

# THE NORDIC MODEL OF SUSTAINABLE VALUE CREATION: ESG, PUBLIC–PRIVATE COLLABORATION, AND MARKET PERFORMANCE ON THE PATH TO CARBON NEUTRALITY

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**Abstract.** Nordic economies rank among the global leaders in sustainability and climate policy, yet the extent to which corporate ESG (environmental, social, and governance) performance and carbon efficiency translate into market value remains insufficiently understood. This paper analyses how large, listed firms in Denmark, Finland, Norway, Sweden, and Iceland create sustainable value under mature disclosure frameworks and dense public–private collaboration. The study investigates the relationship between ESG scores, carbon efficiency indicators, and financial characteristics for 82 firms observed between 2021 and 2024. Cross-sectional and pooled Pearson correlations, complemented by two-sample t-tests, link revenues per tonne of CO<sub>2</sub>, EVIC (enterprise value including cash) per tonne of CO<sub>2</sub>, GHG emissions intensity, and the presence of carbon reduction targets to market capitalisation, assets, leverage, profitability, and capital expenditures. The results show that conventional ESG scores have no meaningful association with firm value or profitability, whereas carbon efficiency indicators exhibit strong and consistent financial linkages. EVIC per tonne of CO<sub>2</sub> is highly correlated with market capitalisation, assets, and especially total debt ( $r \approx 0.90$ ), indicating that the most carbon-efficient firms are also the largest and most capital-intensive. Revenues per tonne of CO<sub>2</sub> show moderate but significant correlations with these size variables ( $r \approx 0.54$ – $0.55$ ). Firms with carbon reduction targets display nearly four times higher market capitalisation and substantially greater EBITDA and CAPEX, confirming that climate commitments are concentrated among financially stronger companies. Cluster analysis reinforces these patterns: seven independent NbClust criteria identify two clusters, with nearly all firms grouped into a single dominant cluster – evidence of a highly homogeneous regional sustainability–financial structure. Only a small set of outliers diverge meaningfully from this Nordic profile. Sectoral asymmetries remain pronounced: financial, technology, and consumer-oriented firms translate sustainability performance into valuation gains far more effectively than industrial and resource-intensive sectors, where technological and operational constraints limit near-term improvements. Overall, the findings indicate that sustainable value creation in the Nordic region is driven primarily by carbon efficiency, firm scale, and institutional capacity, underscoring the importance of targeted industrial policies and innovation programmes in helping heavy industries close the carbon efficiency gap.

**Keywords:** carbon efficiency; sustainable value creation; ESG performance; public-private collaboration; market valuation; corporate decarbonisation; sustainability reporting; Nordic economies.

**JEL Classification:** Q56, Q58, G32, M14

## 1. Introduction

Achieving carbon neutrality has become a central objective of national and international climate strategies, requiring profound structural transformations in energy systems, industrial processes, and governance arrangements. In this context, the public sector plays a critical role in setting regulatory frameworks, long-term climate targets, and financial incentives, while the private sector contributes innovation capacity,

investment capital, and scalable technological solutions. Effective public–private collaboration therefore emerges as a key mechanism through which economies can expand low-carbon infrastructure, reduce emissions intensity, and accelerate progress towards net-zero objectives.

The Nordic countries – Denmark, Finland, Norway, Sweden, and Iceland – provide a distinctive empirical setting for analysing the relationship between

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sustainability performance and corporate market valuation. They consistently rank among the global leaders in environmental governance and corporate responsibility. According to the International Sustainable and ESG Standards Group (2024), Denmark, Finland, Norway, and Sweden occupy the top four global positions in ESG rankings, with Iceland close behind in 13th place. Their overall ESG scores, ranging from 88.1 to 98.8 (grade A), substantially exceed global averages, reflecting mature institutional frameworks, strong stakeholder engagement, and long-standing corporate sustainability practices.

This leadership is further confirmed by performance on the Sustainable Development Goal Index, where Finland ranks first globally, followed by Sweden (second), Denmark (third), Norway (seventh), and Iceland (fifteenth), with SDG scores between 80.79 and 87.02 (SDG Index Report, 2025). These outcomes indicate high achievement across climate action, clean energy deployment, social inclusion, and governance quality. Environmental indicators reinforce this pattern: the Nordic economies exhibit exceptionally low carbon intensity of GDP – Sweden (0.06 kg CO<sub>2</sub>/USD) and Denmark (0.07) compared with a global average of 0.40 – and maintain very high shares of renewable energy in final consumption, led by Iceland (82.4%) and Norway (61.4%), far exceeding the global average of 19.74% (World Bank, World Development Indicators, 2024).

Collectively, these attributes illustrate a balanced and coherent sustainability model in which clear climate policies, strong public–private co-operation, and advanced ESG practices jointly support economic competitiveness and rapid decarbonisation. The aim of this article is to assess whether corporate ESG performance in the Nordic countries translates into measurable market valuation outcomes. To achieve this aim, the article examines ESG performance and carbon efficiency indicators, analyses their relationship with market valuation metrics, and considers the role of public–private collaboration and institutional context in facilitating these effects.

**Hypothesis:** Nordic companies that demonstrate stronger ESG performance – captured through higher carbon efficiency, lower emissions intensity, and the adoption of carbon reduction targets – are more likely to exhibit favourable valuation dynamics. This relationship is moderated by sectoral characteristics, as financial, technology, and consumer-oriented firms are structurally better positioned to translate sustainability improvements into economic value than industrial and resource-intensive companies. Moreover, firms with greater scale and resource availability tend to adopt more ambitious climate commitments, while mature public–private collaboration frameworks and advanced reporting systems further strengthen the capacity of ESG-leading companies to convert

sustainability performance into measurable financial outcomes.

## 2. Literature Review

A growing body of research highlights that strong ESG performance is increasingly linked to positive corporate valuation outcomes. Firms with higher ESG scores not only demonstrate better environmental and social responsibility but also tend to experience enhanced financial performance, reflecting investors' recognition of sustainability as a strategic value driver (Clark, Feiner, & Viehs, 2015; Krüger, Sautner, & Starks, 2020). Carbon efficiency – often measured as revenue or enterprise value per tonne of CO<sub>2</sub> – has emerged as a critical metric in assessing how firms translate sustainability initiatives into tangible market value (Agliardi & Agliardi, 2021).

Sectoral characteristics play a decisive role in shaping the ESG–valuation relationship. Although ESG performance can enhance financial outcomes, its impact varies across industries: firms in finance, technology, and consumer sectors tend to benefit more than industrial and resource-intensive companies. These patterns align with evidence that ESG practices reduce capital constraints (Cheng, Ioannou, & Serafeim, 2014) and that financial gains are strongest when firms improve sustainability issues that are material to their sector (Khan, Serafeim, & Yoon, 2016). In the Nordic context, financial institutions and technology firms have leveraged ESG performance to attract sustainable capital, benefiting from coherent regulatory frameworks and strong stakeholder engagement (OECD, 2022).

