent, and (ii) the most decision-relevant signal for risk management is the asymmetry and tail risk, i.e., relatively moderate "central" losses alongside the possibility of very large downside outcomes when transition is delayed and physical and tipping risks compound (Deutsche Bundesbank, 2022, EDHEC, 2024; Rebonato, Kaith and Melin, 2025):

Figure 6: Estimated Equity Value at Risk from Climate Change: Ranges Across Transition and Physical Risk Models (Selection)



Sources: Deutsche Bundesbank (2022), EDHEC (2024), Rebonato, Kaith and Melin (2025). The chart compares published estimates of equity VaR from climate change (transition and physical risks), showing ranges of roughly −50% to −40% (EDHEC, 2024), −50% to −10% (Rebonato et al., 2025), and −12.4% to −6.0% (Deutsche Bundesbank, 2022). For illustrative purposes.

3.2.2. Firm-Level Evidence

Several recent studies document that externalities` impacts can be large relative to firms' earnings, cash flows and market values, which implies significant risks to financials in the case of even partial internalization of external costs.

Greenstone et al. (2023) document firm-level externalities from CO_2 emissions globally that are large relative to firms' earnings and cash flows.

Pástor, Stambaugh and Taylor (2025) compute a firm-level "carbon burden", i.e., the present value of social costs of future emissions, for U.S. listed firms and estimate a baseline aggregate of ~131% of total U.S. corporate equity value, with 77% of firms showing burdens above their market capitalization (13% even on Scope 1 alone).

Wilkens et at. (2024) show that *externalities are on average c. 40% of the market value* for a large, global sample of firms.

Deutsche Bundesbank's (2022) scenario-based dividend-discount model for 5,000+ firms, 75 jurisdictions suggests *mean value reductions* of ~12.4% without carbon cost pass-through (≈6% with 80% pass-through) and up to €4.4 trillion of potentially *stranded market capitalization in carbon-intensive sectors*.

Translating those exposures into practical portfolio risk metrics such as *"Value-at-Risk" or "Expected Shortfall" (VaR/ES)* requires forward-looking scenarios that shock cash flows and discount rates. The Financial Stability Board's (FSB) Taskforce for Climate-Related Financial Disclosures (TCFD) codified both "transition" such as policy, technology, demand, or legal, and "physical" including acute/chronic hazard risks as financial risks and popularized scenario analysis (TCFD, 2017).

Nowadays, Central Banks and supervisors including the "Network for Greening the Financial System (NGFS) Scenarios" map policy and climate pathways to sectoral earnings and default/loss rates, providing input curves for VaR/ES stress paths. They are extending climate-risk tooling to nature-related financial risks and Nature VaR (NVaR) concepts (NGFS 2023a; NGFS, 2025).

The Dutch Central Bank (DNB), with the Netherlands Environmental Assessment Agency (PBL), provided an early template by mapping the Dutch financial sector's dependencies and impacts on biodiversity, stressing exposures across sectors and proposing scenario-based approaches to *translate biodiversity loss and ecosystem-service decline into financial risk* (DNB, 2020).

The NGFS has since proposed a "conceptual framework for nature-related risks" and is developing *nature-climate scenario building blocks* to support VaR/ES and macro-prudential uses (NGFS, 2023b; NGFS-INSPIRE, 2022).

The TNFD recommends "integrating dependencies and impacts on nature into risk management and disclosure", encouraging use of *monetized nature metrics and scenario analysis* that can feed VaR and capital-allocation decisions (TNFD, 2023). Market and policy studies for the UK and EU likewise document material nature risk channels, supply-chain disruption, regulation, liability and demand shifts, and outline NVaR methods and sector hotspots relevant for banks and investors (GFI, 2024; WEF, 2020).

Together, these developments make externalities operational for risk scenarios and VaR, at corporate, sector and portfolio level.

3.3 Adoption: Impact Valuation Approaches in Decision-Making

Over the last decade, companies have progressed from *qualitative narratives to monetized impact inputs that inform strategy, capex, and portfolio choices.*

This section shows how impact valuation is being used in practice, across corporate decisions, such as investment appraisal, pricing, procurement, risk management and transition planning, and financial market decisions including portfolio construction, stewardship, credit and insurance pricing.

It highlights the *key enablers and constraints* such as data quality, methodological comparability, governance and assurance that determine whether approaches are decision-grade.

3.3.1 Associations

Practice frameworks such as the “Natural Capital Protocol” and “Social & Human Capital Protocol” have codified the impact-pathway and valuation options (Capitals Coalition, 2016; 2018; and Vionnet et al., 2025) the impact-pathway, specifies recognized valuation techniques for “cost-“, “market-“, “revealed-/stated-preferences” and “subjective wellbeing”, and clarifies guardrails including double counting, attribution, uncertainty and disclosure for enterprise and portfolio use and decision-management (VBA, 2021ff.; IFVI, 2024a/b). VBA`s guidance explicitly maps to supervisory and disclosure baselines, the ISSB’s investor-focused S1/S2 (IFRS, 2023) and the EU’s CSRD/ESRS double-materiality architecture European Union, 2022), so that impact metrics are decision-useful for capital providers.

In parallel, both organizations, and their strategic alliance partner, The Capitals Coalition, have supported pilots with corporates and financial institutions to test impact-adjusted P&L/balance sheets (Vionnet et al [Capitals Coalition], 2025), internal price schedules, for example for “carbon” and “water” assessments, and portfolio attribution of externalities, thereby operationalizing impact valuation in capital budgeting, risk and performance reporting (see e.g. VBA, 2021ff.; IFVI, 2024a/b for further references).

VBA`s Research on Carbon Valuation and Decision Making

Scenario analysis is a key tool for assessing how *externalities and sustainability risks affect corporate and financial performance* under different future states.

VBA and Deloitte (VBA, 2025) have developed a concept to align carbon valuation with corporate decision-making, as a strategic lever, not just a compliance cost. They argue that translating CO_2e into monetary decisions clarifies business choices across governance, strategy, performance, review, and communication. The concept distinguishes "value to business" (outside-in financial effects) from "value to society" (inside-out externalities, often proxied by the Social Cost of Carbon) and introduce a "decision-making cube" to match valuation tools to the specific phase, function, and organizational level using different pricing methods for different decisions rather than searching for a single number.

Empirically, most firms still lean on short-term instruments, market prices and carbon taxes, while underusing methods better suited to long-horizon, high-impact choices, including abatement costs, internal carbon prices designed for steering, and the SCC for strategic alignment and stakeholder communication.

Looking ahead, VBA highlights that taxes and market prices are gradually converging toward societal damages, implying rising costs and a premium on early action. VBA calls for a practical, multi-method chain to tailor internal carbon prices by scope/region, use abatement cost curves for investment prioritization, consider market premiums and voluntary credits transparently, and evaluate outcomes using both financial and societal lenses.

Breaking organizational silos and embedding carbon valuation into core financial control is essential, done well, valuation becomes a catalyst for innovation, capital efficiency, and durable value creation, not only for firms but for society and markets overall.

Looking ahead, VBA's agenda is to extend the analytical spine that links impact to finance.

- First, by *comparing and complementing abatement-cost models with damage-based and policy-consistent pricing approaches,* for example, aligning internal carbon prices with "Social Cost of Carbon" (SCC) schedules and credible policy paths, and using multi-method chains to match decisions (compliance, strategy, capital budgeting) to the right pricing tool (VBA, 2025; IWG, 2021; Boardman et al., 2018).
- Second, by *broadening scenario sets beyond climate to nature risk and resilience,* drawing on TNFD, biodiversity science and ecosystem-service valuation to build monetized pathways for water scarcity, land-use change and ecosystem degradation that can flow into DCF, WACC and VaR/ES (TNFD, 2023; Capitals Coalition, 2016; OECD, 2018).

