EcoMap

Announced Increases in Carbon Pricing and Their Implications for Corporate Valuations

Unpriced carbon costs may represent a material risk to corporate earnings and valuations. Global corporate emissions place more than 20% of profit at risk

Research Report

May 2026

EcoMap

This research paper, developed by EcoMap and its partners, provides an in-depth analysis of the global corporate environmental costs stemming from scope 1, 2 and 3 emissions. These findings are analysed and compared to the existing and potential tax and regulation policies aimed at internalising externalities and liabilities in relation to corporate greenhouse gas (GHG) Emissions.

EcoMap is a non-profit research organisation initiated by leading academics and industry professionals with a shared goal: to make environmental impact visible and financially quantifiable. It is supported by an advisory board that combines academic experience with private-sector expertise. EcoMap's interdisciplinary team is dedicated to bridging the gap between advanced academic research and real-world industry practices.

EcoMap's analyses are grounded in peer-reviewed and science-based data, and developed in collaboration with leading research organisations, including the International Foundation for Valuing Impacts (IFVI, now merged into Capitals Coalition), the Norwegian School of Economics (NHH), using MSCI ESG Research LLC corporate CO_2 data. The report has also been reviewed, and contributions have been made by Gunnar S. Eskeland (Professor, NHH and SNF), Endre K. Iversen (Researcher, SNF), Rob Zochowski (Executive Director, Capitals Coalition), Andrea Serra (Director, Capitals Coalition), Sigrid Fjermeros (Investor, Nalka Invest AB), and Benedicte Lorentze Aune (ex CVC Capital Partners).

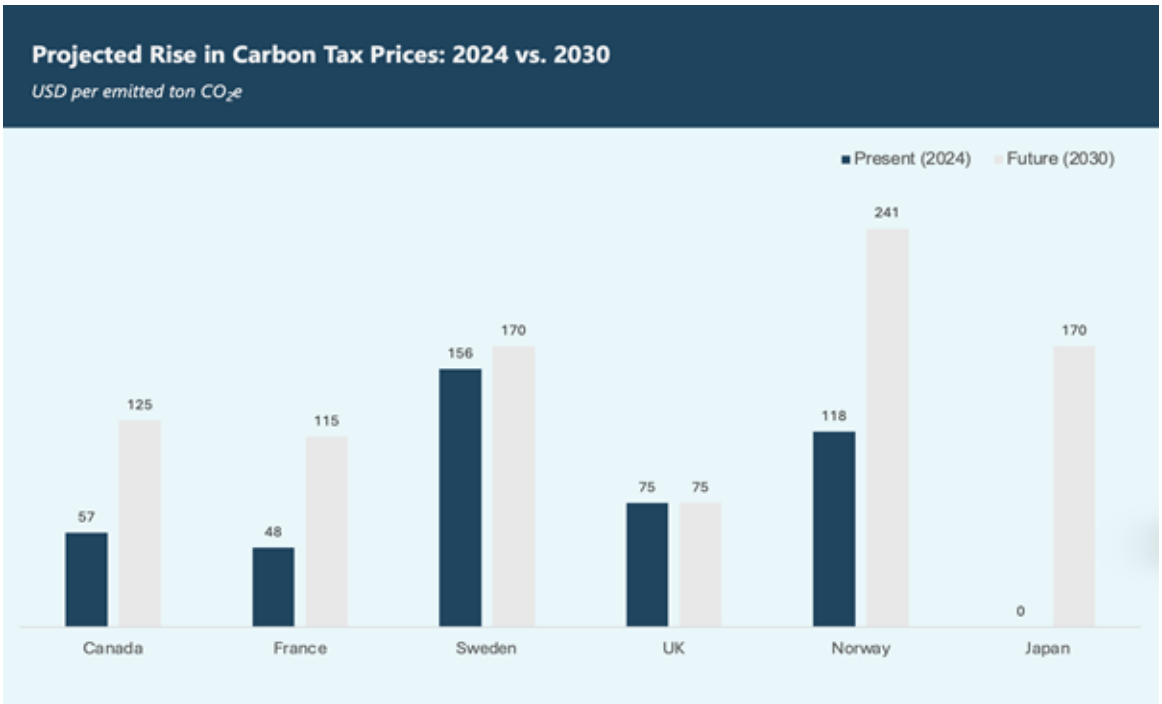
This EcoMap report demonstrates how the EcoMap database and tools allow comparisons and estimations of Social Costs of Carbon and climate risk by corporation, to state how pricing of carbon may reduce operating profits (EBITDA) for emission intensive firms (Scope 1) and firms in emission intensive value chains (Scope 2 and 3).

Executive Summary

EcoMap's Analysis Indicates a Financial Liability of $14.5T Stemming from Scope 1, 2 and 3 Impact

EcoMap's latest analysis reveals a fundamental shift: the cost of emissions is no longer only an external societal challenge, but also a direct risk of material liability on corporate income statements and balance sheets. Carbon pricing mechanisms and regulations are increasingly internalising the costs of corporate emissions, shifting them from society to the companies that generate them, meaning that they now directly impact the companies' financial metrics while clearly exposing the costs of their emissions. The increasing carbon pricing is converging with EcoMap's estimated societal costs of carbon.

The value of the Social Cost of Carbon (SCC) reflects recent advances in scientific literature on climate change and its economic impacts on natural disasters, agricultural productivity, disruptions, and human health. EcoMap is assessing corporate SCC in partnership with Harvard spin-off International Foundation for Valuing Impacts (IFVI, now merged into Capitals Coalition), which provides the monetization methodology, developed through rigorous technical oversight and grounded in findings from peer-reviewed academic research.[1]



Source: Environment and Climate Change Canada (2021), Mengden, A. (2024), Government of Sweden (2025), Department for Energy Security and Net Zero (2025); HM Revenue & Customs (2025).

[1] *The scientific literature on the social costs of carbon is presenting bands of uncertainty (also due to modelling perspectives) for the social costs of carbon; both higher and lower than those considered central.*

Policymakers are increasingly implementing measures to address societal costs of carbon, also defined as carbon externalities. Jurisdictions such as Norway, Canada, the EU, and France are raising carbon prices through taxes and trading schemes:

- **Norway**: Carbon tax set to rise from $118 per ton CO_2e in 2024 to $241 in 2030, a 104% increase, aligning with EcoMap's SCC assessment. This effectively prices carbon at 91% of its true estimated societal cost.
- **Canada**: Federal carbon price to rise from $57 in 2024 to $121 in 2030, a 112% increase.
- **France**: Climate contribution to rise from $48 to $115 by 2030, a 140% increase.
- **EU:** Emissions Trading System (ETS) prices are forecast to reach $81–87 per ton by 2030, up from $73 in 2025.

These trajectories may reflect a broader shift towards incorporating climate and transition objectives directly into corporate income statements, investment models, and national tax systems.

Unpriced carbon costs may represent the next shock to corporate earnings and valuations

Across a dataset of approximately 20,000 companies globally, EcoMap estimates the most critical financial liability today to be Scope 1 emissions, which alone account for $3.2 trillion in direct, attributable, and non-overlapping annual environmental costs. This conservatively estimated figure represents 22.2% of EBITDA for profitable companies only.[2] Including loss-making companies in the analysis increases the share relative to EBITDA by an additional 14.2 %, resulting in a total of 36.4% of EBITDA. When considering emissions across all Scopes (1, 2, and 3), the total implied societal cost rises to c. $14.5 trillion yearly.

The majority of these costs remain unrecognised in corporate accounts today, representing material but unpriced financial risk. Climate-adjusted profitability diverges sharply across sectors: carbon taxes aligned with SCC on Scope 1 emissions could erase up to 20% of revenue for high-emitting industries. EcoMap's valuation models show that fully pricing in Scope 1 emissions could on average reduce enterprise values by 26.9% in aviation and 29.3% in maritime transport. The analysis reveals the greatest risk is not from high emissions alone, but from the combination of high Scope 1 emissions and low profit margins.