The mechanism linking ESG and firm valuation is often explained through stakeholder, legitimacy, and signalling theories. Firms adopt ESG practices to maintain legitimacy with investors, regulators, and customers, while ESG disclosures signal long-term strategic resilience, improving market perceptions and lowering the cost of capital (Hahn & Kühnen, 2013; Grewal et al., 2018). Access to green finance – via loans, bonds, and investment funds – further amplifies these benefits, enabling firms to invest in low-carbon technologies and operational efficiency improvements that enhance both sustainability and financial performance (Wang, Li, & Sun, 2023; Liu & Zhang, 2022).

Public–private collaboration plays a central role in translating ESG performance into measurable financial outcomes. Evidence from Nordic countries indicates that coordinated government policies, transparent ESG reporting standards, and supportive institutional frameworks enhance the effectiveness of corporate sustainability initiatives (OECD, 2022; UNEP FI, 2020). Effective public–private partnerships and blended finance mechanisms are crucial for directing

sustainable capital towards green projects and lowering financing barriers, enabling firms to convert ESG improvements into financial gains (Tsapko-Piddubna, 2022). These mechanisms are reinforced in the Nordic region by shared institutional values – high trust, coordinated governance, and a common sustainability-oriented business model – which strengthen firms' capacity to operationalise ESG commitments (Hurnyak et al., 2025). Illustrative examples include Sweden's Climate Act and Denmark's mission-oriented industrial strategies, which demonstrate how policy-driven incentives, combined with corporate innovation, can enhance carbon efficiency and firm valuation (Mazzucato, 2021).

Empirical evidence from international studies supports the synergistic effect of ESG and public policy. Firms in high-ESG-performing sectors within countries with strong climate governance experience both improved environmental performance and higher market valuation, whereas firms in less supportive institutional contexts often struggle to convert sustainability efforts into financial gains (Clark et al., 2015; Krüger et al., 2020; Agliardi & Agliardi, 2021). Nordic companies, with generally transparent governance structures and advanced ESG reporting, exemplify this dynamic, particularly in technology, finance, and consumer-oriented sectors.

Collectively, the literature suggests that ESG performance and carbon efficiency function not only as sustainability instruments but also as strategic drivers of firm value creation. Sectoral characteristics, institutional support, and robust ESG reporting practices act as moderating factors that influence the extent to which sustainability performance translates into market valuation growth. In the Nordic context, the interaction between advanced ESG practices, high carbon efficiency, and supportive public-private ecosystems strengthens the proposition that sustainability-oriented strategies are associated with positive financial outcomes.

### 3. Aims and Objectives

The aim of the study is to examine how ESG performance – particularly carbon efficiency, emissions intensity, and the adoption of climate targets – affects market valuation among Nordic companies. It further evaluates how sectoral characteristics shape firms' ability to convert sustainability performance into financial outcomes and assesses the role of public-private collaboration and advanced reporting frameworks in strengthening this relationship. The findings are intended to inform strategies and policies that better align environmental commitments with long-term value creation.

### 4. Data and Methodology

*Data Sources and Sample:* The empirical analysis draws on a panel dataset of 82 publicly listed firms from Denmark, Finland, Norway, Sweden, and Iceland observed between 2021 and 2024. The sample includes the largest companies by market capitalisation for which harmonised financial, environmental, and ESG indicators were available across the period. Data were compiled from Nordic ESG databases, Sustainalytics, Yahoo Finance, corporate sustainability reports, and annual financial statements.

The environmental dimension focuses on reported Scope 1–2 greenhouse gas emissions and derived carbon efficiency indicators, while financial data capture firm scale, profitability, capital structure, and investment activity. The ESG dimension includes the Sustainalytics ESG risk score, available for 2024, and a categorical variable indicating whether a firm has disclosed carbon reduction targets.

The observation period coincides with a major shift in European sustainability reporting. All Nordic EU member states transitioned from the Non-Financial Reporting Directive (NFRD) to the Corporate Sustainability Reporting Directive (CSRD) in 2024, while Iceland implemented parallel requirements through its European Economic Area obligations. Because Nordic firms already operated within a mature ESG disclosure environment – supported by long-standing national legislation such as Denmark's 2008 CSR reporting mandate, Sweden's rules for state-owned enterprises, Finland's state ownership guidelines, and Norway's 2022 Transparency Act – the 2021–2024 window provides a suitable context for assessing the sustainability-valuation nexus under relatively stable and consistent reporting regimes.

*Variables:* To evaluate how effectively firms translate emissions into economic value, three carbon efficiency indicators were constructed. Revenues per tonne of CO<sub>2</sub> and EVIC per tonne of CO<sub>2</sub> – each expressed in EUR per tonne of emissions – measure operational and market-based carbon productivity, respectively. GHG intensity, defined as emissions relative to operating scale, captures the underlying emissions burden. A binary carbon reduction target variable additionally identifies firms that have publicly disclosed decarbonisation commitments. Financial variables include market capitalisation, total assets, total debt, and leverage ratios, EBIT, EBITDA, net income, and capital expenditures (CAPEX). These measures capture firm scale, profitability, and investment capacity. The ESG dimension is represented by the 2024 Sustainalytics ESG risk rating, where lower scores indicate stronger ESG performance.

*Empirical Strategy:* The empirical strategy combines multiple complementary approaches to assess the

relationship between sustainability performance and financial outcomes. First, a cross-sectional analysis for 2024 uses Pearson correlations to examine associations between ESG scores, carbon efficiency indicators (Revenue/CO<sub>2</sub> and EVIC/CO<sub>2</sub>), profitability metrics, and firm size variables, assessing whether ESG performance and carbon productivity help explain differences in valuation and earnings in the most recent reporting year. Second, two-sample t-tests compare market capitalisation, EBITDA, and CAPEX between firms that disclose carbon reduction targets and those that do not, evaluating whether climate commitments correspond to distinctive financial characteristics such as larger scale, higher profitability, or greater investment intensity. Third, to capture structural and time-persistent relationships, Pearson correlations for the pooled panel (2021–2024) are computed between carbon efficiency indicators, GHG intensity, ESG commitment, and core financial variables, with interpretation restricted to statistically significant results ( $p < 0.05$ ), thereby reducing noise inherent in single-year observations.