This forward program aims to help organizations move from narrative to numbers across carbon and nature, so that transition plans, financing terms and performance incentives reflect both business value ("outside-in") and societal value ("inside-out") with consistency and credibility (IFRS Foundation/ISSB, 2023; VBA, 2025).

3.3.2. Investors / Asset Owners

Large-scale *disclosure infrastructures,* such as CDP, and *corporate reporting surveys* (for example KPMG's G250/N100) indicate a broad uptake of sustainability concerns and a rising data availability that investors now channel into screening values, integrated decision-making, internal prices, scenario testing, impact-linked KPIs and indexing rules (CDP, 2024; KPMG, 2022).

However, many investors still struggle to define, rationalize and communicate sustainability strategies consistently, in part because the absence of *globally aligned standards* and *comparable data* creates a "framework gap" for decision-use (for references, see e.g., PwC, 2022; PRI, 2023; OECD, 2025). *Externalities and impact valuation* help close this gap by translating sustainability exposures into portfolio-relevant risk and return inputs, aligning with the "universal owner" view that diversified asset owners ultimately bear system-wide externality costs (see e.g., Hawley and Williams, 2000).

Research and product blueprints show that *decarbonized indices and hedge portfolios* can reduce climate exposure at *limited tracking error* (Andersson, Bolton and Samama, 2016; Jondeau, Rockinger and Schaeffer, 2021). Empirical work further links climate and broader externality exposures to asset pricing, expected returns and downside risk, motivating impact-adjusted security selection and capital allocation (Bolton and Kacperczyk, 2021; Ilhan, Sautner and Vilkov, 2021; Giglio, Kelly and Stroebel, 2021; Schoenmaker and Schramade, 2019).

In a *portfolio-optimization* setting, investors can use issuer- and *product-level monetized externalities* to construct portfolios that jointly target financial returns and net societal value, subject to risk limits and relevant policy or mandate constraints (Serafeim, Zochowski and Downing, 2019; Serafeim and Trinh, 2020; Lehmann, Macpherson and Ung, 2022). This is increasingly operationalizable as impact accounting and "value to business" frameworks mature, helping translate externality baselines into decision-useful value drivers and investable guardrails (see e.g., IFVI 2024a/b; VBA, 2021 ff.; 2025; Schoenmaker, 2023).

In practice, *monetized externalities* are being implemented by asset managers as a decision input for portfolio construction and sustainability reporting, either directly via impact-adjusted valuation/return concepts or indirectly through internal pricing and resource-intensity metrics that translate externality exposure into financially relevant indicators. This aligns with the "universal owner" perspective that diversified asset owners bear a meaningful share of system-wide externality costs and therefore have incentives to manage them through allocation and stewardship (Hawley and Williams, 2000), and it is increasingly compatible with investor duties (see e.g., PRI, UNEP FI and Generation Foundation, 2021 for an overview). For example, Amundi develops *carbon-pricing sensitivity metrics* (e.g., a carbon price threshold) to link emissions exposure to *credit-risk-relevant outcomes* (Bouchet and Le Guenedal, 2020).

Finally, *scenario-based techniques* support implementation at scale: climate scenarios and banking translation methods provide "plumbing" for *converting transition and physical pathways into portfolio risk constraints*, *factor tilts and stress-tests* (NGFS, 2023a; UNEP FI, 2018), reinforcing how externality internalization dynamics can be embedded in index design, risk budgeting and product structuring (Wilkens, Jacob, Rohleder and Zink, 2025).

Effectual defines "Sustainable Return" *as financial return adjusted for ESG externalities*, with externalities quantified in monetary terms and used as a binding element of portfolio construction (Effectual, 2022). Schroders' SustainEx framework (established in 2018) *monetizes the costs/benefits* companies impose on society to derive "impact-adjusted profits" that inform analysis and investment decisions (Howard, 2021; Schroders, 2024). Qblue

explicitly frames *corporate externalities as "Public Value"* and integrates this logic into its Sustainability Cube and its treatment of industries associated with severe negative externalities (Qblue Balanced, 2023). Osmosis focuses on "resource efficiency" using underlying physical quantities ("carbon", "water" and "waste") relative to value creation, an operational proxy for externality intensity (Osmosis Investment Management, n.d.).

With the *growth of passive investment strategies and exchange-traded funds* (ETFs), financial indices have become crucial tools for investors and asset managers. The inherently quantitative concepts of externalities and impact valuation naturally lend themselves *to index construction* by, e.g., ranking by net impact per revenue or enterprise value, nature-positive benchmarks allocating capital using biodiversity/ecosystem metrics, and sector scorecards that identify leaders/laggards on monetized externalities (Serafeim, Zochowski and Downing, 2019; Serafeim and Trinh, 2020; IFVI and VBA, 2024; Schoenmaker and Schramade, 2019; TNFD, 2023).

Examples for indices built on externalities or impact valuation include the AEX Futureproof Index (Schoenmaker, Schramade, Hemels, 2025) and the externalities-efficient index family for a broad universe of equities and bonds jointly developed by Bloomberg and Effectual, where index tilts and benchmark design can reflect externality exposure without abandoning benchmark discipline (see in this context, Andersson, Bolton and Samama, 2016; Jondeau, Rockinger and Schaeffer, 2021; Wilkens, Jacob, Rohleder and Zink, 2025).

Finally, *externalities and impact valuation methodologies* are increasingly used in *regulatory and client reporting*, for example to evidence and monitor "sustainable investment" characteristics and impacts under fund classifications and disclosure regimes, supported by maturing impact-accounting frameworks and practical implementation playbooks (see e.g., PRI, UNEP FI and Generation Foundation, 2021; and Effectual, 2022; Schroders, 2024).

Effectual Capital Fund SICAV

Effectual is a retail fund platform dedicated to investment strategies that focus on managing externalities, because they are a key determinant of economic value creation and a measure of sustainability. Effectual was established in 2021 by the Wilsdorf family to realize its vision of objective and value generating sustainable investing. Effectual partners with global financial industry leaders such as PIMCO, Northern Trust, and UBS to implement strategies.

The key investment objective of Effectual investment strategies is achieving superior "sustainable return", correcting traditional financial return by externalities, in diversified portfolios at risks comparable to standard benchmarks (see Effectual, 2022).

Hence, managing externalities is the key element of Effectual's portfolio construction, shifting portfolio weights away from firms with large negative externalities and towards firm with low negative or even positive externalities. The resulting broadly diversified portfolios exhibit significantly better externalities of up to 2% p.a. at low tracking errors (in the range of 1% to 3% p.a.), showing that such portfolios are suitable for core allocations.

Externalities-managed portfolios benefit as internalization progresses. That translates into long-run outperformance over conventional benchmarks and strategies.

Effectual's track record shows that externalities-managed portfolios combine sustainability, as evidenced by significantly better externalities than traditional benchmark, broad diversification, low tracking errors, and positive outperformance.

3.3.3. Financials / Banks

Banks and supervisors have moved from high-level climate risk narratives to *structured scenario analysis* and *credit-portfolio translation*, often using the "NGFS Scenarios" as a common reference set for supervisory and bank stress-testing exercises (NGFS, 2023a).

Industry pilots convened under UNEP FI, explicitly designed to operationalize the TCFD recommendations for banks, demonstrate how scenario variables can be translated into borrower financial impacts and then into core credit-risk metrics.