[2] *EBITDA is an abbreviation for Earnings Before Interest Tax, Depreciation and Amortization*

Three potential critical risks for corporates and investors

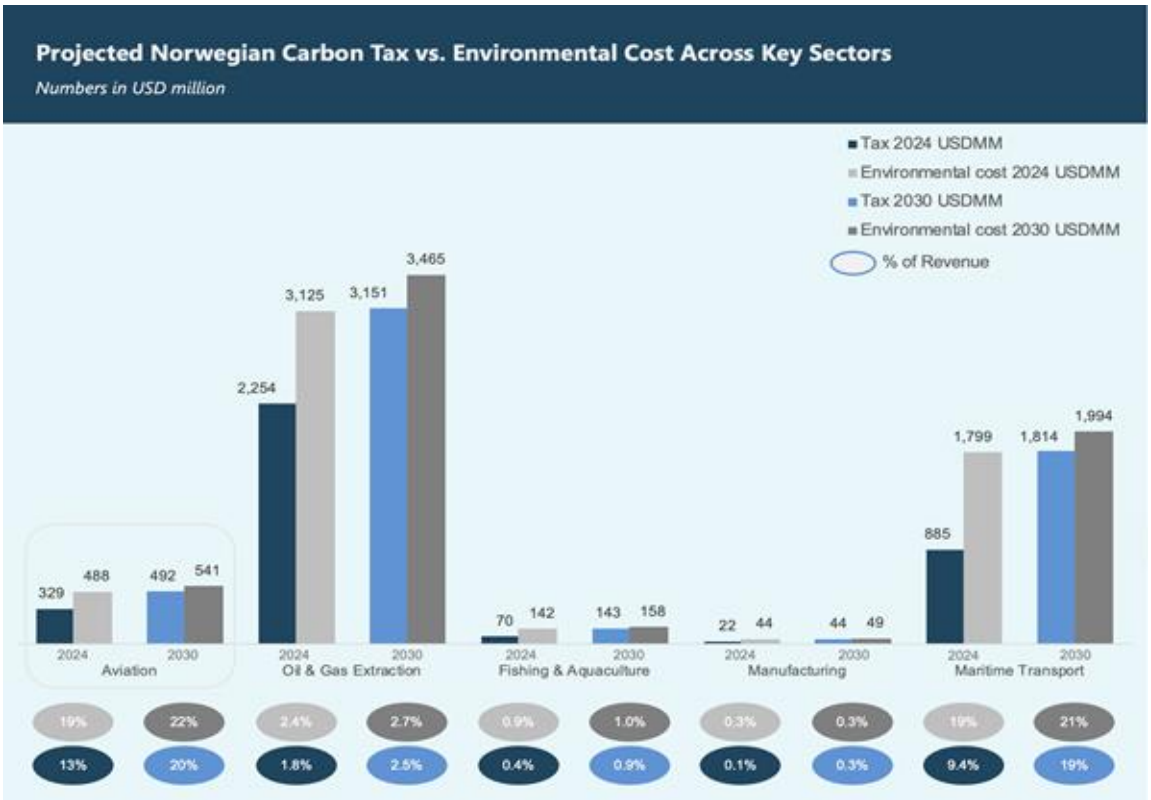
As emissions pricing mechanisms evolve and investor scrutiny intensifies, failing to integrate these costs into core planning exposes corporates and their investors to three critical risks:

1. Reduced Profitability and Earnings Volatility: Unanticipated increases in carbon costs have the potential to materially reduce operating margins and cash flows, potentially erasing more than 20% of profit if regulatory changes are not anticipated for high-emitting industries

Aviation: Projected carbon tax obligations are equivalent to approximately **20% of aviation companies revenue** by 2030, up from around 13% in 2024. This highlights the severe exposure of the airline business model to carbon pricing.

Maritime Transport: The shipping sector is projected to see its carbon costs double on average, from **roughly 9.4% to over 19% of revenue.** This sector-wide average likely masks significant variations between operators, with some facing much higher exposure depending on fleet age, fuel efficiency, and routes.

Oil and Gas: The oil and gas industry is expected to see environmental costs increase on average from **1.8% to 2.5% of revenue.** This stands in sharp contrast to low-margin sectors, as the industry's higher profitability allows it to absorb such costs with less immediate financial distress.

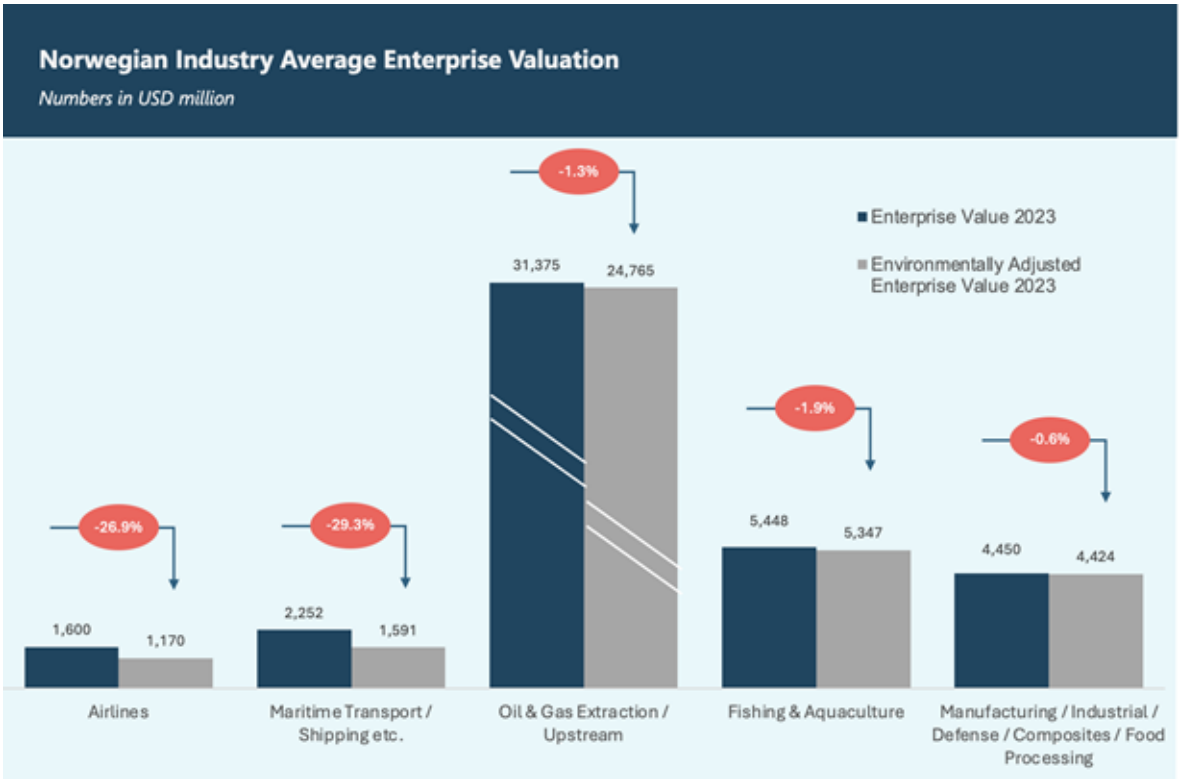


Source: EcoMap 2025, MSCI ESG Research LLC, Government of Norway, Ministry of Finance (2023a)

2. Elevated Cost of Capital and Valuation Risk: Companies with high climate risk are estimated to face valuation pressure due to the following:

Lenders charging higher rates: High-emission companies are already facing a "carbon premium" on debt, with an ECB working paper finding they pay, on average, **14 basis points more in borrowing costs** than their low-emission peers.

Investors repricing transition risk in valuation models: Markets are beginning to adjust valuations to account for profitability risk and future liabilities. EcoMap's valuation models illustrate this risk, showing that fully pricing in Scope 1 emissions could reduce enterprise values by **26.9% in aviation** and **29.3% in maritime transport** due to their combination of high emissions and thin margins.

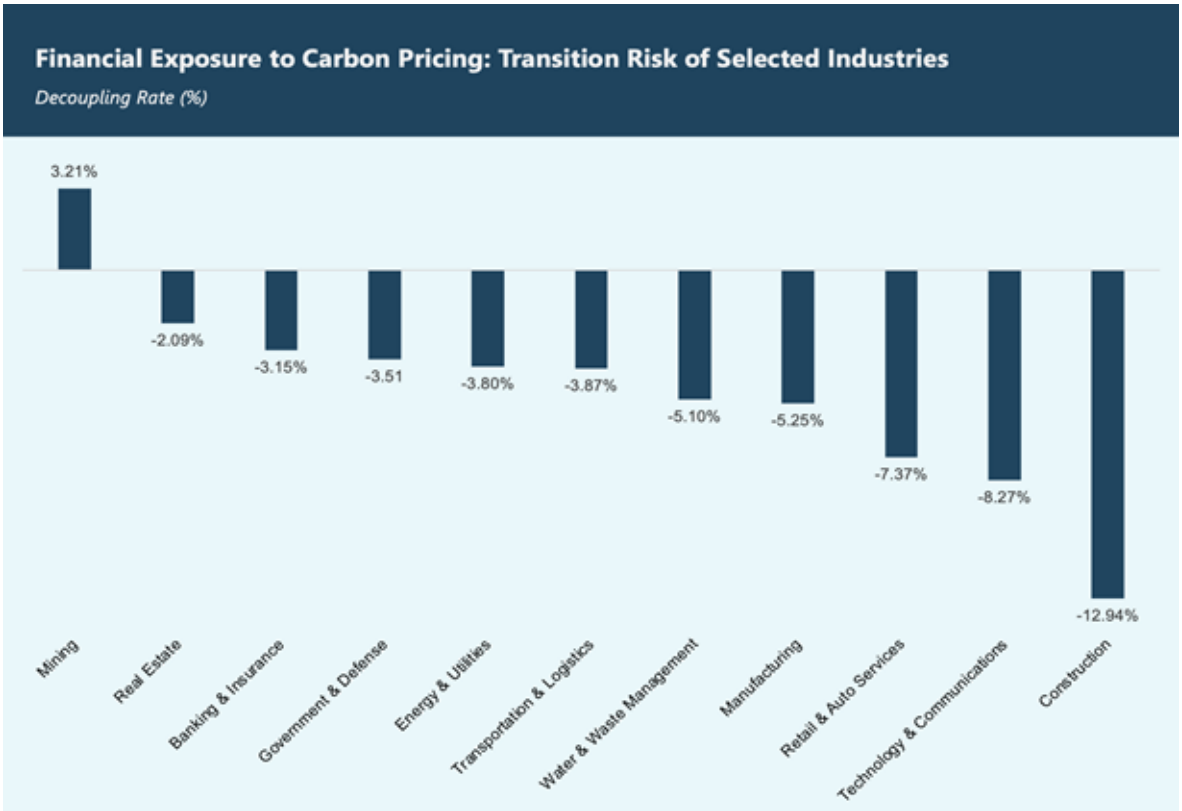


Source: EcoMap, MSCI ESG Research LLC, Finbox.com

3. Global transition risk has increased since 2020: Between 2020 and 2023, global environmental cost grew faster than revenues, resulting in a negative decoupling rate of −5.3%.