Additionally, k-means clustering supported by NbClust criteria is applied to identify structural patterns across firms based on market capitalisation, ESG performance, and carbon efficiency indicators. This enables assessment of whether Nordic companies form clearly differentiated sustainability–financial patterns or operate within a relatively homogeneous regional framework.

All computations and reading of financial statement data were conducted in Python (pandas, numpy, seaborn, matplotlib, and other packages), R (stats, dplyr, ggplot2, ggrepel, NbClust), and cross-validated in Excel.

## 5. Results

*Cross-sectional relationships in 2024: ESG scores and market valuation:* The ESG score exhibits only very weak and statistically insignificant correlations with market capitalisation and profitability measures (EBIT, EBITDA, net income) (Appendix A – Table A1). This indicates that, within the Nordic sample, an aggregate ESG score alone does not meaningfully explain cross-sectional differences in firm value or earnings in 2024.

In contrast, the carbon efficiency indicators – reflecting only the environmental pillar of ESG – display much stronger linkages to firms' capital structure than to short-term profitability or equity valuation. In the 2024 cross-section, both revenues per tonne of CO<sub>2</sub> and the EVIC-to-emissions ratio exhibit strong positive correlations with total debt, indicating that companies generating higher value per unit of emissions tend to be more highly leveraged. By comparison, their correlations with market capitalisation are weak, suggesting that equity markets do not fully reflect cross-sectional differences in carbon efficiency within a single year. The relationships with current profit measures remain modest, indicating that carbon efficiency indicators are more strongly associated with long-term, structural financial characteristics – such as assets, debt, and capitalisation – than with short-term earnings like EBIT or EBITDA. This means that carbon efficiency reflects deeper balance-sheet fundamentals rather than immediate operational performance.

*Carbon reduction targets and firm characteristics:* To assess whether explicit decarbonisation commitments are associated with distinct financial profiles, Table 1 reports mean comparisons and t-tests for firms with and without carbon reduction targets in 2024. The results indicate statistically significant differences across all examined metrics. Firms that have adopted carbon reduction targets exhibit substantially higher market capitalisation – on average almost four times larger than firms without targets – with a t-statistic corresponding to a p-value below 1%. Companies with targets also display significantly higher EBITDA, indicating stronger earnings capacity. In addition, these firms report notably larger capital expenditures (CAPEX), consistent with more intensive investment activity, including investments supporting energy transition and decarbonisation.

Overall, these findings suggest that in the Nordic context, explicit carbon reduction commitments are predominantly adopted by larger, more profitable, and more investment-intensive firms – those with the financial capacity necessary to implement climate-related strategies. This pattern aligns with the hypothesis that the ability to commit to decarbonisation is itself shaped by firm size and resource availability.

*Pooled Correlations: Relationships Between Carbon Efficiency, ESG Commitment, and Firm Size (2021–2024):*

Table 1

**Comparison of market capitalisation, EBITDA, and CAPEX by the presence of carbon reduction targets: t-test results (2024)**

Variable	Mean Target = 1	Mean Target=0	t-stat	p-value
Market Capital	22.701	5.69	2.852	0.00588
EBITDA	1.32E+10	2.35E+09	3.212	0.00219
CAPEX	-3.6E+09	-5E+08	-3.1	0.0027

Source: author's calculations in Python

The pooled correlation analysis (Table 2), which examines statistically significant associations ( $p < 0.05$ ) between carbon efficiency indicators, ESG commitments, and core financial variables, reveals a clear and economically meaningful pattern: firms with higher carbon efficiency and stronger ESG engagement tend to be larger, more capital-intensive, and better positioned to convert sustainability performance into market value.

– Carbon efficiency and firm size

EVIC-to-emissions shows the strongest correlations with firm scale, displaying very high associations with total capitalisation ( $r \approx 0.88$ ), total assets, and especially total debt ( $r \approx 0.90$ ). This indicates that the most carbon-efficient firms are also the largest and most leveraged. These patterns suggest that carbon efficiency is closely tied to scale advantages: large firms have diversified operations, stronger resource bases, and better access to capital, enabling greater investment in decarbonisation and efficiency. As a result, carbon-efficient companies tend to be not only greener but also financially stronger and more organisationally advanced.

– Revenue-based carbon productivity and financial structure

A similar pattern appears for revenues per tonne of CO<sub>2</sub>, which are moderately and significantly correlated with total capitalisation ( $r \approx 0.54$ ), total assets ( $r \approx 0.54$ ), and total debt ( $r \approx 0.55$ ), all at  $p < 0.001$ . These results reinforce that firms generating more revenue per unit of emissions tend to be structurally larger and more capital-intensive. Two mechanisms may explain this relationship. First, low-emission business models (finance, telecom, technology) naturally

generate high revenue per tonne of CO<sub>2</sub>. Second, larger firms with advanced digitalisation and process optimisation are better able to decouple growth from emissions. In both cases, carbon efficiency functions as a proxy for organisational competence and competitive strength.

– ESG commitment and profitability

Firms with formally declared carbon reduction targets exhibit slightly higher EBITDA ( $p < 0.05$ ), confirming that companies adopting climate targets tend to be more profitable and better resourced. The small but significant positive correlation between target-setting and market capitalisation further supports this interpretation. ESG commitments therefore appear to be more common among large, mature firms with sufficient financial and managerial capacity to engage in long-term climate planning.

– Emissions intensity and firm size

GHG intensity shows a weak but statistically significant negative correlation with total capitalisation ( $p < 0.05$ ), indicating that more emission-intensive firms tend to be smaller. Although modest, this finding is consistent with the broader pattern: firms with lower emissions intensity are generally larger and more diversified, whereas highly emission-intensive companies often operate in structurally constrained industrial sectors.

Cluster Analysis Results

The k-means clustering results show a high degree of structural similarity among Nordic firms across market capitalisation, ESG scores, carbon efficiency indicators, and global sustainability rankings (Figure 1). Across seven NbClust criteria, two clusters are consistently identified, with one containing almost

Table 2  
**Significant correlations between carbon-efficiency indicators and financial characteristics of Nordic companies, pooled data 2021–2024<sup>1</sup>**

Carbon/ESG variable	Financial variable	r (Pearson)	p-value	N
EVIC per tonne of CO <sub>2</sub>	Total Debt	0.898	< 0.01	79
	Total Capitalisation	0.886	< 0.01	79
	Total Assets	0.88	< 0.01	79
	Leverage	0.316	0.0045	79
Revenues per tonne of CO <sub>2</sub>	Total Debt	0.55	< 0.01	84
	Total Capitalisation	0.545	< 0.01	84
	Total Assets	0.536	< 0.01	84
Presence of carbon target	EBITDA	0.232	0.0002	252
GHG intensity	ROIC	-0.264	< 0.001	213
	EBITDA	-0.273	< 0.001	151
	EBIT	-0.285	< 0.001	161

Source: author's calculations in Python.