In particular, the *UNEP FI transition-risk methodology* shows how climate-policy drivers, including carbon price pathways, a practical monetization of a key externality, can be mapped into changes in borrower risk and portfolio outcomes via "Expected Loss = PD × LGD × EAD", with transition risk measured as the change in expected loss under a given scenario (UNEP FI, 2018). Complementary UNEP FI work provides a physical-risk methodology for assessing how extreme events and longer-term shifts in climate patterns can affect borrower financial health and sector performance, supporting translation into lending-portfolio risk assessment (UNEP FI, 2018).

More broadly, the TCFD positions scenario analysis as a tool to assess resilience under different transition and physical pathways (TCFD, 2017), and IFRS S2 embeds comparable expectations for climate-related risks and opportunities (IFRS, 2023).

In implementation, this typically means *incorporating carbon price escalators* and other transition assumptions alongside physical hazard changes, and translating resulting stresses into decision metrics used in banking and supervision for example to assess "borrower cash-flow impacts", "NPV-style valuation impacts", "portfolio loss measures", "limits" and "pricing decisions".

For externalities beyond climate, IFRS S1 (IFRS, 2023) provides the overarching framing for sustainability-related risks and opportunities, i.e., not limited to climate, supporting extension of scenario approaches to other domains where decision-useful, such as nature-related regulation or broader societal shocks, consistent with the NGFS's parallel workstream on nature-related scenarios (NGFS, 2023b).

3.3.4. Corporates

Scenario analysis remains the key tool for assessing how externalities and sustainability risks affect performance under alternative futures, also at a corporate level.

By embedding impact-adjusted assumptions, such as "carbon-price escalators", "biodiversity regulation", and "health shocks", companies can *stress-test earnings, CAPEX and leverage under transition scenarios* for example related to rapid decarbonization, or policy tightening. They can also run physical scenarios for acute or chronic hazards, and ecosystem decline, and social scenarios to assess labor-market shifts, or health crises.

When paired with the IFVI–VBA "Impact Accounting Methodology" and the VBA "Value to Business (V2B)" framework (see e.g., VBA, 2021 ff., IVFI 2024a/b), *climate and broader sustainability scenarios can be converted into finance-ready inputs*, i.e., quantified shocks to revenues, costs, capex, asset lives and risk premia that feed DCF valuation, WACC, and risk metrics such as VaR/ES, making externalities explicit drivers of enterprise value and portfolio risk (see e.g., VBA, 2025).

Disclosure infrastructure is also scaling rapidly: over 24,800 companies disclosed through CDP in 2024, and CDP's 2024 corporate questionnaire is aligned with IFRS S2 as the

foundational baseline, supporting more consistent scenario inputs and comparability for investors and lenders (CDP, 2024; CDP, 2024a; and see IFRS, 2024 for further references how the ISSB delivers further harmonization of the Sustainability Disclosure Landscape).

Empirically, most firms *still lean on short-term market prices and taxes*, underusing tools that are better suited to long-horizon, high-impact choices such as “abatement cost”, “internal shadow prices”, “social cost of carbon” (SCC). VBA and the OECD expect convergence between taxes/market prices and societal damage estimates over time, implying rising costs and a premium on early action (VBA, 2025; OECD, 2022).

For financial decision-makers, *impact and externalities valuation and accounting principles* translate into *shadow pricing and internal pricing* (e.g., internal carbon prices), contract and covenant design and engagement on rule-making that clarifies property rights and liability, thereby embedding externality internalization directly into capital allocation, stewardship and risk governance (see e.g., A4S, 2019; OECD, 2022 for examples and further references).

Corporates and financial institutions then operationalize these standards through tools, pilots and products, including *impact-weighted (or integrated) P&L and balance-sheet accounts* and *integrated profit & loss methodologies* that can generate more consistent, decision-ready and, in principle, auditable datasets for management, reporting and assurance (see Serafeim, Zochowski and Downing, 2019; Impact Institute, 2020; Schramade, Schoenmaker and De Adelhart Toorop, 2023; Impact Economy Foundation, 2024 and Annex for further references).

BNP Paribas and Accelerating Positive Business Impacts

A prominent example is *BNP Paribas’ “Positive Impact Business Accelerator” (PIBA*), launched in 2021 to coordinate the Group’s impact investing and financing strategy across impact bonds, proprietary impact funds, and advisory (BNP Paribas, 2024; 2025a/b) in line with ICMA guidance documents (see e.g. ICMA, 2022, 2023b, 2024). PIBA’s “Activity & Social Performance Report” (BNP, 2024) documents pipeline, volumes, and measured outcomes across social-purpose issuers and impact bonds, illustrating how a bank-led, indicator-driven approach can scale financing while minimizing greenwashing risk.

To make impacts finance-ready, BNP Paribas developed “MESIS” (“Measuring and Monitoring of Societal Impact”) a scalable framework used across inclusive finance and social/solidarity-economy deals (BNP Paribas, 2025a). MESIS structures analysis into 13 impact areas, 38 sub-areas, and 400 indicators, enabling quantification of social / environmental outcomes that can be linked to enterprise value and cost of capital via project cash flows, pricing, or risk terms (BNP Paribas, 2025a/b).

BNP Paribas applies MESIS to qualify projects as “impactful” ex-ante against defined pathways and eligibility criteria (BNP Paribas, 2025a), to measure impacts across areas, for example “climate”, “employment”, “biodiversity”. It uses monetizable indicators such as “CO_2e avoided”, “number of beneficiaries”, “hours of training”, to inform deal structuring, portfolio selection, and index creation (BNP Paribas, 2025a), and to track outcomes over time to adjust projects, guide stewardship, and attract funding, with public reporting aligned to ICMA impact-reporting templates for social/transition instruments (BNP Paribas, 2025b; ICMA, 2023a).

3.4. Policymakers and Standard Setters

Standard setters now anchor *decision-useful* sustainability information in core reporting: the ISSB establishes an investor-focused global baseline through "IFRS S1" and "IFRS S2" (IFRS, 2023) calling for disclosures on sustainability- and climate-related risks and opportunities that affect enterprise value, including cash flows, access to finance and cost of capital.

In parallel, the EU's CSRD and "European Sustainability Reporting Standards" issued by EFRAG mandate *double materiality*, requiring disclosures on both *financial materiality* and *material impacts on people and the environment* (European Union, 2022; European Commission, 2023b). Complementing these reporting regimes, ISO standards provide practical measurement scaffolding for monetized environmental information, covering determination of environmental costs/benefits and monetary valuation of environmental impacts, supporting consistent impact metrics where relevant (see e.g. ISO, 2019; for a comprehensive overview on the sustainability reporting landscape, prior to "Omnibus", please refer to Macpherson (2024), in E. Elgar`s "Research Handbook on Sustainability Reporting".

The OECD "Guidance on Transition Finance" *specifies credibility criteria for corporate transition plans* (e.g., price paths, capex alignment), effectively internalizing *externalities* into financing terms and stewardship expectations (see e.g., OECD, 2022). *Nature-related adoption* is expanding via the "Taskforce on Nature-Related Financial Disclosures" (TNFD, 2023, now part of the ISSB), which embeds dependencies/impacts and encourages monetization for risk and strategy.

There is also a *growing recognition among central banks, development banks, and sovereign wealth funds* that, as public sector entities, managing externalities may be part of their policy mandate and that, as large, near-universal asset owners, they may be bearing a large part of the *negative consequence of externalities* (see e.g. Hawley and Williams, 2000). The papers by Oehmke and Opp (2025a and 2025b) and Papoutsi et al. (2022) analyze how externalities may be addressed by public sector financial institutions. An example for a sovereign wealth fund applying externalities analysis in its investment decisions and due diligence is Temasek (2024): valuations include internal carbon tax.