Decreasing environmental efficiency among corporates globally: The current global transition risk metric, often referred to as the decoupling rate, indicates that environmental costs are increasing relative to revenue, which is contrary to what would be expected under a sustainable transition pathway. This trend suggests a deterioration in environmental cost efficiency per unit of revenue and an increase in transition risk.

EcoMap's sector-level analysis shows that transition risk is not evenly distributed: While some industries demonstrate relative improvement, including **education (10.6%**, not shown in the graph) and **mining (3.21%),** many core sectors of the global economy exhibit increasing emissions intensity. The construction sector's negative decoupling rate of 12.94% makes it especially exposed to carbon pricing shocks. **Manufacturing records a negative rate of 5.25%,** while **technology and communications (8.27%)** and **retail and auto services (7.37%)** also show significant deterioration.



Source: EcoMap, MSCI ESG Research LLC. Values (%) are average per industry, 2020 - 2023

Glossary

Carbon Emissions Scope 1	Direct emissions from sources owned or controlled by the company
Carbon Emissions Scope 2	Indirect emissions resulting from the generation of purchased energy consumed by the company, directly tied to its operations
Carbon Emissions Scope 3	All other indirect emissions across the company's value chain, both upstream and downstream
Change in Environmental Cost Intensity	Change in Environmental Cost Intensity measures the difference in a company's Environmental Cost Intensity between two specific time periods, reflecting how the company's environmental efficiency relative to revenue has evolved over time. It is calculated by subtracting the Environmental Cost Intensity of the earlier period from that of the later period. This metric indicates whether the company is improving or declining in managing its environmental costs in relation to its revenue and financial performance.
Decoupling	Decoupling financial performance from environmental impact refers to reducing the environmental impact or externalities per dollar earned, regardless of whether financial performance improves, remains stable, or declines. It focuses on breaking the link between economic activity and environmental harm, allowing businesses to operate more sustainably by minimizing their environmental costs relative to their revenue or output. This approach is central to achieving sustainability goals without requiring absolute growth or shrinkage in financial terms.
Decoupling Rate/ Transition Rate	The Decoupling Rate measures the annualized percentage change in a company's Environmental Cost Intensity over a specific period. It indicates how effectively the company is reducing its environmental costs relative to revenue over time. The Decoupling Rate is calculated using the Compound Annual Growth Rate (CAGR) formula multiplied by -1, applied to the Environmental Cost Intensity. Positive Decoupling Rate: Indicates that the Environmental Cost Intensity has decreased over time, signifying improved environmental efficiency. The company is incurring less environmental cost per unit of revenue each year. Negative Decoupling Rate: Indicates that the Environmental Cost Intensity has increased, signifying decreased environmental efficiency. The company is incurring more environmental cost per unit of revenue each year
Environmental Cost Intensity	Environmental Cost Intensity measures the ratio of a company's environmental cost to its revenue, indicating the environmental efficiency of its operations. It is calculated by dividing the environmental cost by the company's revenue. Lower Environmental Cost Intensity: Indicates higher environmental efficiency, meaning the company incurs less environmental cost per unit of revenue earned. Higher Environmental Cost Intensity: Suggests lower environmental efficiency, as more revenue is consumed by environmental costs.
Externality / Environmental Cost	An externality is a cost or benefit caused by a producer that is not financially incurred or received by that producer but rather an unrelated third party to some or full extent. Externality may also be referred to as environmental or societal cost or benefit. EcoMap applies the valuation methodology for externalities but will label the measurements as environmental cost, which may include already internalised elements like taxes or carbon emission quotas
Emissions Trading System (ETS)	A market-based policy instrument designed to reduce greenhouse gas (GHG) emissions by putting a price on carbon. Often referred to as a "cap-and-trade" system, it sets a mandatory limit (cap) on the total emissions allowed within specific sectors. To comply, entities must hold tradable permits, or "allowances," for every tonne of CO_2e emitted. This mechanism ensures that emissions are reduced where it is most cost-effective, turning carbon into a manageable financial liability or asset.
Environmental P&L	Environmental Profit & Loss (P&L) provides a monetary valuation and analysis of a company's environmental externalities stemming from direct business operations. The Environmental P&L is based on the EcoMap Framework
Operational Environmental Cost	Operational Environmental Cost is defined as the combined monetized emissions from Scope 1 and Scope 2, as both scopes fall directly under the company's operational control

Glossary

Internalising	The process of incorporating external environmental costs into a company's financial statements and decision-making. This occurs when costs previously borne by society (externalities) become direct financial obligations for the emitter, typically through carbon pricing mechanisms, regulatory requirements, or voluntary accounting practices.
CO_2e (Carbon Dioxide Equivalent)	A standardized metric that expresses the climate impact of different greenhouse gases in terms of the amount of CO_2 that would create the same warming effect. This allows emissions of methane, nitrous oxide, and other GHGs to be aggregated and compared on a common basis, measured in metric tons of CO_2e (tCO_2e). The conversion uses Global Warming Potential (GWP) factors over a specified timeframe, typically 100 years.
Carbon Tax	The actual price imposed by a government on each ton of CO_2e emitted, typically targeting Scope 1 emissions. This reflects the portion of environmental cost that has been internalised through policy.
Carbon Liability	The gap between a company's environmental cost and the carbon tax it currently pays. It reflects the unpaid portion of emissions-related harm, a financial risk that may be internalised in the future via taxation, regulation, or market shifts

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1. Introduction

The last year has seen reduced ambitions on climate action from major companies across the world, with increasing concerns that governments are also scrapping climate regulation in favour of a "pro-business" agenda. While this is true for some governments, others are expanding carbon pricing and taxation, knowing that when polluters internalise the societal cost of carbon (SCC) they reduce emissions and climate impacts for their citizens and the planet as a whole.

According to the World Bank's latest *State and Trends of Carbon Pricing 2025 report*, 80 carbon pricing systems are now in place globally, consisting of 37 carbon markets to trade emissions and 43 carbon taxes, that apply to 28% of global emissions and generated more than $100 billion in 2024. The study notes that "all large middle-income economies have either implemented or are considering direct carbon pricing". Here, 'direct' refers to policies explicitly pricing emissions rather than Scope 1 or 2 coverage. This trend is accelerating. A report from Harvard and MIT on carbon pricing coalitions notes that the expansion of China's national Emissions Trading Scheme (ETS) is one of several announced extensions of carbon pricing schemes in just the last 12 months.

Beyond setting up national schemes, countries are also working on implementing the EU Carbon Border Adjustment Mechanism (CBAM). This regulation imposes a carbon price on imports of carbon-intensive goods, to ensure that their own producers are not penalised unfairly nor encouraged to relocate their production abroad. The EU's introduction of the CBAM has had a domino effect on encouraging the ongoing growth in EU ETS: Turkey is instituting an ETS to harmonise fully with the EU's, while the UK has committed to its own CBAM by 2027 and may yet rejoin the EU's carbon market. Canada and Australia are exploring similar systems. A recent study also showed a tangible effect of this scheme on Brazilian corporate emissions. China, a large economy and emitter, is both far beyond the experimental stage of carbon trading schemes, and the world's largest renewable energy producer.

As a growing number of countries are strengthening their carbon pricing frameworks, research from EcoMap, a non-profit organisation initiated by industry professionals and leading academics, presents research through an open data platform showing the environmental cost (also explained as the financial climate risk) of companies globally. The research concludes that the financial impact on companies is becoming increasingly significant and tangible. Carbon tax trajectories in Norway, Canada, France, Sweden, the UK, and Switzerland are gradually moving closer to EcoMap's estimates of SCC, which is based on the Harvard spin-off International Foundation for Valuing Impacts' (IFVI) GHG Emissions Topic Methodology.[3]

[3] *IFVI is an independent non-profit that develops and publishes impact accounting methodologies as a public good, developed through a transparent and rigorous due process designed to ensure credibility and broad stakeholder input.*

The value of the Social Cost of Carbon reflects recent advances in scientific literature on climate change and its economic impacts on natural disasters, agricultural productivity, economic disruptions, and human health.

As the pricing of emissions rises, previously uninternalised climate liabilities are increasingly accepted as near-term financial costs – thus emphasizing an example of *financial transition risk*. Recent research indicates that carbon taxes and cap-and-trade systems such as EU ETS are reducing profit margins in carbon-intensive sectors by increasing costs and dampening sales growth (Duan et al., 2024). Also, lenders and investors are reacting to climate risk: high-emission companies now face higher borrowing costs and increased scrutiny in equity markets (Altavilla et al., 2024; Allianz, 2024). This marks a shift where climate goals are no longer just a distant political aspiration, but also entail significant financial risk, and opportunity, for companies and their investors.