Notes: Profitability measures may be influenced by accounting practices, which can weaken observed correlations. But external financing shows a strong link: more socially responsible companies tend to receive more funding.

<sup>1</sup> The table reports only statistically significant Pearson correlation coefficients ( $p < 0.05$ ) with absolute values  $|r| \geq 0.20$ . Variables include revenues per tonne of CO<sub>2</sub>, EVIC-to-emissions, GHG intensity, a dummy for the presence of carbon reduction targets, and core financial metrics such as total capitalisation, total assets, total debt, and profitability indicators.

all firms. This dominant cluster, tightly grouped along the first two principal components, reflects the broadly aligned sustainability practices and financial characteristics of the Nordic corporate environment. The much smaller second cluster captures only a few firms that deviate meaningfully from this common profile. Overall, the clustering confirms that Nordic firms operate within a largely homogeneous sustainability framework, reinforcing that the pooled correlations reflect broad regional patterns rather than isolated firm-level effects.

The evidence shows that carbon efficiency is the strongest and most consistent predictor of financial scale in Nordic firms. Carbon-efficient companies are typically larger, more capital-intensive, and better positioned to leverage sustainability for valuation gains. While firms with carbon reduction targets tend to be more profitable and better resourced, carbon efficiency itself remains the more robust indicator of financial performance. These patterns confirm the hypothesis that sustainability advantages in the Nordic region are realised most effectively by firms with the scale, capital, and technological capability to implement decarbonisation strategies.

**Country Case Studies:**

**Denmark**

Denmark offers a representative case within the broader Nordic tradition of strong ESG performance. The country demonstrates how a mature regulatory framework and long-standing corporate sustainability culture generate measurable outcomes across firms of all sizes (Table 3). While Denmark’s largest

companies – such as Novo Nordisk and Vestas Wind Systems – combine strong ESG scores with superior carbon efficiency and financial scale, ESG rankings also reveal that several smaller firms, including Zealand Pharma and ALK-Abelló, achieve comparatively high global positions. This pattern reflects Denmark’s wide diffusion of sustainability norms.

Nearly all Danish firms have established carbon reduction targets; however, the translation of these commitments into measurable outcomes varies across sectors. Financial institutions, such as SPAR Nord Bank, and high-value industrial or consumer goods companies, including Pandora, show notable improvements in GHG intensity, carbon efficiency, and market valuation per unit of emissions. In contrast, industrial and production-intensive firms, such as Carlsberg, face operational and energy-intensity challenges that can result in increased emissions despite formal targets. Tryg, Denmark’s largest insurance company, contributes differently: its sustainability strategy includes reducing operational emissions, sourcing 100% renewable electricity by 2030, and promoting climate-resilient practices among customers and suppliers, thereby aligning with Denmark’s broader climate policies. The observed variation in revenues per tonne of CO<sub>2</sub> and EVIC-to-emissions growth highlights the heterogeneous nature of corporate performance. Collectively, these findings demonstrate that ESG excellence – through targeted carbon reduction, operational efficiency, and market recognition – can act as a catalyst for advancing climate goals, while sector-specific

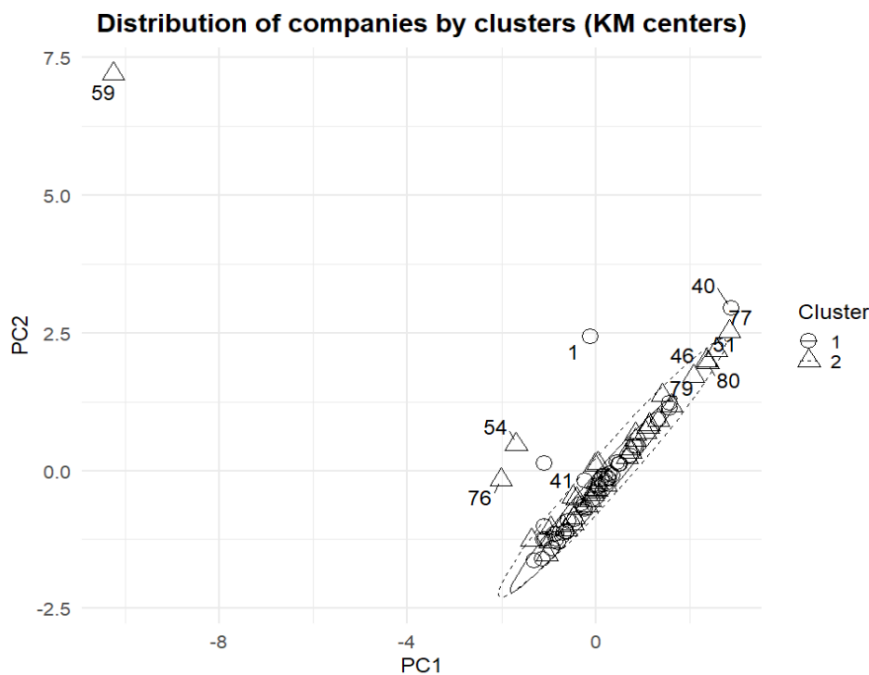


Figure 1. Distribution of Nordic Companies by Clusters (K-means, 2-cluster solution)

Source: author’s data processing in R

Table 3

**Corporate Sustainability, Market Valuation, and Carbon Efficiency of Danish Companies**

Company	Market Capital (billion USD)	ESG 2024	Global Universe (out of 14377)	Revenues per tonne CO <sub>2</sub> (2023–2024 growth)	EVIC / Emissions (2023–2024 growth)
NOVO NORDISK	364	23,2	5653	393768.077 (-55.3)	4117614.119 (-14.9)
DSV	49.36	12,4	651	60959.439 (-33.9)	174801.799 (-12.1)
NOVONESIS	26.26	17,6	2603	8841.969 (-48.6)	153878.374 (38.5)
COLOPLAST	25.06	14,1	1165	207871.524 (233.5)	1575485.496 (206.1)
DANSKE BANK	22.83	19,1	3411	6265808.736 (-8.8)	218392030.404 (-14.2)
ORSTED	19.51	19,7	3712	14542.339 (87.5)	62363.092 (104.3)
PANDORA	14.08	15,9	1842	3422186.491 (521.4)	13960137.098 (656.3)
VESTAS WIND SYSTEMS	13.3	22,1	5044	166296.478 (16.7)	329980.757 (-26.3)
CARLSBERG	13.27	17,8	2684	27681.115 (-14.4)	64868.253 (-28.7)
GENMAB	12.97	21	4480	2051535.451 (-53.9)	8525548.509 (-75.5)
TRYG	12.84	22,1	5052	3908123.781 (-3.0)	14628360.103 (-5.3)
DEMANT	8.01	24,1	6160	102673.361 (12.3)	360368.369 (2.1)
ROCKWOOL	7.5	21,2	4542	2285.784 (-9.7)	4689.043 (5.3)
ZEALAND PHARMA	7.18	28,2	8600	250538.086 (-24.4)	42576070 (126.6)
H. LUNDBECK	5.38	20,4	4153	110568.673 (12.7)	347930.111 (50.4)
ALK-ABELLÓ	4.98	27,9	8481	132199.572 (16.2)	897901.817 (54.9)
JYSKE BANK	4.2	20,8	4351	3888028.504 (-0.5)	94609168.23 (-8.1)
RINGKJØBING LANDBOBANK	4.2	19,7	3768	3282835.825 (4.9)	65545819.466 (3.2)
AMBU	3.95	17,8	2714	37966.733 (19.1)	198186.341 (18.0)
SPAR NORD BANK	3.28	20,8	4330	2389772.529 (127.1)	34444168.777 (18.0)