Within *transition finance*, *externalities accounting* is the bridge from narrative commitments to decision-grade financial numbers: it converts "transition intent" such as targets, roadmaps, and plans into quantified cash-flow drivers, risk factors, and performance guardrails that can be priced, covenanted, monitored, and escalated (as before, see e.g., Schoenmaker and Schramade, 2019; and A4S, 2019, OECD, 2022, NGFS, 2023a for further examples).

Japan's "METI Basic Guidelines on Climate Transition Finance" emphasize the credibility of issuer transition strategy and disclosure to support labelled transition instruments, while ICMA`s "Climate Transition Finance Handbook" (ICMA, 2023a) sets *market expectations for strategy, governance, science-based alignment and transparency*.

Impact valuation/externalities accounting operationalizes these frameworks in three practical steps: (1) baselining the negative and positive externalities of a business model (e.g., "carbon", "air pollution", "water", "health and safety"), (2) mapping credible transition measures ("capex", "operational changes", "product shifts") to quantified reductions in those externalities over time, and (3) translating those reductions into investable guardrails, such as carbon-price and policy "price paths", capex alignment tests, KPI trajectories, and impact metrics that can be embedded into financing structures, stewardship objectives, and portfolio constraints. This is consistent with OECD`s guidance (OECD, 2022) that *transition finance credibility must be*

anchored in robust transition plans and decision-useful metrics that reduce greenwashing risk and enable comparability across issuers and instruments.

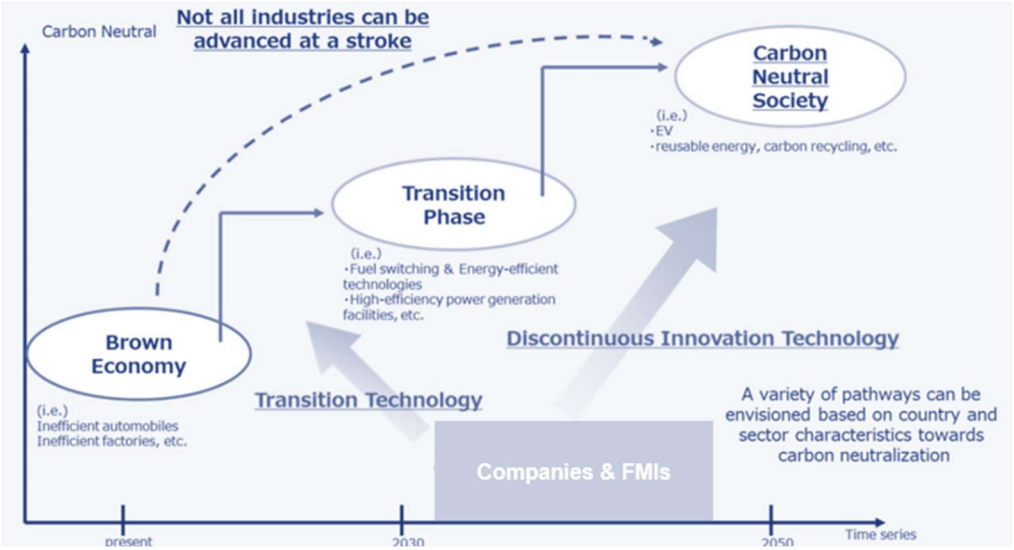
The same logic also scales to asset allocation. Work on *carbon risk hedging and decarbonized benchmark construction* shows how climate-related exposures can be treated as a systematic risk that can be managed through rules-based portfolio design without necessarily sacrificing benchmark characteristics. For example, Jondeau, Rockinger and Schaeffer (2021) develop benchmark-anchored portfolio construction approaches that progressively reduce portfolio carbon footprints while controlling tracking error and other benchmark constraints, illustrating how quantified externality exposures can be reflected directly in asset-allocation rules, mandates, and performance objectives (Jondeau, Rockinger and Schaeffer, 2021).

Universal owners may prefer additional engagement and policy guardrails that reduce system-wide *transition costs* rather than purely reallocating holdings (see e.g. Hawley and Williams, 2000 and Freshfields/PRI–UNEP FI–Generation Foundation, 2021, for further references how to address system-wide ESG/impact issues). Meanwhile, academics and stewardship practitioners, including Dr. Shinji Ayuha, increasingly emphasize the *operational infrastructure of transition finance*. They link technology pathways, issuance components, and credibility guardrails and highlight the need to connect transition claims to measurable, *decision-useful metrics*. (Ayuha, 2021; ADB, 2024).

Finally, VBA and Deloitte (VBA and Deloitte, 2025*) advance a practical carbon-valuation approach* that frames carbon valuation as a strategic steering lever, not merely a compliance cost, by encouraging firms and financiers to use decision-relevant carbon values for capex choices, product strategy, and transition planning, including recognition that market prices/taxes may not fully reflect *longer-horizon risks* (for details, see also Box, page 20).

This is precisely where externalities accounting becomes essential for transition finance: it enables pricing, covenants, KPIs, and capital allocation to be anchored in quantified impact pathways so that "transition" can be financed and verified as a measurable trajectory rather than a narrative label.

Figure 7: Transition Finance: From the Brown Economy to the Carbon Neutral Society



Sources: VBA and Japan Ministry of Economy, Trade and Industry, www.meti.go.jp. The chart shows a stylized pathway from today's "brown economy" to a "carbon neutral society" over time, driven by companies and financial market institutions (FMIs). For illustrative purposes.

4. Conclusion

In this whitepaper, we document that *externalities are financially relevant and increasingly inescapable.* We summarize that:

- **Empirical asset-pricing studies show that exposures to environmental and social externalities are reflected in prices,** expected returns and tail risk.
- **At firm level, monetised impact measures link directly to value:** contemporaneous impact valuations correlate with market value.
- **Incorporating externalities through impact/integrated valuation gives boards and investment committees decision-useful inputs** for capital budgeting, performance measurement and risk spread premia.
- **Meanwhile, the impact valuation and externalities implementation gap is closing.** Methods for example by the VBA, IFVI and Capitals Coalition are maturing, data/tools are serviceable at issuer and portfolio level for "Impact-Weighted Accounts" or "Integrated Value".
- **For transition finance, monetised externalities translate transition pathways into investable guardrails such as price paths,** capex alignment and outcome-linked metrics supporting underwriting, portfolio tilts and engagement escalation.
- **As a consequence, adoption by asset owners, corporates, financial institutions, policy makers, regulators and standard setters is progressing.**

Lastly, we include a few practical calls to action:

1. **Institutionalise impact valuation in finance and strategy***:* embed priced externalities in capex gates, M&A screens and performance dashboards; require impact-adjusted views alongside conventional KPIs.
2. **Hard-wire priced externalities into transition financing** with linked instruments and covenants so milestones move cash (margins/coupons/fees), not only narratives.
3. **Align reporting with ISSB/CSRD by using consistent monetary inputs** across TCFD/ISSB climate disclosures, double-materiality analyses and management commentary.
4. **Publish sector playbooks: for each sector,** select 2–3 material externalities (e.g., carbon and air quality in heavy industry; water and nature in agri/food), set pricing assumptions, data sources and governance; link to incentives.
5. **Research and collaborate**: initiate or support academic research, e.g. with the Externality Investment Research Network (see https://eirnetwork.org), and (investor-linked) engagement initiatives driven by the Value Balancing Alliance, the Capitals Coalition, the Principles for Responsible Investment (PRI), the World Benchmarking Alliance (WBA) or the Institutional Investor Group on Climate Change (IIGCC).