Regulators and standard setters are also embedding physical climate risk into financial reporting. In November 2025, the International Accounting Standards Board (IASB) finalized guidance clarifying the requirement for companies in 169 jurisdictions to reflect climate impacts, such as floods, storms, and droughts, directly in profit and loss accounts. This marks a decisive move away from sustainability reports as a side document and toward climate risks being recorded alongside other impairments and provisions. As Natasha Landell-Mills of Sarasin & Partners notes, this kind of "financial rewiring" ultimately drives decision-making, signalling that climate-related losses will be treated as material financial events rather than peripheral disclosures.

A European Central Bank working paper finds that high-emission companies now pay, on average, 14 basis points more in borrowing costs than low-emission peers (Altavilla et al., 2024). Similar findings from the Dutch central bank show that firms with higher climate exposure face higher capital costs, signalling increased climate risk perception in financial markets (de Vries et al., 2024). This marks trends that asset creation, through financial flows, increasingly are shaped by climate and transition considerations.

Yet, significant perception gaps persist. Nearly half of investors surveyed by MSCI do not believe financial asset prices currently reflect climate risks (MSCI Institute, 2024). And EDHEC Climate Institute estimates that more than 40% of global equity value could be exposed to repricing if climate risks are not fully integrated. This disconnect suggests substantial room for market repricing as climate costs become more tangible.

The implication is clear: Throughout financial markets, emissions-intensive firms are already seeing their financial positions weaken, not just from future taxes, but from how markets view and price environmental risk today. Companies and investors failing to incorporate these dynamics into strategy and capital planning risk being caught off guard as climate costs shift from externalities to line items.

2. Methodology: From Emissions To Financial Cost

EcoMap uses company-level greenhouse gas emissions data to quantify environmental cost and risk. Emissions are classified in accordance with the GHG Protocol (WRI/WBCSD, 2015), which defines:

- Scope 1: Emissions directly from corporation's owned or controlled sources (stacks)
- Scope 2: Indirect emissions, through purchased electricity, steam, heating, and cooling
- Scope 3: All other indirect emissions in a company's value chain, including both upstream (e.g., purchased goods, transportation) and downstream (e.g., use of sold products, end-of-life treatment) emissions

Raw emissions data is sourced from MSCI ESG Research LLC, including both reported and estimated values. To monetize these emissions, EcoMap applies environmental cost factors from IFVI grounded in peer-reviewed academic research.

This approach uses the Social Cost of Carbon (SCC), which is calculated using Integrated Assessment Models (IAMs) that link projections of future GDP, population, and GHG emissions to changes in societal outcomes and impacts. Specifically, the methodology uses two advanced models, The Greenhouse Gas Impact Value Estimator (GIVE) and the Data-driven Spatial Climate Impact Model (DSCIM), to quantify damages. These models assess a wide range of climate impacts, including reduced human health, losses in labour availability, damage to the built environment, and reduced agricultural production.

The resulting environmental cost factor represents the monetary value of the net harm to society from emitting one additional metric ton of GHG in a given year. This ensures:

1. Scientific Credibility: dollar-value assigned to emissions is based on peer-reviewed academic research and reflects the latest scientific understanding of climate-related damages.

2. Standardization and Comparability: EcoMap enables consistent insights across companies, industries, and geographies.

3. Integration of Environmental Impact into Financial Analysis: environmental costs are embedded directly into Profit & Loss (P&L) statements through Environmental Cost, Adjusted financial metrics.

2.1 Focus on Scope 1 and Indirect Scope 2 Impacts

This analysis centres on the taxation of Scope 1 emissions to avoid the double-counting that would occur if Scope 2 emissions were also directly taxed (company Anna's Scope 2 emissions are also reported as Scope 1 emissions by Billy, who sells electricity to Anna). Nevertheless, the financial impact from a company's Scope 2 emissions is still a critical factor for the company. For example, if energy producers face higher taxes on their direct emissions (Scope 1), these costs are expected partly to be passed on to consumers through raised power prices.

Consequently, companies with high energy consumption (and therefore high Scope 2 emissions) will experience a rise in operating expenses through their energy bills, reflecting the indirect cost of carbon taxation. Over time, the intended effect is that the energy buyer becomes more energy efficient, and the energy producer becomes less fossil dependent.

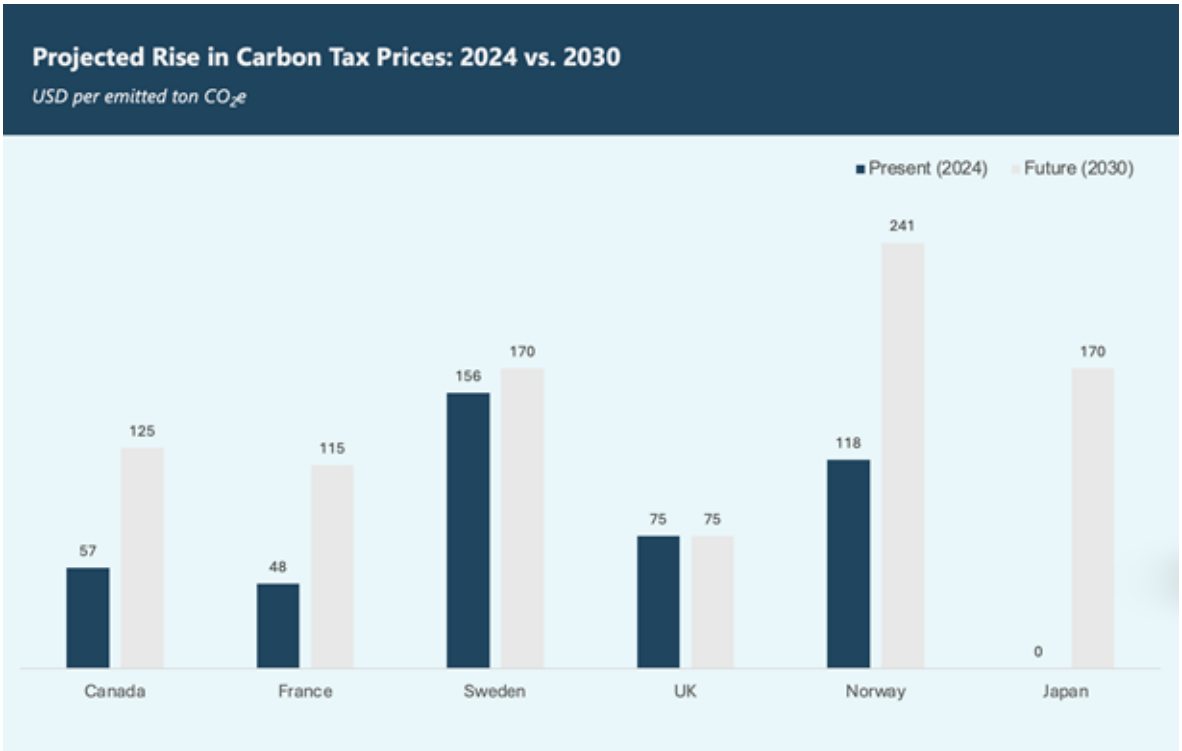
3. Carbon Tax Alignment and Regulatory Risk for Leading Nations

A growing number of jurisdictions are strengthening their carbon pricing frameworks, and the financial implications for companies are increasingly tangible. Tax trajectories in countries such as Norway, Canada, France, Sweden, the United Kingdom, Japan, and Switzerland are moving closer to modelled societal cost estimates of greenhouse gas (GHG) emissions for a significant part of their industries. As carbon prices rise, previously externalized climate liabilities are becoming quantifiable near-term financial costs, reflecting earnings exposure and policy-driven transition risk across sectors. Scenarios that model international cooperation on carbon pricing estimate that such policies could generate up to $200 billion annually, with the vast majority of this revenue coming from domestic carbon pricing, excluding border adjustments.

In leading examples, as shown in Table 1, governments are explicitly pricing emissions at levels designed to reflect climate damage. Norway, for instance, has legislated an increase in its national carbon tax from approximately $118 per ton CO_2e in 2024 to $241 per ton by 2030 (Norwegian Ministry of Finance, 2023a; 2023b). According to EcoMap modelling, this rate is expected to internalise 91% of the environmental cost (social cost of carbon, SCC) associated with Scope 1 emissions in 2030.

Other jurisdictions are on a similar path. Canada's federal backstop price on carbon pollution is scheduled to increase from $57 per ton in 2024 to $121 per ton in 2030 (Environment and Climate Change Canada, 2021). France is targeting an increase in its climate contribution from $48 to $115 per ton over the same period (Mengden, A., 2024). Sweden currently applies one of the highest carbon taxes globally, with rates at $156 per ton of CO_2e for fossil fuels (Government of Sweden, 2025). The United Kingdom's carbon pricing mechanism, combining the UK ETS price with a Carbon Price Support, results in an effective price estimated at approximately $75 per ton (Department for Energy Security and Net Zero, 2025; HM Revenue & Customs, 2025). Reinforcing this trend in the Asia-Pacific region, Japan is operationalizing a mandatory national Emissions Trading System (ETS) beginning in fiscal year 2026 as part of its Green Transformation (GX) policy. While the carbon price will be market-determined, the move by the major industrial economy signals a significant shift toward the internalisation of emissions costs. These increases reflect a clear policy signal: environmental costs may no longer remain off the balance sheet.