Source: Sustainalytics, 2024; CEOWORLD Magazine, 2024; Nordic ESG Data Platform, 2024

strategies remain essential to achieve meaningful results.

Pandora A/S and Ørsted exemplify complementary approaches to advancing ESG and climate performance within Denmark's corporate sector. Pandora has established itself as a benchmark by reducing GHG intensity while improving revenue per tonne of CO<sub>2</sub> and EVIC-to-emissions ratios, demonstrating that environmental efficiency can align with financial performance. Its initiatives – such as transitioning to 100% recycled silver and gold by 2025, engaging

suppliers in renewable energy sourcing, and integrating circular economy principles – resonate with Denmark's broader climate objectives, illustrating how private sector leadership can complement national policies and create both operational and market value (Buck, 2025; Nordea, 2024; Pandora A/S, 2025).

Ørsted's Green Fuels for Denmark initiative – supported by the Danish Business Authority under the EU's Important Projects of Common European Interest – illustrates the effectiveness of structured state–corporate collaboration. The project brings together major Danish

and international partners to produce renewable hydrogen and green fuels for hard-to-decarbonise sectors such as shipping and aviation. Combined with state-funded carbon capture investments at the Avedøre and Asnæs plants, these initiatives demonstrate how public policy and corporate capital can mutually reinforce high-risk, capital-intensive innovation (Ørsted, 2023). Ørsted's performance further reflects this synergy: revenues per tonne of CO<sub>2</sub> increased nearly fivefold and EVIC-to-emissions ratios more than sixfold between 2018 and 2024. Together, Pandora and Ørsted show that strategic alignment between private initiative and public support can accelerate decarbonisation, strengthen market valuation, and position Danish firms as leaders in ESG and climate transition.

#### **Finland**

Finland reflects the broader Nordic pattern of strong ESG performance, shaped by its industrial structure and innovation-oriented economy. Smaller and mid-sized firms often exhibit strong ESG integration and comparatively low risk scores, indicating that sustainability leadership is influenced more by sectoral characteristics and technological specialisation than by firm size alone. ESG data (Table 4) show that high performance is concentrated in sectors with low operational emissions and advanced technological capabilities. Firms such as Nokia, Amer Sports, and Konecranes illustrate this trend, demonstrating that in Finland, sectoral positioning plays a decisive role in shaping sustainability outcomes.

Sectoral variation remains pronounced. Telecommunications and pharmaceuticals, represented by Elisa and Orion, demonstrate high carbon efficiency and steady improvements in emissions productivity, reflecting structurally low-emission business models. By contrast, energy and industrial firms such as Neste, Valmet, and Kemira display higher ESG risk and, in several cases, declining efficiency – highlighting persistent challenges in decarbonising carbon-intensive operations.

GHG intensity trends from 2018–2024 reinforce these patterns. Most Finnish firms achieved gradual reductions in emissions intensity, with UPM-Kymmene, Stora Enso, and Kone showing consistent downward trajectories. However, volatility persists among energy and heavy industrial firms – most notably Fortum, Neste, and Valmet – whose performance reflects exposure to energy price cycles and production dynamics. Service-oriented companies, including Nordea and Elisa, maintain low and stable emission levels, underscoring sectoral asymmetries in carbon exposure.

Growth indicators further reveal these divides. Firms such as Elisa and Amer Sports recorded strong gains in revenue and EVIC-to-emissions efficiency, linking innovation to financial performance. Conversely, carbon-intensive incumbents continue to face

difficulties translating sustainability commitments into outcomes aligned with EU climate objectives and the CSRD framework.

Overall, the divergence between ESG scores, market valuation, and carbon efficiency illustrates the heterogeneous nature of Finnish corporate sustainability. Finance and telecom sectors function as low-carbon leaders, while industrial and energy firms confront structural constraints in balancing competitiveness with decarbonisation. Finland's experience, much like Denmark's, exemplifies how ESG excellence can drive climate ambition, though differentiated, sector-specific transitions remain essential to achieving net-zero alignment.

In Finland, Nokia exemplifies a benchmark approach to ESG and climate performance within the corporate sector. The company has maintained continuous carbon reduction targets since 2018, achieving measurable improvements in both environmental and financial metrics: revenues per tonne of CO<sub>2</sub> increased by 25.7% and EVIC-to-emissions ratios grew by 56% between 2023 and 2024. Operating in the telecommunications sector, Nokia benefits from inherently low-emission operations, yet it continues to improve emissions productivity and integrate ESG principles across its business. Its initiatives – including the deployment of energy-efficient network infrastructure and sustainable 5G base stations in collaboration with Elisa – align with Finland's national climate objectives, demonstrating how corporate leadership can generate both operational and market value.

In parallel, Finland has leveraged strategic public-private partnerships to accelerate decarbonisation. For example, Fortum and Microsoft utilise waste heat from data centres to provide district heating in Espoo, reducing urban carbon emissions, while Fortum's collaboration with Norsk e-Fuel and the Port of Rauma seeks to produce sustainable synthetic aviation fuel, decarbonising emissions-intensive transport sectors (Fortum, 2024).

Together, Nokia and Finland's public-private partnerships highlight the country's reliance on technologically advanced firms and coordinated policy support to drive its sustainability transition.