The bottom line is that externalities do not stay external: They usually, and to a significant degree, internalized into prices, cash flows and covenants, if they materially affect stakeholders and because, if unaddressed, they are an impediment to economic efficiency.

Treating them as central to value is not philanthropy: it is financial discipline that improves capital allocation, strengthens resilience and accelerates credible transition - at product, corporate and portfolio level.

Recommended Reading

1. **Accounting for Sustainability (A4S) (2019) – *Capex Deep Dive***
   Practical corporate guide on embedding sustainability in investment appraisal/capex governance, i.e., the "where decisions get made" layer.

2. **Busch, T., Pruessner, E. and Brosche, H. (2023) – *Principles for Impact Investments***
   A principles-based guide to common sticking points (life cycle, magnitude, trade-offs), helpful when building robust impact measurement and valuation in investment processes.

3. **NGFS (2023a) – *Climate Scenarios: Phase IV Technical Documentation* and *UNEP FI (2018) – Navigating a New Climate: Assessing Credit Risk and Opportunity in a Changing Climate***
   Together, these are the most operational "plumbing" references for translating scenarios into credit risk and portfolio metrics (PD/LGD/EAD, losses, risk appetite) and for making externality internalization dynamics decision-grade.

4. **PRI / UNEP FI / Generation Foundation (2021) – *A Legal Framework for Impact***
   The "why you can (and sometimes should) do this" reference: clarifies how impact considerations can fit within investor duties across jurisdictions and supports more ambitious impact-accounting adoption.

5. **Schoenmaker, D. (2023) – *Corporate Finance for Long-Term Value***
   Practical corporate-finance toolkit (NPV/valuation/cost of capital) adapted for long-term value creation, with sustainability/impact integrated into mainstream finance methods.

6. **Schoenmaker, D. and Schramade, W. (2019) – *Principles of Sustainable Finance***
   Core conceptual framing for sustainable finance, including externalities, impact, and transmission into finance decisions across markets and institutions.

7. **Serafeim, G. and Trinh, K. (2020) – *A Framework for Product Impact-Weighted Accounts***
   One of the most widely used academic-practice bridges for monetizing impacts and linking impact-weighted measurement to accounting-style analysis.

8. **Value Balancing Alliance (2021) – *General Methodology: Conceptual Framework for Impact Accounting***
   Foundational "conceptual framework"-style document for impact accounting, clarifying key concepts, qualitative characteristics, and monetization logic for decision use.

9. **Value Balancing Alliance (2025) – *Introduction into the Value to Business (V2B) Framework***
   Issuer-facing bridge from impact measurement to business steering and value drivers, useful for connecting externalities to management KPIs and financial performance narratives.

10. **Wilkens, M., Jacob, S., Rohleder, M. and Zink, J. (2025) – *The Impact of Sustainable Investment Funds***
    Strong synthesis of impact channels for funds (portfolio allocation, engagement, etc.) and how to communicate and evidence investor impact more credibly.

Annex 1 - Transition Finance: From Externalities to a Decision Inputs Framework (Selection)

The table below summarizes how transition finance operationalizes sustainability goals by mapping externalities through translation mechanisms into decision inputs that enable specific use cases such as "pricing", "credit decisions", "covenants", "portfolio construction" and "engagement").

EXTERNALITIES	TRANSLATION MECHANISMS	DECISION INPUTS	USE CASES IN TRANSITION FINANCE
CARBON EMISSIONS (SCOPE 1–3)	Internal carbon pricing, marginal abatement cost curves, lifecycle GHG analysis	Carbon-adjusted ROI, hurdle rate, EBIT, NPV	Evaluating green capex vs. fossil-based alternatives; pricing emissions into investment returns
ENERGY EFFICIENCY / INTENSITY	Energy audits, avoided cost modelling, intensity benchmarks	Payback period, IRR, transition readiness score	Retrofitting assets with energy-efficient tech; assessing eligibility for green bonds or loans
PHYSICAL CLIMATE RISK	Climate VaR, catastrophe modelling, location-based hazard maps	Cost of capital, insurance premiums, asset impairment forecasts	Adjusting financing terms for assets in flood-prone or heat-exposed regions
STRANDED ASSET RISK	Scenario analysis (IEA, NGFS), fossil dependency ratios	Asset write-downs, transition risk premium, adjusted valuation	Repricing fossil-heavy portfolios; divestment decisions and impairment modelling
GREEN REVENUE POTENTIAL	EU Taxonomy alignment, revenue segmentation, product lifecycle analysis	ESG-linked revenue growth, strategic optionality, valuation uplift	Forecasting revenue from low-carbon products; eligibility for sustainability-linked products
SOCIAL CO-BENEFITS (JOBS, HEALTH)	Just transition metrics, SROI, employment multipliers	Stakeholder value creation, reputational uplift, blended finance eligibility	Funding retraining programs, or health positive infrastructure with concessional capital
BIODIVERSITY & NATURE DEPENDENCIES	TNFD-aligned metrics, ecosystem service valuation, land-use impact modelling	Nature-adjusted NPV, risk-weighted ROI, ESG score	Financing regenerative agriculture or nature-positive infrastructure
REGULATORY EXPOSURE (CARBON BORDER, TAXONOMY)	Compliance cost modelling, regulatory stress testing	Compliance-adjusted ROI, litigation risk, governance score	Anticipating EU CBAM or taxonomy misalignment in cross-border investments
INSURANCE & LEGAL PROTECTIONS	ESG-linked insurance pricing, liability exposure modelling	Governance-adjusted cost of capital, D&O premium forecasts	Structuring ESG-linked insurance for directors; pricing legal risk into blended finance structures

Annex 2-

Impact Valuation and Corporate Use Cases (Selection)

The investment value chain, research, portfolio construction, stewardship, risk management and reporting, relies on accurate, decision-grade corporate impact valuation data and processes because these translate real-world externalities into comparable, finance-ready signals that can be priced, monitored and acted on. Accordingly, this whitepaper introduces a small set of illustrative corporate impact valuation best practice examples below (further references are included in the Literature List):

COMPANY			
ABN AMRO:	Model-based biodiversity impact accounting for the bank's own operations and (especially) lending & investment portfolio; decomposes impacts by country/sector and locates hotspots within the portfolio.	Portfolio biodiversity-impact breakdown (countries/sectors; influential portfolio segments); client dialogue priorities; biodiversity-related initiatives and transition support.	Greater transparency on biodiversity impact; identifies where impacts are greatest to support portfolio steering, client engagement, and preparation for rising biodiversity-related regulation and risk management.
ANSA MERCHANT BANK (GROUP)	Natural capital approach to identify, quantify and communicate nature-related impacts, dependencies, risks and opportunities; includes portfolio-level 'natural capital vulnerability assessment' framing and Natural Capital Protocol-aligned reporting journey.	Natural capital statement of intent; portfolio vulnerability / risk-opportunity assessment; product & programme design (e.g., grants/green finance pilots); material ecosystem services and local economic values of natural capital.	Supports nature-positive lending and new green/blue finance opportunities; strengthens risk management (nature-related risks) and stakeholder value narrative; builds internal capability via hub/partnerships.
YARRA VALLEY WATER	Integrated Profit & Loss (IP&L) accounting that monetizes natural, social and human capital externalities alongside financial performance (developed with Trucost and GIST).	Monetized externality 'accounts' across capitals (NCX/SCX/HCX) and financial value addition; project prioritization signals; restorative-strategy baselines.	Used to improve strategic decision-making and prioritize projects with higher net value for customers/community; strengthens license-to-operate narrative and stakeholder communication of "full value delivered".
REDEIA	Impact Measurement & Management reporting that quantifies shared social value and explains how impacts are managed; uses an impact-index / 'value to society' framing (e.g., value created relative to net profit).	Shared social value metrics and impact index by strategic pillar; management-of-impacts narrative; ESG financing / sustainability plan tracking.	Provides management dashboard for impact strategy and stakeholder reporting; supports credibility with investors/financiers and informs ESG-financing/strategic commitments through quantified "value created".