3.1 Overview of Carbon Tax in Selected Countries (Table 1)



Future (2030) prices reflect official government targets or projections. Sweden's price is indexed to inflation, and Japan's future price will be market-determined by its ETS launching in 2026. France's 2030 value reflects the statutory target set by the 2015 Energy Transition Law. In practice, the carbon tax rate has been frozen at €44.60 (approx. $48) since 2018, and further scheduled increases are currently paused.
Source: Environment and Climate Change Canada (2021), Mengden, A. (2024), Government of Sweden (2025), Department for Energy Security and Net Zero (2025); HM Revenue & Customs (2025).

In the European Union, carbon pricing is tightening through successive reforms of the Emissions Trading System (EU ETS), which now covers maritime transport and will expand to buildings and road transport under ETS 2 from 2027. The Carbon Border Adjustment Mechanism (CBAM) further extends carbon costs to imports of selected goods, underscoring the cross-border dimension of transition risk. Together, these measures signal a trajectory of declining emissions caps, rising allowance costs, and broader sectoral coverage. Anchored by the EU Climate Law's neutrality target for 2050, this framework reflects an increasingly stringent financial environment for companies operating in or trading with the EU. A detailed overview of the EU carbon pricing framework is provided in Appendix 1. While the EU illustrates a supranational approach to carbon pricing, the latter's interaction with financial reporting standards highlights how these costs are already shaping corporate accounts.

3.2 How Carbon Costs Affect Financial Statements under IFRS

As carbon pricing regimes spread across the EU, EEA, and UK, carbon costs are no longer theoretical; they're being gradually embedded into corporate financials. These costs are treated as operating expenses, directly affecting EBITDA and EBIT, and are subject to increasingly stringent disclosure standards.

For instance, under IFRS-aligned accounting, Scope 1 carbon taxes and emissions-trading obligations (e.g. EU ETS and UK ETS) are typically recorded as operating expenses, reducing both EBITDA and EBIT. When emissions allowances are acquired, firms may classify them as intangible assets under IAS 38 or as inventories under IAS 2, but they are expensed upon surrender, in line with impacts tied to verified emissions (ESMA, 2024b).

(Table 2)

Type of Carbon Cost	EBITDA Impact	EBIT Impact	Notes
Carbon tax (per ton CO_2)	Yes	Yes	Operating expenses (OPEX)
Allowances (used same year)	Yes	Yes	Other operating expenses (OPEX)
Allowances (held, then expensed)	No	No	Balance sheet (intangible asset)

Source: European Securities and Markets Authority (2024), Simplified for illustrative purposes

Recent updates from the European Financial Reporting Advisory Group (EFRAG) reaffirm that these costs must align with the period in which emissions occur and be recognized as recurring operational outflows (EFRAG, 2024). ESMA further emphasizes clarity in reporting, actual allowances held and surrendered should be transparently reflected in income statements, and as resources used, not deferred (ESMA, 2024) .

Globally, the ISSB's IFRS S2 Climate-related Disclosures, effective in 2024, require companies to quantify and disclose the financial impacts of climate-related risks, including carbon pricing mechanisms, in direct connection with profitability and cash flow (ISSB, 2023)

(Table 3)

Financial Metric	Treatment of Carbon Costs
EBITDA	Reduced by recurring operating costs tied to carbon taxes and allowance purchases
EBIT	Further lowered when intangible allowances are expensed during surrender
Operating Cash Flow	Directly reduced by cash outflows for carbon emissions compliance

Source: European Securities and Markets Authority (2024), Simplified for illustrative purposes

3.3 Case Study: Norway's Emerging internalisation of Scope 1 Liabilities through Carbon Taxation

As mentioned, Norway's carbon tax scheduled to $ 241 per ton CO_2e by 2030 is expected to capture nearly the full societal cost of Scope 1 emissions. The implications are direct: higher emissions will equate to higher costs, potentially on par with other major operating costs such as labour and other inputs. Norway's carbon pricing structure incorporates both ETS-covered sectors and non-ETS industries. For ETS participants, the tax serves as a top-up to reach the $241 per ton target, while non-ETS sectors pay the full amount directly. This unified framework offers clarity and consistency across economic activity, factors that reinforce its relevance as a policy benchmark.

Norway's carbon pricing trajectory is grounded in its own national cost-benefit and policy analysis (Norwegian Ministry of Finance, 2023a). While independently developed, the cost to society per ton CO_2e emitted closely aligns with EcoMap's modelled environmental cost estimates, underscoring the convergence between public policy and academic valuation frameworks.

3.4 Projected Carbon Price Path (Carbon Tax Rate) for Use in Economic Analyses (2024-2030), Norway (Table 4)

Year	(1) Quota-regulated emissions (excluding aviation and petroleum)	(2) Non-quota-regulated emissions	(3) Petroleum	(4) Aviation	(5) Emissions/removals from land use and forestry
2024	934 NOK / $88	1176 NOK / $118	1724 NOK / $172	1608 NOK / $161	934 NOK / $93
2025	951 NOK / $95	1382 NOK / $138	1902 NOK / $190	1784 NOK / $178	951 NOK / $95
2026	970 NOK / $97	1587 NOK / $159	2115 NOK / $212	2000 NOK / $200	970 NOK / $97
2027	990 NOK / $99	1793 NOK / $179	2370 NOK / $237	2265 NOK / $227	990 NOK / $99
2028	1015 NOK / $102	1998 NOK / $200	2410 NOK / $241	2410 NOK / $241	1015 NOK / $102
2029	1040 NOK / $104	2204 NOK / $220	2410 NOK / $241	2410 NOK / $241	1040 NOK / $104
2030	1066 NOK / $107	2410 NOK / $241	2410 NOK / $241	2410 NOK / $241	1066 NOK / $107

Quota-regulated emissions refer to those covered by the EU/EEA Emissions Trading System (ETS). For these sectors, Norway's carbon tax functions as a top-up to the ETS allowance price to reach the target level of $ 241/tCO_2e by 2030. Non-quota-regulated emissions fall outside the ETS and are instead subject to the full carbon tax directly.
Source: Karbonprisbaner for bruk i samfunnsøkonomiske analyser i 2024. Finansdepartementet.

3.5 Assessing the Financial Exposure: Norway's Carbon Tax vs. Environmental Cost for Key Industries (2024 and 2030)[4]

To assess the potential impact of carbon liabilities on the revenue of key Norwegian industries, EcoMap conducted an analysis to estimate the hypothetical cost if the companies' total emissions were taxed according to four distinct scenarios:

1. Norway's carbon tax for 2024
2. The estimated Social Cost of Carbon (SCC) for 2024, which represents the full environmental damage cost
3. Norway's government carbon tax scheduled for 2030
4. The estimated Social Cost of Carbon (SCC) for 2030

The results highlight significant financial exposure for emissions-intensive sectors under Norway's 2030 tax path. Notably, the analysis also shows that the 2030 emissions tax rate is converging towards the SCC.

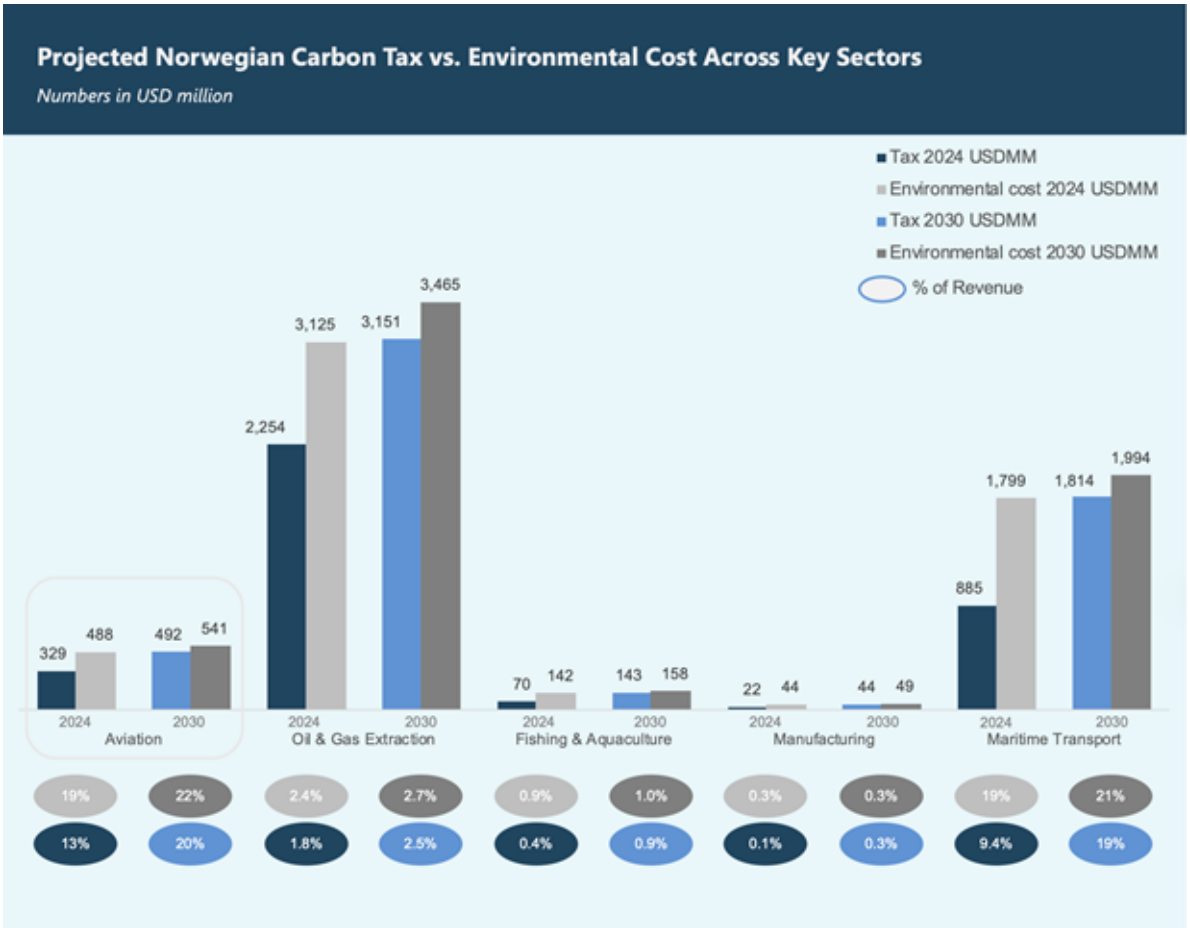
Aviation: Projected carbon tax obligations are equivalent to approximately **20% of aviation companies revenue** by 2030, up from around 13% in 2024. This highlights the severe exposure of the airline business model to carbon pricing.