#### **Norway**

Norwegian companies present a diversified ESG landscape (Table 5) in which sustainability leadership extends beyond the traditional energy sector. Between 2018 and 2024, firms demonstrate a steady yet differentiated trajectory in sustainability performance and carbon efficiency. While large energy producers such as Equinor and Aker BP continue to dominate market capitalisation, the most notable gains in revenues per tonne of CO<sub>2</sub> and EVIC-to-emissions ratios are achieved by financial, technology, and engineering firms. This evolution indicates that Norway's corporate

Table 4

**Corporate Sustainability, Market Valuation, and Carbon Efficiency of Finnish Companies**

Company	Market Capital (billion USD)	ESG 2024	Global Universe (out of 14377)	Revenues per tonne CO <sub>2</sub> (2023–2024 growth)	EVIC / Emissions (2023–2024 growth)
NORDEA BANK ABP	37.26	13.6	989	6362136.88 (11.41)	154528960.02 (10.94)
KONE	25.42	20.1	3999	101333.64 (7.46)	279228.18 (10.47)
NOKIA	23.78	10.2	283	221629.21 (25.67)	456864.77 (55.97)
SAMPO	21.87	14	1131	3525460.46 (15.63)	20474653.90 (-2.28)
UPM-KYMMENE	14.26	13.9	1101	3097.34 (7.81)	6429.59 (-4.76)
FORTUM	12.27	24	6118	4421.63 (7.55)	14743.61 (12.85)
WÄRTSILÄ	10.46	22.2	5109	131789.63 (20.14)	303171.80 (37.58)
NESTE	8.98	26.7	7760	7532.15 (-9.91)	6354.89 (-45.76)
METSO OUTOTEC	7.72	20.8	4344	119210.31 (-11.5)	289135.63 (-3.13)
STORA ENSO	7.68	14.9	1470	7780.33 (19.85)	14320.80 (10.33)
KESKO	7.49	18.7	3191	152908.63 (-6.73)	153191.21 (-1.66)
ELISA	6.95	16.5	2133	936359.78 (141.85)	3745785.15 (148.69)
ORION	6.27	20.4	4153	141241.44 (65.05)	605093.57 (39.22)
KONECRANES	5.12	13.1	846	114136.36 (15.61)	207973.02 (36.53)
AMER SPORTS	5.09	11.5	488	194371.88 (82.49)	704076.43 (246.37)
VALMET	4.4	23.3	5721	81546.49 (-6.26)	128390.14 (-11.08)
HUHTAMÄKI	3.66	15.3	1575	9065.80 (19.56)	13759.24 (17.76)
KEMIRA	3.13	15.3	1575	5066.18 (-12.47)	7822.41 (4.98)
KOJAMO	2.38	14	1127	18149.66 (31.43)	272894.18 (21.6)

Source: Sustainalytics, 2024; CEOWORLD Magazine, 2024; Nordic ESG Data Platform, 2024

sustainability leadership is increasingly driven by innovation capacity and structural transformation rather than the scale and legacy of its energy industry.

Financial institutions, including DNB Bank, SpareBank 1 Østlandet, and Storebrand, exhibit exceptionally high carbon productivity and consistent improvements in emissions efficiency. In 2024, DNB's revenue efficiency approached 40 million EUR per tonne of CO<sub>2</sub>, while Storebrand achieved an EVIC-to-emissions ratio exceeding 1.6 trillion EUR – the highest among all analysed firms. These results reflect

both the low emissions intensity of financial services and the growing alignment of Norwegian finance with sustainable investment principles.

Engineering and technology-oriented firms such as Kongsberg Gruppen, Aker Solutions, and Tomra Systems also demonstrate continuous improvement. Aker Solutions nearly tripled its carbon efficiency between 2022 and 2024, supported by its expansion into offshore renewables and low-carbon engineering. Kongsberg Gruppen's EVIC-to-emissions ratio increased more than fivefold since 2019, highlighting

the sector's strong innovation capacity and contribution to emissions reduction.

By contrast, energy-intensive and resource-based firms – including Statkraft, Yara International, and SalMar – display greater volatility and, in some cases, declining performance. Although Equinor and Aker BP have achieved moderate improvements in emissions productivity since 2022, both remain constrained by the inherent challenges of decarbonising fossil fuel operations. Yara International's weakening carbon efficiency further underscores the

technological and cost barriers facing heavy industry and agriculture.

GHG intensity data between 2018–2024 reinforce these contrasts. While Equinor and Aker BP have reduced emissions from their 2020 peaks, overall progress remains gradual. Yara International follows a similar downward trend yet remains highly emissions intensive. Low-emission sectors – such as finance, telecommunications, and services – maintain stable performance, whereas industrial firms like Kongsberg Gruppen and Norsk Hydro record incremental gains.

Table 5

### Corporate Sustainability, Market Valuation, and Carbon Efficiency of Norwegian Companies

Company	Market Capital (billion USD)	ESG 2024	Global Universe (out of 14377)	Revenues per tonne CO <sub>2</sub> (2023–2024 growth)	EVIC / Emissions (2023–2024 growth)
EQUINOR	61.15	37.2	12489	12 098,19 (41.5 %)	17 461,14 (18.9 %)
DNB BANK	29.22	17.6	2604	39 902 848,83 (-4.5 %)	689 806 199,96 (-16.2 %)
SPARBANK 1 ØSTLANDET	25.57	12.9	788	4 112 644,37 (168.6 %)	69 092 490,18 (170.0 %)
KONGSBERG GRUPPEN	19.62	25.8	7227	436 342,73 (4 %)	2 438 369,91 (99.7 %)
TELENOR	15.07	19	3329	19 672,10 (27.5 %)	77 484,39 (30.7 %)
AKER SOLUTIONS	14,89	19.4	3566	321 822,16 (75.3 %)	239 802,25 (12.0 %)
AKER BP	11.85	32.8	10852	14 602,05 (5.5 %)	47 222,17 (6.9 %)
NORSK HYDRO	10.89	15.3	1587	1 985,14 (3.9 %)	2 129,58 (-6.9 %)
MOWI	8.88	23.5	5796	25 244,62 (-5.6 %)	58 954,43 (-5.6 %)
GJENSIDIGE FORSIKRING	8.83	17.5	2554	4 285 675,39 (-21.1 %)	25 237 184,55 (24.8 %)
ORKLA	8.61	18	2821	52 522,09 (5.9 %)	100 778,55 (16.6 %)
VAR ENERGI	7.46	34.1	11432	21 593,13 (174.0 %)	63 237,61 (116.2 %)
YARA INTERNATIONAL	6.71	26.7	7749	843,54 (-9.1 %)	892,59 (-14.3 %)
SALMAR	6.25	23.1	5537	69 653,74 (-14.2 %)	277 387,89 (-8.3 %)
STOREBRAND	4.58	17.3	2468	34 281 724,51 (17.9 %)	1 693 958 538,24 (13.7 %)
TOMRA SYSTEMS	3.92	28.2	8602	42 886,64 (-7.7 %)	149 353,79 (1.1 %)
AKER	3.5	12.3	620	3 567,09 (-40.4 %)	15 764,14 (-19.1 %)
WALLENIUS WILHELMSEN	3.36	20.3	4085	1 220,89 (8.3 %)	1 964,74 (0.3 %)
AUTOSTORE HOLDINGS LTD.	3.25	16.2	1966	210 593,62 (-12.1 %)	1 408 444,51 (-49.2 %)
STATKRAFT	state owned	14.7	1363	6 631,11 (-38.8 %)	24 933,88 (-21.7 %)

Source: Sustainalytics, 2024; CEOWORLD Magazine, 2024; Nordic ESG Data Platform, 2024

Persistent fluctuations in Var Energi and Aker ASA highlight Norway's ongoing dependence on resource-based activities, limiting aggregate progress towards low-carbon alignment.