BNP PARIBAS ASSET MANAGEMENT	Portfolio biodiversity foot printing using investee reported + modelled data (Iceberg Data Lab & I Care Corporate Biodiversity Footprint); IO/LCA modelling linked to biodiversity loss (e.g., km² MSA via GLOBIO).	Issuer-level biodiversity footprint metrics; portfolio-level footprint and peer positioning; data-gap identification and engagement requests; nature-risk materiality considerations.	Integrates biodiversity impacts into investment decision process and engagement; improves ability to identify hotspots/exposures and anticipate nature-related financial risks and reporting expectations.
OFI (OLAM FOOD INGREDIENTS)	Natural Capital Accounting with Natural Capital P&L and forward-looking Natural Capital Balance Sheet (aligned with BS 8632 where possible), supported by AtSource granular supply-chain data and scenario assumptions (e.g., water scarcity, carbon pricing, reforestation).	NC P&L and multi-year NC Balance Sheet outputs; valuation factors for GHG, land-use change/deforestation, water use/scarcity, pollination, soil health; scenario results for planned investments.	Assesses whether current/planned programs create or erode natural capital value; informs regenerative agriculture and supply-chain investments; provides publishable, audit-friendly structure for communicating nature impacts.
NATURA	Integrated Profit & Loss (IP&L) accounting across natural, human and social capital, built on impact pathways and protocol-aligned methods (Natural Capital Protocol; Human & Social Capital Protocol).	Monetized impacts across the value chain and business model (products, operations, consultants, communities); 'net societal value' and drivers; internal decision dashboards and case studies.	Created to drive business and sustainability decisions using impact data; clarifies trade-offs and hotspots; supports strategy (e.g., Amazon program, waste reduction, carbon initiatives) and external transparency.
EOSTA	True cost accounting (tca-fff) approach and dashboard to measure and monetize environmental and social impacts for smes in finance/food/farming; designed for use in p&l/balance-sheet style reporting and investment/loan assessment pilots.	Tca-fff kpis and monetization factors (environmental and social); supply-chain assessments; pilot outputs for financing decisions and market communication.	Makes externalities visible for product/supply-chain choices and financing; supports 'true price/true cost' communication and helps align incentives toward ethical enterprises and green finance.
FORICO	Natural Capital Report with Environmental Profit & Loss and Natural Capital Balance Sheet valuing ecosystem-service stocks/flows over the planned lifecycle (discounting future flows); includes environmental assets and liabilities with 'value to business' and 'value to society' columns.	Environmental P&L and Natural Capital Balance Sheet metrics (e.g., biomass, carbon sequestration, habitat; provisions for maintenance and future carbon emissions); auditable methods, assumptions and assurance.	Supports investment and management decisions to maintain/improve ecosystem quality and natural assets; improves transparency to investors and stakeholders by reporting nature assets/liabilities in a finance-like format.

Sources: Corporate Case Studies and Links

ABN AMRO – Valuing Impact on biodiversity	https://assets.ctfassets.net/1u811bvgvthc/57Zzrtpw4zqxEBffRBC1Re/92118bebba8e5e82c1e1006544feb4a1/ABN_AMRO-s__impact_on_Biodiversity.pdf
ANSA Merchant Bank – Natural Capital (2023 report page + statement of intent)	https://tt.ansamerchantbank.com/natural-capital /
ANSA Merchant Bank – Statement of Intent	https://tt.ansamerchantbank.com/wp-content/uploads/2022/07/Statement-of-Intent.pdf
Yarra Valley Water – Integrated Profit & Loss	https://media-2.yvw.com.au/inline-files/Yarra%20Valley%20Water%20IPL_November%202016_v2_0_0.pdf
Redeia – Annual Impact Measurement & Management Report 2023 (landing page)	https://www.redeia.com/en/publications/sustainability-and-environment/sustainability/annual-impact-measurement-and-management-report-2023
Redeia – Impact report 2022 press release	https://www.redeia.com/sites/default/files/paragraph/2023/07/file/0703_NP_Informe%20Impacto%202022_ENG.pdf
BNP Paribas AM – Biodiversity Footprint (PDF)	https://docfinder.bnpparibas-am.com/api/files/60B8656F-6A6F-4A35-9244-A997DCCB59FD
Ofi – Balance sheet approach to natural capital accounting	https://www.littleblueresearch.com/case-studies/a-balance-sheet-approach-to-natural-capital-accounting
Ofi – IP&L / Impact Statement compendium	https://capitalscoalition.org/wp-content/uploads/2025/06/IPLReport-FullDocument.pdf
Natura – Integrated Profit & Loss Accounting 2021	https://api.mziq.com/mzfilemanager/v2/d/9e61d5ff-4641-4ec3-97a5-3595f938bb75/d8f2cae6-7a86-1d24-8100-62ae5871c7fc?origin=2
Eosta – True Cost Accounting for Food, Farming & Finance	https://www.socila.eu/wp-content/uploads/sites/5/2018/01/True-Cost-Accounting-for-Food-Farming-and-Finance.pdf
Forico – Natural Capital Report 2023	https://forico.com.au/volumes/documents/Natural-Capital-Report/Natural-Capital-Report-2023.pdf

Annex 3 – Impact Valuation Alignment with Public Policy and Global Standards (Selection)

Standard-setters and regulators are converging around the need for monetized externalities and decision-useful sustainability data. This shift supports enterprise-value-focused disclosure, credible corporate and investor transition planning, and capital allocation aligned with systemic goals. Emerging policies aim to "reward" firms and investors who can quantify externalities as part of enterprise value and transition planning:

BODY / REGIME	WHAT IT DOES FOR MONETISED EXTERNALITIES & DECISION-USEFUL DATA:	WHERE IT LINKS TO FINANCIAL DECISION MAKING:	LATEST STATUS / NOTES:
ISSB / IFRS S1/S2 (ISSB, 2023 FF.)	Global investor-focused baseline for sustainability (S1) and climate (S2); encourages scenario analysis, transition planning, and decision-useful metrics that affect cash flows, access to finance, and cost of capital. Impact valuation supplies consistent monetary inputs.	Disclosure; integration into DCF / WACC / VaR; comparability across markets.	S1/S2 in force (2023). Jurisdictional uptake growing; Japan's SSBJ standards designed to be functionally aligned (2025).
EU / CSRD / ESRS (EFRAG) (EFRAG, 2023)	Double materiality: requires clear articulation of impacts, risks, opportunities; monetized externalities help evidence both financial- and impact-materiality and support management commentary.	Mandatory reporting; assurance; feeds banks/investors with decision-useful inputs.	Set 1 ESRS and implementation guidance live; alignment pathways to ISSB.
UK / SDR & TPT (FCA / HMG) (FCA 2024B, UK GOVERNMENT, 2025)	Sustainability Disclosure Requirements and Transition Plan Taskforce guidance require credible, forward-looking transition plans with governance, metrics/targets, and scenarios—amenable to monetized inputs.	Issuer and fund disclosures; product labelling; investor stewardship; transition plan comparability.(see UK Government, 2025)	2025 consultations on routes to mandatory transition plans; SDR policy live and evolving.
JAPAN / SDS / SSBJ & TRANSITION FINANCE (METI, 2023 FF.)	Japan endorses the ISSB approach via SSBJ standards; METI Transition Finance Guidelines and GX bonds emphasize sectoral pathways and credible transition plans that can incorporate priced externalities.	Corporate disclosure; labelled debt; transition-plan bankability.	SSBJ inaugural standards issued Mar-2025; METI updated Basic Guidelines on Climate Transition Finance