Maritime Transport: The shipping sector is projected to see its carbon costs double on average, from r**oughly 9.4% to over 19% of revenue.** This sector-wide average likely masks significant variations between operators, with some facing much higher exposure depending on fleet age, fuel efficiency, and routes.

Oil and Gas: The oil and gas industry is expected to see environmental costs increase on average from **1.8% to 2.5% of revenue.** This stands in sharp contrast to low-margin sectors, as the industry's higher profitability allows it to absorb such costs with less immediate financial distress.

[4] Norway's territorial emissions cover coastal and domestic shipping, while EcoMap's is also shipping companies' international shipping. These may, of course, diverge in policy development, with the latter depending more on World Maritime organisation and EU (ETS) than on Norwegian policy towards coastal and domestic shipping.

(Table 5)



Notes: Illustrative analysis of the Norwegian Industry. *High level analysis based on Norwegian companies available, using 2023 as the latest reported for the majority of companies. Industry consolidation as follows: Aviation: Norwegian Air Shuttle ASA. Maritime transport: Odfjell SE, Belships AS, Wallenius Wilhelmsen ASA, Hoegh Autoliners ASA, MPC Container Ships ASA. Oil and Gas Extraction: Bluenord ASA, DNO ASA, AkerBP ASA, Equinor ASA. Fishing and aquaculture: Grieg Seafood ASA, Austevoll Seafood ASA, Leroy Seafood Group ASA, Mowi ASA, Salmar ASA Manufacturing: Kongsberg Gruppen ASA, Nordic Semiconductor ASA, Kitron ASA, Hexagon Composites ASA, Orkla ASA, Tine SA. Using 2023 emission data for illustrative purposes as 2024 is not available at the same scale. Values are total (sum of the) industry.*
Source: EcoMap 2025, MSCI ESG Research LLC, Government of Norway, Ministry of Finance (2023a)

3.6 Valuation at Risk: The Impact of Internalising Carbon Costs

To estimate the valuation at risk, we use the Enterprise Value / EBITDA (EV / EBITDA) valuation multiple methodology, which is a standard metric for the valuation of companies. The output of the analysis illustrates how a company's value to investors changes when EBITDA is impacted by the SCC's if total emissions were internalised and assuming no changes to valuation multiple.

The methodology derives an "Adjusted EBITDA" by subtracting the monetized societal cost of a company's direct emissions (Scope 1, reflecting its direct liability) from its reported EBITDA. This adjustment accounts for carbon taxes already paid by the company, by only subtracting the difference between the full social cost of carbon and the estimated carbon tax paid. Then, we derive a Climate Risk Adjusted Enterprise Value by applying the company's current EV/EBITDA multiple to the climate adjusted EBITDA. This approach isolates the impact of unpriced carbon on valuation and offers an estimation of the company's value when emissions costs are fully internalised. Importantly, this analysis does not incorporate any stock market reaction to anticipated declines in EBITDA; therefore, it reflects only the direct impact on EBITDA, not the full market repricing of environmental risk.

Note on Methodology for Estimating Historical Carbon Taxes: *It is important to note that officially reported EBITDA already includes existing carbon taxes and emissions trading costs, as these are recognized as operating expenses under IFRS. To avoid double counting, EcoMap estimates the portion of emissions already taxed by multiplying reported Scope 1 emissions by the applicable cost per ton from the Projected Carbon Price Path Table 4. This approach is simplistic: because disclosures do not specify which emissions are covered by which tax regime, the full Scope 1 emissions volume is assumed to face the sector-specific rate.*

This methodological choice highlights the gap between reported financial accounts and the societal cost of emissions. At the same time, it exposes a key structural issue: investors typically lack understanding of how much of a company's carbon costs are already captured (paid for) in EBITDA through taxation, and how much remains unpriced. Unlike income tax, carbon tax is not reported as a separate line item in most financial statements. This lack of transparency makes it difficult for markets to distinguish between emissions that are already priced in and those that remain unpriced liabilities.

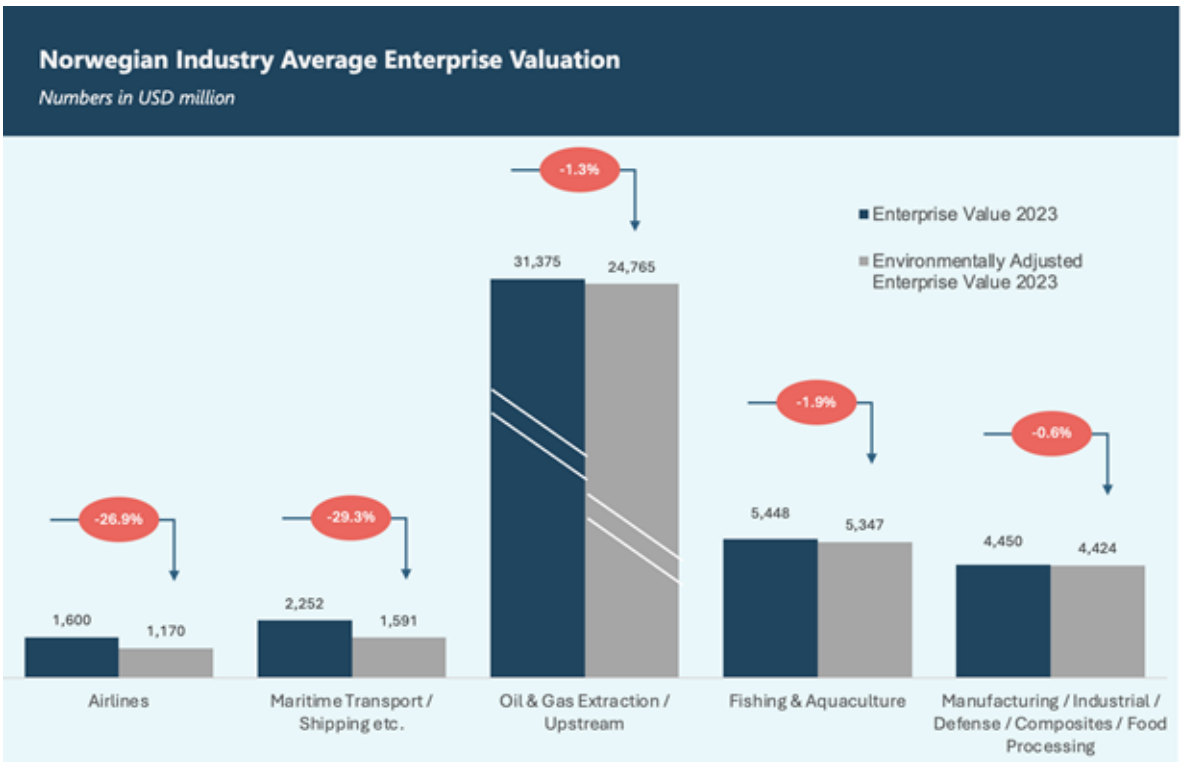
For investors, the absence of standardized disclosure of carbon tax payments is in itself a material risk. More granular reporting would allow stakeholders to identify firms most exposed to future increases in carbon taxation and to separate "priced" from "unpriced" environmental liabilities. Likewise, investors would benefit from knowing where emissions occur, since exposure to carbon costs depends heavily on jurisdiction: a ton of CO_2e emitted in Norway, with one of the world's highest carbon taxes, carries a very different financial implication than the same ton emitted in a country with weaker or no carbon pricing. Users of EcoMap in today's status will, nevertheless, readily see the impact of carbon intensity, and also use this in making adjustments as shown here in the Norwegian illustration

3.7 Uneven Impact on Company Valuations

The biggest financial risk occurs when a company's direct emissions are high relative to its profits. Because of this, the financial impact varies significantly across different industries, as shown below.[5]

Airlines and Maritime Transport may face the greatest impact. Their valuations could fall by 26.9% and 29.3%, respectively. Their business models are dominated by Scope 1 emissions from the fuel they burn, and they operate on thin profit margins, making them extremely sensitive to direct carbon costs. At the same time, however, Table 6 shows they have been charged a good portion of their CO_2 costs in the Norwegian regime today.