Overall, Norway's corporate sustainability profile shows that ESG leadership is increasingly concentrated in finance, technology, and engineering, while fossil fuel-based sectors remain constrained by structural decarbonisation challenges. This trajectory reflects a gradual shift from resource-dependent competitiveness towards innovation- and finance-driven decarbonisation.

Kongsberg Gruppen exemplifies a benchmark in Norway's corporate sustainability transition. Although mid-sized relative to major players such as Equinor or DNB, Kongsberg has achieved pronounced growth in EVIC-to-emissions ratios, increasing from 4.3 million EUR in 2018 to over 2.4 billion EUR in 2024. This performance surpasses the proportional progress of most large emitters and reflects substantial improvements in carbon efficiency, innovation-driven value creation, and active participation in state-supported energy transition initiatives, including offshore wind and renewable energy storage projects. Furthermore, Kongsberg has launched Kongsberg Renewables Technologies, aiming for significant revenue growth in renewable energy by 2030. Through collaborations with entities like TGS, the company is developing integrated data and digital solutions for offshore wind field development, contributing directly to the decarbonisation of the energy sector (Kongsberg Gruppen, 2022). As a high-technology and engineering firm, Kongsberg illustrates Norway's broader shift from resource-based to knowledge-based sustainability, integrating competitive advantage with emissions reduction.

Complementing this, finance-oriented companies such as Storebrand and SpareBank 1 Østlandet can also serve as benchmarks. These institutions demonstrate strong CO<sub>2</sub> productivity and maintain climate-aligned investment portfolios, thereby supporting the national energy transition through financial mechanisms rather than direct operational decarbonisation.

Statkraft, Norway's state-owned renewable energy company, demonstrates strong carbon efficiency, especially in its most productive years. However, due to fluctuations in its EVIC-to-emissions and revenue-per-tonne of CO<sub>2</sub> ratios, and its moderate performance compared with cross-industry leaders, Statkraft is best regarded as a sector-specific benchmark within renewable energy rather than a universal corporate sustainability benchmark.

### **Sweden**

Swedish firms exhibit consistent improvement in sustainability performance and carbon efficiency between 2018 and 2024, driven by robust ESG integration and alignment with national climate

goals and EU decarbonisation frameworks (Table 6). This trajectory reflects Sweden's gradual transition from resource-based industrial growth towards an innovation- and finance-driven low-carbon economy.

Financial and investment institutions demonstrate the strongest carbon productivity and value efficiency, confirming their structural advantage of low operational emissions and effective ESG-valuation linkages. Investor AB, Industrivärden, and EQT stand out with remarkable 2023–2024 gains – Investor AB reports a 65% rise in value efficiency (EVIC-to-emissions ratio) and over 540 million EUR in revenues per tonne of CO<sub>2</sub>, translating active ownership and portfolio decarbonisation directly into market value growth. Similarly, Industrivärden and EQT achieve double-digit efficiency increases, while Svenska Handelsbanken and Swedbank maintain stable carbon profiles, reflecting climate-aligned financial models with limited volatility.

A broad decline in GHG intensity across listed companies signals tangible progress in decarbonisation and energy efficiency. Investor AB shows the steepest and most consistent reduction, cutting GHG intensity nearly fivefold – from 68.6 in 2018 to 13.5 in 2024. Comparable declines in AB Volvo and Ericsson indicate effective emissions management in industrial and technology operations. In contrast, fluctuations observed in Atlas Copco, Assa Abloy, and EQT likely reflect structural adjustments, acquisitions, or shifts in reporting boundaries.

Industrial and engineering leaders – AB Volvo, Atlas Copco, Assa Abloy, and Alfa Laval – demonstrate steady efficiency improvements through electrification, process optimisation, and low-carbon technologies. Volvo's 19% increase in revenue per tonne of CO<sub>2</sub> and Alfa Laval's 25% rise in value efficiency confirm measurable progress in industrial decarbonisation. However, persistent volatility in Sandvik, Epiroc, and Investment Latour underscores continued exposure to resource-intensive operations and cyclical market dynamics that constrain long-term carbon gains.

Technology and consumer-oriented firms such as Ericsson, Evolution, and Hennes & Mauritz combine strong ESG performance with expanding emission productivity – up to 33% annual growth – illustrating how innovation-led and digital business models increasingly drive low-emission value creation.

Overall, the Swedish corporate landscape demonstrates gradual but measurable decarbonisation accompanied by widening sectoral divergence. Financial and technology sectors increasingly anchor sustainability leadership, while heavy industry advances more incrementally under structural and cost constraints.

Public-private collaboration remains a cornerstone of Sweden's green transition. Business Sweden-led

Green Transition Alliances, including the Sweden–US and Sweden–Taiwan consortia, connect government agencies, export offices, and major firms such as Atlas Copco, Assa Abloy, Ericsson, and Volvo to promote low-carbon technologies and international pilot projects. National partnerships also link Volvo with the state-owned Vattenfall on electrification and charging infrastructure, while Atlas Copco and Ericsson engage in publicly supported consortia and

digital innovation programmes that enhance energy and resource efficiency. Collectively, these initiatives exemplify Sweden’s coordinated approach to climate governance – combining public finance, regulatory support, and joint R&D to de-risk investment and accelerate measurable corporate decarbonisation.