OECD / TRANSITION FINANCE & IMPACT MEASUREMENT (OECD 2022 FF.)	Guidance on credible transition plans and impact measurement/valuation—guardrails against greenwashing; encourages quantified impacts, milestones, governance.	Use in lender covenants, SLB/SLL KPIs, policy design; improves investability.	Guidance current and widely referenced by supervisors and MDBs.
NGFS / CLIMATE & NATURE (NGFS, 2023A/B**)**	Supervisory scenario building blocks for climate and (emerging) nature-related risks; supports translation to earnings, losses, VaR/ES for banks and investors.	Stress testing; macro-prudential policy; portfolio VaR/ES.	Climate scenarios (v2023); Nature conceptual framework and scenario workstreams ongoing.
TNFD (TNFD, 2023)	Disclosure framework integrating dependencies, impacts, risks & opportunities for nature; encourages monetized nature metrics where decision-useful.	Nature-risk governance; scenario analysis; pipeline for nature VaR/NVaR.	Final recommendations (v1.0, 2023); growing market piloting.
ICMA / TRANSITION FINANCE, SLBS/LOANS, IMPACT REPORTING (ICMA, 2022 – 2025; 2023A).	Debt market playbooks that operationalize transition credibility and impact-linked finance: (i) Climate Transition Finance Handbook (CTFH) for issuer-level transition credibility and disclosures; (ii) Sustainability-Linked Bond Principles (SLBP) (including 2025 KPI Registry updates, e.g., nature-related KPIs); (iii) Harmonized Framework for Impact Reporting to monetize/quantify outcomes. Together, they make impact valuation transaction-ready (UoP & SLB).	Use-of-proceeds bonds; SLBs/SLLs with impact-linked coupons; post-issuance impact reporting (monetized where feasible); structuring transition instruments.	2025: Principles Guidance Handbook refreshed; SLBP KPI Registry updated (incl. nature); continuing convergence with national transition-finance regimes (e.g., METI 2025).

Annex 4 - Comparative Overview for Transition Finance Policies and Approaches: EU versus APAC (Selection)

This table provides a high-level comparison of key transition finance policies and market approaches in the EU versus APAC, highlighting where frameworks converge or diverge on definitions, instruments, disclosure expectations and implementation mechanisms.

DIMENSION	EU – REQUIREMENTS	APAC – REQUIREMENTS	USE CASES
Definition of Transition Finance	Defined in EU Commission Recommendation 2023/1425: financing consistent with credible corporate transition plans; aligned with EU Taxonomy and "do no significant harm" principle.	Japan – METI & JFSA Basic Guidelines on Climate Transition Finance (2021). Singapore – MAS / GFIT Singapore-Asia Taxonomy with "amber" (transition) category. China – Green Bond Catalogue allows certain transitional activities.	EU – Banks using sustainability-linked loans tied to EU Taxonomy KPIs. Japan – Marubeni issued world's first transition bond (2021). Singapore – OCBC & DBS finance "amber" gas-to-renewables.
Taxonomy & Classification	EU Taxonomy (2020/852): strict, science-based screening; coal excluded; conditional role for nuclear & gas.	Japan – No binding taxonomy; relies on guidelines. Singapore – Traffic light taxonomy (green/amber/red). China – Green Bond Catalogue; includes "clean coal."	EU – Companies disclose % of CapEx/OpEx aligned with Taxonomy. Singapore – MAS pilots taxonomy in project finance. China – Green bonds funding "clean coal" retrofits.
Disclosure / Reporting	CSRD/ESRS: mandatory disclosures (phased 2024–2028). SFDR: funds disclose sustainability impacts. Taxonomy: mandatory activity alignment disclosures.	Japan – TCFD-aligned mandatory reporting for listed firms. Singapore – SGX mandates climate reporting (from 2025–2027 rollout). Australia/NZ – Mandatory ISSB/TCFD-based climate disclosures. China – ESG disclosure mandatory for central SOEs (2023).	EU – Automotive & energy firms reporting Taxonomy CapEx alignment. Japan – Transition bond issuers disclose roadmaps. Singapore – SGX firms disclose taxonomy-linked KPIs. China – SOEs integrate carbon transition in annual reports.

Guidance & Regulation	EU Commission Recommendation (2023): detailed requirements for transition plans, milestones, financing strategy. Supervisory oversight by ESMA/ECB.	Japan – METI/ICMA guidance for transition bonds. Singapore – MAS / GFIT transition finance handbook. HK – HKMA transition finance guidance for banks.	EU – ECB climate stress tests incorporate transition plan quality. Japan – Utilities issue transition bonds Singapore – MAS guides steel decarbonization financing. HK – Banks assess corporate transition plans in lending.
Hard-to-Abate Sectors	EU Taxonomy: only activities meeting strict thresholds (steel, cement, aviation). No coal allowed. Requires avoidance of lock-in.	Japan – Guidelines cover steel, aviation, shipping, power. Singapore – Amber allows gas with phase-out timelines. China – Gas & "clean coal" eligible. ASEAN – Transition support for coal phase-down.	EU – EU Hydrogen Bank supports green steel pilots. Japan – JERA uses transition finance for ammonia co-firing. Singapore – Banks finance LNG as interim fuel.
Transition Plans & Benchmarks	Transition plans must be science-based, Paris-aligned. EU benchmarks (CTB, PAB) guide funds. Disclosure expected under CSRD.	Japan – Issuers must publish decarbonization roadmaps with KPIs. Singapore – MAS requires entity-level plans for amber financing.	EU – Asset owners require credible transition plans (CA100+). Japan – Steel firms publish roadmaps linked to bond proceeds. Singapore – Loans tied to company carbon reduction milestones.
Enforcement & Oversight	Mandatory, enforced by national regulators (CSRD, SFDR). Penalties for misreporting. ESMA monitors greenwashing.	Japan – Voluntary, "comply or explain" basis. Singapore – MAS enforces SGX disclosure rules. China – Central SOE ESG disclosure mandated.	EU – French AMF fines funds for mislabeling ESG. Singapore – MAS blocked issuance not taxonomy-compliant. Japan – JFSA encourages best practice but no penalties.