The Oil & Gas sector's valuation sees a much smaller drop of 1.3%. For a major producer like Equinor, for instance, its direct operational emissions (Scope 1) are a small fraction of its overall climate impact. As an example: In 2023, the social cost of Equinor's carbon Scope 1 emissions accounted for just 2.46% of its revenue, whereas its Scope 3 emissions (from customers using its products) were equivalent to 53.9% of revenue. Because this Scope 3 liability is not included in this valuation model, the financial impact shown here is moderate. Other industries like Fishing & Aquaculture and Manufacturing also face valuation risks, with potential drops of 1.9% and 0.6%. This shows that nearly all sectors have some level of exposure to their direct emissions.



(Table 6) Illustrative analysis of the Norwegian Industry. *Average EV/EBITDA ratio for industries; Airlines: 2.8x; Maritime Transport / shipping: 3.2x; Oil & Gas Extraction / Upstream: 2.9x; Fishing & Aquaculture: 7.2x; Manufacturing / Industrial / Defence / Composites / Food Processing: 15.4x.. Enterprise values are average values*
Source: EcoMap, MSCI ESG Research LLC, Finbox.com

[5] *Our treatment of presently paid CO2 externalities in Norway is aggregate and may miss certain aspects, such as quotas under ETS that are paid for/not paid for.*

3.8 Implications for Investors and Companies

The potential for such significant value erosion has direct implications for investment analysis and corporate financial strategy.

For investors, this analysis reveals a hidden liability that may not be reflected in current stock prices. Valuations could be significantly inflated by ignoring unpriced carbon costs. As regulatory frameworks like Norway's carbon tax continue to strengthen globally, this "Adjusted EV" becomes an increasingly realistic measure of a company's future worth. This underscores the need for investors to integrate carbon liability assessments into their due diligence and risk management processes to avoid stranded assets and identify companies that are effectively managing their transition risk.

For companies, the message is unmistakeable: reducing emissions is a fundamental aspect of preserving and growing enterprise value. This analysis thus provides, in itself, an incentive to accelerate decarbonization efforts. Proactively investing in operational efficiency, cleaner technologies, and transparently reporting on emissions liabilities are no longer just matters of corporate social responsibility, they are strategies for protecting a company's valuation and ensuring its long-term financial resilience.

4. Carbon Liability as a Core Transition Risk

EcoMap’s analysis quantifies corporate financial exposure arising from unpriced greenhouse gas emissions. While the most immediate risk lies in Scope 1 emissions, EcoMap and IFVI estimate that the total societal cost across all scopes is $14.5 trillion annually (NPV).

While this figure includes overlapping value-chain emissions, the direct and tax attributable Scope 1 share is estimated at $3.2 trillion, equivalent to 22.2% of EBITDA for profitable firms. For loss-making companies, incorporating the Scope 1 societal cost of carbon would deepen losses by an additional 14.2% in total.

These results demonstrate that a substantial portion of global corporate profitability remains structurally dependent on the continued externalization of carbon costs. As carbon pricing regimes tighten and climate-adjusted profitability becomes embedded in financial markets, this reliance translates into material transition risk for firms with high direct emissions exposure.

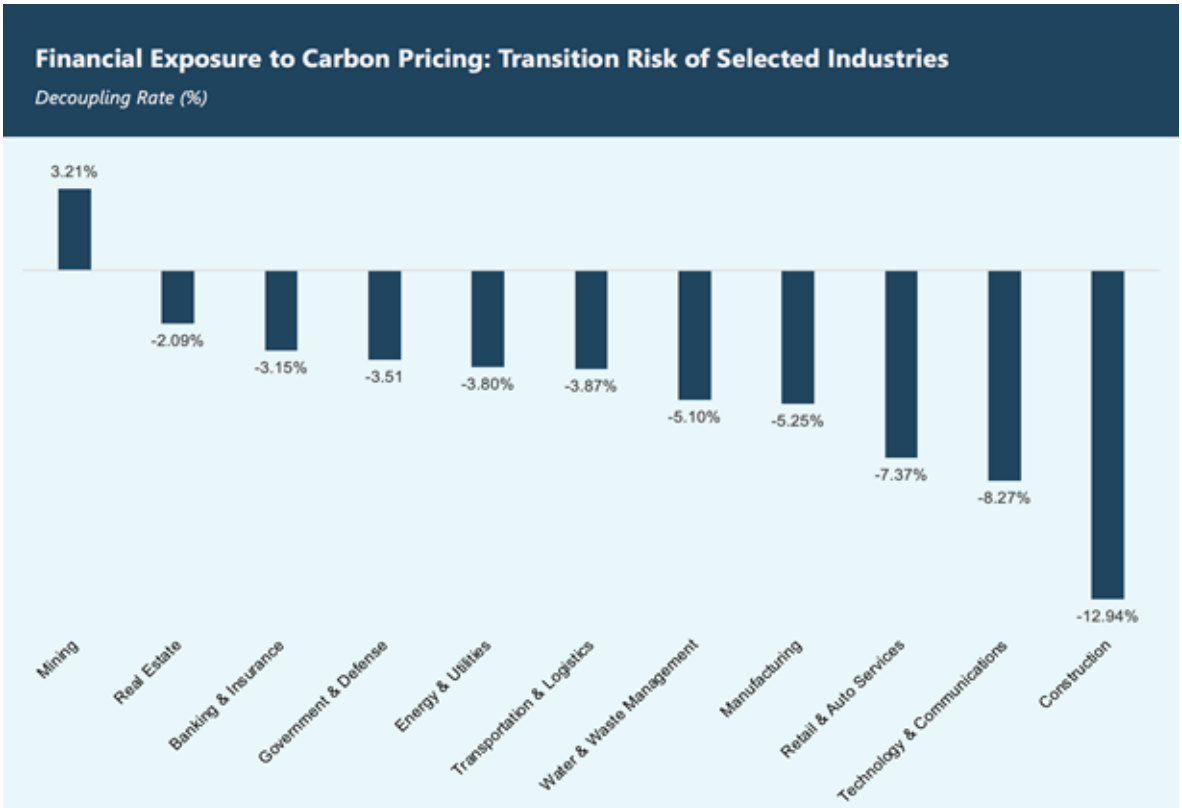
4.1 The Global Climate Transition Risk Rate

To assess progress in managing these liabilities, EcoMap applies the *decoupling rate* as a transition risk metric. This is defined as the annualized change in environmental cost relative to revenue growth. Positive values indicate improved carbon efficiency, where environmental costs decline relative to revenues, while negative values capture deteriorating efficiency and escalating exposure to transition risk.

Despite rising carbon taxes across jurisdictions and mounting evidence of higher credit risk and financing costs for carbon-intensive industries, EcoMap's analysis of nearly 20,000 companies reveals a concerning trend: a global transition risk rate of –5.3%. This indicates that, on aggregate, environmental costs are rising faster than revenues. In other words, financial performance is not decoupling from emissions reduction. Each additional unit of production and revenue now comes with a greater environmental cost, when the opposite is required for a sustainable transition. [6]

4.2 Uneven Transition Risk Across Key Economic Sectors

(Table 7)



Source: EcoMap, MSCI ESG Research LLC. Values (%) are average per industry. 2020-2023

[6] The metric is the annualized % change in Operational Environmental Cost Intensity, calculated using the Compound Annual Growth Rate (CAGR) formula and multiplied by -1. A positive rate indicates that operational environmental costs per revenue are decreasing (improving efficiency), while a negative rate means they are increasing (declining efficiency).

EcoMap's sector-level analysis shows that transition risk is not evenly distributed. While some industries demonstrate relative improvement, including education (10.6%, not shown in the graph) and mining (3.21%), many core sectors of the global economy exhibit increasing emissions intensity. The construction sector's negative decoupling rate of 12.94% makes it especially exposed to carbon pricing shocks. Manufacturing records a negative rate of 5.25%, while technology and communications (8.27%) and retail and auto services (7.37%) also show significant deterioration.

These results indicate that the global -5.3% transition risk rate is driven primarily by a concentration of negative decoupling in major emitting sectors. This uneven distribution suggests that transition risk is not only a systemic concern but also an acute vulnerability in industries critical to economic stability.

5. Strategic Implications for Business and Investment

The internalisation of carbon costs represents a fundamental and natural shift in corporate finance: what was once an externality is rapidly becoming a line-item expense with implications for earnings, valuations, and access to capital (Bloomberg, 2025).

Earnings Volatility and Cost Management

Volatile or rising carbon costs can raise risk premia in valuation and access to capital, and compress margins, if not anticipated in planning, investment and hedging. Supervisory and ratings analyses highlight how disorderly transitions and policy shocks can translate into profitability pressure (Financial Supervisory Authority of Norway, 2021; Fitch Ratings, 2023).

Credit Rating Risk and Cost of Capital

Lenders and credit analysts are increasingly incorporating climate liabilities into risk assessments, which can elevate borrowing costs for high-emission firms. Evidence from European banking data and related studies shows higher financing spreads for more carbon-intensive borrowers (Altavilla et al., 2024; de Vries et al., 2024), and research on bond markets documents a carbon premium in primary issuance (Kim & Pouget, 2023). These dynamics feed into ratings considerations (Fitch Ratings, 2023).

Capital Allocation and M&A

Investment decisions, including capex and transactions, are increasingly screened for transition risk and potential liability exposure to avoid asset stranding or overvaluation (Allianz, 2024).

Preparing for the Future

Firms that embed environmental cost considerations into governance, strategy, and operations, e.g., using shadow carbon pricing aligned with evolving reporting expectations, are better positioned to navigate the transition (Bloomberg, 2025; Allianz, 2024).

6. About EcoMap: Democratizing Climate Data and Analysis

EcoMap is a nonprofit research organisation and open data platform developed in collaboration with leading academic institutions and MSCI Institute. The platform provides quantified and monetized environmental costs through impact accounting and integrates these values into financial analysis. Free from commercial influence, EcoMap provides accessible, transparent, and academically rigorous analysis of financial climate risk, enabling stakeholders across industry, academia, government, and civil society to understand the total economic impact of corporate activities.

Collaborative Expertise and Credibility

This project is initiated by leading academics and industry professionals with a shared goal: to make environmental impact visible to decision-makers. EcoMap is supported by a distinguished advisory board that combines academic excellence with private-sector expertise.

The advisory board includes prominent professors and researchers from institutions such as the University of Oxford, University of Cambridge, Norwegian School of Economics (NHH), the Norwegian University of Life Sciences, and Utrecht University, ensuring the platform is academically rigorous and grounded in cutting-edge research.

Alongside this, representatives from global organisations and networks such as the Global Reporting Initiative (GRI), International Foundation for Valuing Impacts (IFVI) and board members of Science Based Targets initiative (SBTi), together with industry leaders ranging from asset managers to corporate executives, bring practical insights to ensure real-world relevance.

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Appendix

EU Carbon Pricing: Framework and Anticipated Reforms

The European Union Emissions Trading System (EU ETS) is one of the world's largest and most established carbon markets. Phase 4 of the EU ETS (2021—2030) regulates approximately 10,000 power generation and industrial installations as well as intra-EU aviation (European Parliament and Council, 2003; European Commission, 2023). Under Directive 2003/87/EC, participants surrender one allowance per tonne of verified Scope 1 CO_2e emissions. The annual emissions cap is scheduled to decline by 4.3% between 2024 and 2027, and by 4.4% thereafter, aiming for a 62% reduction in covered sector emissions by 2030 relative to 2005 levels (European Commission, 2023).

Since 1 January 2024, the EU ETS has included maritime transport, applying progressively increasing allowance surrender obligations from 40% in 2024 to full coverage in 2026 for ships above 5,000 gross tonnage operating in EU ports (European Parliament and Council, 2023a).

The EU's Fit for 55 package further extends carbon pricing through the Carbon Border Adjustment Mechanism (CBAM), operational from October 2023. CBAM imposes an equivalent carbon price on imports of selected goods, including iron, steel, cement, fertilizers, aluminium, and electricity, to mitigate carbon leakage risks (European Parliament and Council, 2023b). The proposed ETS 2 scheme, planned for implementation in 2027, aims to cover emissions from buildings, road transport, and smaller industrial installations (European Commission, 2021).

These policies reflect a regulatory trajectory of tightening emissions caps and expanding coverage, gradually aligning with EcoMap's modelled societal costs of Scope 1 emissions.
This evolving EU framework provides a regional context for carbon cost internalisation efforts like Norway's, and signals potential directions for other jurisdictions. Moreover, measures such as CBAM highlight the cross-border implications of carbon pricing, reinforcing the global nature of transition risk for companies and investors.
Beyond 2030, the European Climate Law (Regulation (EU) 2021/1119) sets legally binding targets for climate neutrality by 2050, including intermediate goals for 2040. The law mandates progressive emissions cap reductions and scope expansions to achieve these objectives, reinforcing long-term policy certainty and ambition (European Parliament and Council, 2021).

These developments demonstrate the EU's commitment to deepen carbon pricing coverage, tighten caps, and integrate trade measures to safeguard climate progress. For firms operating in or trading with the EU, these reforms signify an increasingly stringent financial environment around carbon emissions, with significant implications for risk management and strategic planning.

Table 8: Summary of Carbon Tax Globally

Jurisdiction	Current price (local / USD)	Future price (local / USD)	Official source
EU ETS	Market-determined via weekly auctions (Apr ’25 avg. €63 / $73)	Forecast €70–75 / $81–87 by 2030	*Directive 2003/87/EC & Auctioning Regulation (EU)*
Sweden (carbon tax)	SEK 1,510 / tCO_2 (≈ $159.7)	Indexed annually by CPI (next adjustment Nov ’25)	Swedish Government: *“Carbon tax rates”*
France (Contribution Climat-Énergie)	€44.60 / tCO_2 (≈ $48)	€100 / t (2030 SNBC ambition) ≈ $115.7	*Décret n° 2022-1402* (Ministère de la Transition écologique)
Germany (BEHG)	€55 / tCO_2 (2025 fixed) ≈ $63.6	€55–65 / t (2026 corridor) ≈ $63.6–75.2	*Brennstoffemissionshandelsgesetz (BEHG)*
UK ETS	Market-determined via daily auctions (Jan ’25 ~ £45 / $57)	Forecast ~£60–65 / $76–83 by 2030	*UK Emissions Trading Scheme Regulations 2021* (DESNZ)
RGGI (Northeast US)	US $ 13.50 / tCO_2	≥ US $18 / t by 2030	*RGGI Model Rule* (RGGI, Inc.)
Canada (fuel charge)	C$ 65 / t (2024) ≈ $47.9	C$170 / t by 2030 ≈ $125.2	*Greenhouse Gas Pollution Pricing Act* (Finance Canada)
Switzerland (CO_2 levy)	CHF 96 / t (2025) ≈ $117.9	CHF 210 / t by 01.01.2026 ≈ $257.9	*CO_2 Act & Ordinance* (Federal Office for the Environment, FOEN)
Norway (CO_2-avgift)	NOK 1 176 / t (2025) ≈ $118.6	NOK 2,410 / t by 2030 (2024-nivå) ≈ $243.6	Finansdepartementet (2023a) *“Karbonpriser…”* & (2023b) Prop. 3 LS: Skatter og avgifter

Table 9: Global Decoupling Rate (2020-2023) by NACE Section

Industry	2020-2023 Decoupling Rate
Education	11.68%
International organisations	4.84%
Entertainment & Recreation	3.03%
Mining	3.21%
Energy & Utilities	−3.80%
Hospitality & Food Services	−1.95%
Government & Defense	−3.51%
Banking & Insurance	−3.15%
Real Estate	−2.09%
Transportation & Logistics	−3.87%
Business Support Services	−4.44%
Manufacturing	−5.25%
Water & Waste Management	−5.10%
Retail & Auto Services	−7.37%
Healthcare & Social Services	−8.35%
Construction	−12.94%
Technology & Communications	−8.27%
Professional Services	−17.38%
Agriculture & Forestry	−23.97%
Other Services	−82.22%

Source: 2023 annual reports and EcoMap database

Table 10: Companies in the Norwegian Enterprise Valuation

Company	Industry	Calculated EV/EBITDA	Carbon Taxation Category
Norwegian Air Shuttle ASA	Airlines / Passenger Transport	2,8x	4
ODFJELL SE	Maritime Transport	3,6x	1
Belships AS	Maritime Transport	4,6x	1
Wallenius Wilhelmsen ASA	Maritime Transport	3,1x	1
HOEGH AUTOLINERS ASA	Maritime Transport	2,3x	1
MPC Container Ships ASA	Maritime Transport	2,3x	1
Bluenord ASA	Oil & Gas	2,1x	3
DNO ASA	Oil & Gas Extraction	4,9x	3
Aker BP ASA	Oil & Gas Extraction	1,8x	3
Equinor ASA	Oil & Gas Extraction	2,0x	3
Grieg Seafood ASA	Seafood	8,3x	2
Austevoll Seafood ASA	Seafood	5,8x	2
Leroy Seafood Group ASA	Seafood	9,8x	2
Mowi ASA	Seafood	6,5x	2
Salmar ASA	Seafood	5,3x	2
Kongsberg Gruppen ASA	Manufacturing / Defense / Industrial	1,9x	1
Nordic Semiconductor ASA	Semiconductors / High Tech Manufacturing	57,6x	1
Kitron ASA	Electronics / Contract Manufacturing	7,9x	1
Hexagon Composites ASA	Specialty Manufacturing / Composites	2,4x	1
Orkla ASA	Consumer / Packaged Goods etc.	7,5x	1

Source: 2023 annual reports and EcoMap database

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