Annex 5 - Impact Valuation Industry Resources and Tools (Selection)

This table translates "theory into industry practice(s)" by highlighting a selection of key resources and tools that operationalize impact valuation for corporate strategy, investment processes and financial risk management:

Methods / Approach	*Provider / Initiative*	*Typical use cases (finance & reporting)*	*Notes / References*
Standardized impact metrics taxonomy (IRIS+) aligned to SDGs and impact investing norms	**Global Impact Investing Network (GIIN)**	Investment screening, impact monitoring, LP/GP reporting, benchmarking	IRIS+ catalogue & sector standards; links to IFC Operating Principles. (GIIN, 2023)
Portfolio- and issuer-level impact valuation (monetized externalities)	**GIST Impact**	Fund allocation, SDG alignment, portfolio diagnostics, client reporting	Fund- and issuer-level impact valuation with monetized outputs. (GIST Impact, 2022)
Integration frameworks & open tools for impact in portfolio construction	**Impact Frontiers**	Capital allocation policies, impact-adjusted alpha, efficient impact frontier, manager governance	Practical guidance and open-source templates used by asset owners/GPs. (Impact Frontiers, 2021)
Integrated Value Model (IVM) / True Price methods (monetized multi-capital)	**Impact Institute (NL)**	Corporate finance, transition planning, CSRD alignment, product/portfolio "true value"	Combines financial, environmental & social value in currency units. (Impact Institute & RSM, 2022)
Impact → finance translation at product level (RIFT™)	**Richmond Global Sciences**	Impact benchmarking, portfolio selection, index creation, product design	Translates sustainability metrics into financial terms for comparability. (RGS, 2023)
Net Impact Model (positive/negative across people, planet, society, knowledge)	**Upright Project**	Issuer screening, thematic tilts, engagement, reporting	Directional "net impact" scores; portfolio mapping and analytics. (Upright, 2020)
Impact valuation methodologies & guardrails (impact pathway, valuation techniques)	**Value Balancing Alliance (VBA) & International Foundation for Valuing Impacts (IFVI); Capitals Coalition**	Standardization; regulatory alignment (ISSB/CSRD); transition planning; impact-adjusted P&L/BS	Method custodians; mapping to disclosure/prudential regimes; natural & social capital protocols. (VBA, 2021ff.; IFVI, 2024a/b; Capitals Coalition, 2016/2018; Vionnet et al, 2025)
Health & productivity impact monetization	**WifOR Institute**	Linking health outcomes to macroeconomic value; workforce health ROI; policy evaluation	Disease/health program valuation; productivity & GDP effects. (WifOR, 2023)

Annex 6 -

Impact Valuation and Externalities Accounting Logic

The *standard impact-pathway* logic is: "activity" → "pressure" → "environmental state change" → "human and ecological exposure" → "effects" (biophysical outcomes) → "valuation". For example, a tone of SO_2 emitted by a facility ("activity/pressure) disperses ("state change"), elevates local $PM_{2.5}$ concentrations ("exposure"), increases cardiopulmonary morbidity ("effects"), and is then *monetized using willingness-to-pay* ("WTP") *for risk reduction or cost-of-illness methods* ("valuation") (European Commission, 2005; ISO, 2019; OECD, 2018).

Quantification typically combines engineering inventories and dispersion models with *dose–response* or *concentration–response functions* from epidemiology and ecology, followed by *economic valuation* techniques such as "*WTP/contingent valuation", "revealed-preference*" such as hedonics, travel cost, or "*shadow prices"* from policy markets (Boardman et al., 2018). Results are often reported as *marginal damage costs* for example as "€/tone pollutant by location and stack height" and aggregated to the *total external cost of a process, product or portfolio*, with *sensitivity analysis* for *discount rates, uncertainty and spatial heterogeneity* (see e.g., European Commission, 2005; OECD, 2018).

A canonical example is the so called "Social Cost of Carbon (SCC)". In environmental economics, the SCC measures the present value of incremental global damages from emitting one additional tone of CO_2e today (see e.g., Interagency Working Group on Social Cost of Greenhouse Gases, 2016; EPA, 2023).

The modern "Social Cost of Carbon" (SCC) emerged from integrated assessment models ("IAMs"), which couple simplified climate modules to intertemporal growth models to translate emissions into temperature, damages and welfare (Nordhaus, 1977; Stern, 2006/2007; Nordhaus, 2018). The SCC is widely used by governments for rulemaking and appraisal and has been refined via updated climate science, socioeconomic pathways and discounting **(**Interagency Working Group, 2016; EPA, 2023; HM Treasury, 2024). Methodologically, SCC estimation exemplifies the impact-pathway chain (Boardman et al., 2018), while the choice of social discounting under uncertainty is a major driver of SCC levels and term structure **(**Newell and Pizer, 2003; Weitzman, 2001; Gollier, 2012**).**

***Translating externalities into finance-ready inputs involves mapping those monetized effects into cash-flow statements, valuation models and risk metrics*:**

- ***First, adjusted cash flows****:* expected OPEX/CAPEX should capture explicit prices, for example carbon taxes/European Trading Scheme (ETS) permit costs, implicit costs such as internal shadow prices for biodiversity-sensitive land conversion, and avoidance benefits from mitigation or nature-positive investments (see e.g., European Commission, 2023a; UK Government, 2024; OECD, 2022 for further references).
- ***Second, risk premia and discount rates:*** transition and physical risks alter the *cost of capital* via *cash-flow volatility, downside skew and potential covenant or regulatory costs*. These can be reflected through *scenario-consistent WACC adjustments or explicit risk charges* (NGFS, 2023a).
- **Third, valuation accuracy**: incorporating *monetized externalities reduces model error in DCFs* by *aligning scenarios, capex timing and terminal values with credible policies,* for example carbon price trajectories, and *damage functions.* It also improves

comparability across scenarios for project selection and portfolio construction (Boardman et al., 2018; OECD, 2022).

- ***Finally, firms increasingly institutionalize this with internal carbon prices****, screening values for biodiversity and water, and shadow-pricing in hurdle-rate setting and impairment tests*, consistent with guidance in the "Capitals Protocols" and contemporary reporting frameworks (see e.g., VBA, 2021 ff.; IVFI 2024 a/b; Capitals Coalition, 2016 ff.; 2025; Vionnet et al, 2025).

All this matters for *decision-usefulness*: under mainstream accounting notions of *relevance and materiality,* information is financially relevant when it can change investor and lender decisions by affecting expected cash flows, access to finance, or the cost of capital (see e.g., IFRS, 2018; IFRS, 2023; FASB, 2018). Because priced *externalities* can be translated into cash-flow adjustments, risk metrics (e.g., VaR / stress losses) and valuation parameters (e.g., discount rates, WACC, impairments), they meet this threshold in both corporate finance and financial risk practice (TCFD, 2017; UNEP FI, 2018; Freiberg, Rogers and Serafeim, 2020). Omitting them risks *systematic mispricing and capital misallocation* and can amplify systemic financial risk as internalization dynamics materialize through policy, technology and physical impacts (see e.g., BIS, 2020; NGFS, 2023a; Dietz et al., 2016).

- **Cost-Based Valuation**: This approach estimates the damage cost of an externality, such as the economic loss from air pollution or water contamination. It is commonly used in environmental economics and health impact assessments. For example, *the Stern Review* in 2006 (Stern, 2006/2007) uses damage cost estimates to quantify the economic impact of climate change. Alongside damage-cost (ex post) valuation, there is also a well-established literature strand (see e.g. Toimil, Losada, Álvarez-Cuesta et al., 2023*)* that prices externalities using ex ante "opportunity/avoided cost" logic, i.e., what it would cost to prevent the impact in the first place, or to meet a target at least cost.
- **Market-Based Valuation:** This method uses market proxies such as *carbon prices, water tariffs*, or *carbon credits to value externalities.* It reflects the cost of compliance or mitigation in regulated markets. A relevant example is the *EU Emissions Trading System (EU ETS) (European Commission, 2005; 2023a)* which provides a market-based carbon price used in financial modelling.
- **Stated and Revealed Preference Methods**: These techniques infer value from consumer behavior or survey responses. Revealed preference uses actual choices, e.g., housing prices near green spaces, while stated preference relies on hypothetical scenarios, e.g., willingness to pay for clean air. For example, the *OECD* (2022) recommends these methods for valuing ecosystem services and social outcomes
- **Subjective Well-Being Valuation:** This emerging approach links externalities to changes in life satisfaction or mental health, using econometric models to derive monetary equivalents*. Fujiwara & Campbell* (UK Government, 2011) apply well-being valuation to assess the social impact of public services in the UK.

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