#### **Iceland**

Data availability constitutes a substantial limitation in the assessment of ESG performance in Iceland. Of

Table 6

#### **Corporate Sustainability, Market Valuation, and Carbon Efficiency of Swedish Companies**

Company	Market Capital (billion USD)	ESG 2024	Global Universe (out of 14377)	Revenues per tonne CO <sub>2</sub> (2023–2024 growth)	EVIC / Emissions (2023–2024 growth)
INVESTOR AB	80.69	11,9	543	535 541 428.462 (46.2%)	6 917 958 272.3 (65.4%)
ATLAS COPCO	2.38	20,2	4043	136 685.636 (3.9%)	685 110.761 (-0.3%)
VOLVO	49.45	27,7	8321	540 286.104 (19.3%)	426 248.766 (17.1%)
ASSA ABLOY	32.84	19,6	3686	61 117.854 (25.5%)	195 239.995 (32.2%)
EQT	32.68	17,4	2521	7 641 689.373 (52.2%)	95 208 852.044 (22.6%)
ENSKILDA BANKEN	27.49	17,6	2629	4 397 979.997 (-56.0%)	87 538 921.622 (-58.5%)
ERICSSON	26.94	15,1	1526	431 423.103 (24.5%)	847 931.887 (59%)
HEXAGON	25.71	13,1	838	130 374.974 (8.8%)	735 205.493 (-4.7%)
SANDVIK	22.65	24,2	6242	73 117.318 (-8.1%)	198 348.165 (-11.5%)
HENNES & MAURITZ	21.97	19,3	3488	493 098.361 (27.7%)	791 070.638 (19.0%)
SWEDBANK	21.77	24,5	6423	2 837 097.867 (7.5%)	62 057 193.323 (4.3%)
EPIROC	20.69	19	3368	112 927.83 (-44.8%)	464 783.354 (-47.6%)
SVENSKA HANDELSBANKEN	20.24	14,2	1203	6 861 065.886 (8.0%)	132 170 572.428 (1.2%)
ESSITY	18.55	23,5	5802	5 690.855 (-4.5%)	11 676.082 (1.3%)
ALFA LAVAL	17.46	25,6	7088	284 914.492 (17.1%)	994 644.426 (25.6%)
EVOLUTION	17.16	20,4	4133	480 122.777 (33.3%)	3 672 585.455 (-24.0%)
INVESTMENT LATOUR	15.9	16,4	2103	137 475.363 (-31.7%)	1 041 646.32 (-28.6%)
INDUSTRIVÄRDEN	13.6	13,9	1098	58 046 413.077 (39.3%)	1 067 632 285.3 (10.1%)
LIFCO	13.21	36,2	12178	170 940.173 (24.0%)	1 075 817.346 (45.8%)
L E LUNDBERGFÖRETAGEN	11.23	18,5	3098	44 166.963 (-1.6%)	228 502.212 (-2.4%)
SKANSKA	9.1	31	10128	100 171.439 (6.5%)	115 053.158 (19.1%)

Source: Sustainalytics, 2024; CEOWORLD Magazine, 2024; Nordic ESG Data Platform, 2024

the 25 listed firms, only 16 disclose overall ESG scores, and within this group, merely four provide publicly accessible information on the Nordic ESG Data Platform. This narrow disclosure landscape can be attributed to the small size of the domestic market, comparatively less institutionalised reporting practices, and the absence of fully harmonised disclosure standards. Consequently, the scope for comprehensive benchmarking is restricted, and transparency for investors is affected.

The ESG landscape in Iceland demonstrates a moderate level of development, with considerable variation across sectors (Table 7). Between 2018 and 2024, Icelandic companies show incremental improvements in carbon efficiency and in value creation relative to emissions, although their overall performance remains below that of other Nordic economies. Financial institutions exhibit the most consistent advancements, particularly in revenues generated per tonne of CO<sub>2</sub> and in market valuation relative to emissions. By contrast, the single industrial company included in the analysis displays more volatile year-to-year results and comparatively limited gains in emission-related efficiency.

#### Cross-Country Comparison of Nordic Sustainability Outcomes

Across the Nordic region, corporate sustainability performance is broadly aligned, yet shaped by distinct national industrial structures and sectoral profiles. Denmark and Sweden demonstrate the most mature and consistently high sustainability outcomes, with firms across multiple sectors achieving strong ESG integration and notable improvements in carbon efficiency. Finland's performance is more sector-driven, with technologically advanced and low-emission industries – particularly telecommunications and pharmaceuticals – showing the strongest sustainability results. Norway exhibits a pronounced structural divide: financial, technology, and engineering firms lead in carbon productivity, whereas fossil fuel-based and heavy industrial sectors continue to face persistent

decarbonisation challenges. Iceland's progress is steady but constrained by limited disclosure and a smaller corporate base.

Overall, sectoral characteristics and firm size remain the strongest determinants of ESG effectiveness in the Nordics. Financial, technology, and consumer-oriented companies convert sustainability practices into carbon efficiency and valuation gains more effectively than industrial and resource-intensive sectors, which require targeted policy support and long-term technological transitions. These patterns underline the central importance of innovation, reporting quality, and coordinated public-private action in linking ESG performance to financial and strategic outcomes.

## 6. Conclusions

The findings show that sustainable value creation in the Nordic economies is driven primarily by carbon efficiency and firm scale, not by conventional ESG scores. Carbon efficiency indicators display strong and consistent links to market capitalisation, assets, and leverage, confirming that firms generating higher economic value per unit of CO<sub>2</sub> are better positioned to benefit from sustainability-linked valuation effects. In contrast, aggregate ESG ratings offer little explanatory power for differences in profitability or market value.

Firms with carbon reduction targets are significantly larger and more profitable, although sectoral constraints mean that commitment alone does not guarantee superior carbon performance. Financial, technology, and consumer-oriented firms consistently achieve higher emissions productivity, while industrial and resource-intensive sectors face structural decarbonisation barriers.

Clustering analysis shows that Nordic firms operate within a largely homogeneous sustainability framework, with only a few outliers. This reinforces that the pooled correlations reflect broad regional patterns rather than isolated firm-level effects.

Table 7

#### Corporate Sustainability, Market Valuation, and Carbon Efficiency of Icelandic Companies

	Market Capital (billion USD)	ESG 2024	Global Universe (out of 14377)	Revenues per tonne CO <sub>2</sub> (2023–2024 growth)	EVIC / Emissions (2023–2024 growth)
MAREL HF.	3.18	32,9	10907	141 362.89 (-4.83 %)	128 128.079 (-11.33%)
ARION BANKI HF.	1.66	12,1	583	22 302 285.609 (17.97%)	211 168 708.303 (18.19%)
ÍSLANDBANKI HF.	1.66	20,8	4349	21 077 033.209 (82.44%)	210 068 662.873 (79.95%)
KVIKA BANKI HF.	0.672	25,4	6952	3 671 238.824 (89.77%)	36 852 302.941 (66.56%)

Source: *Sustainalytics, 2024; CEOWORLD Magazine, 2024; Nordic ESG Data Platform, 2024*

Overall, the results highlight the strategic importance of carbon efficiency, scale, and institutional capacity for converting sustainability performance into financial value. Targeted industrial policies and technological support remain crucial for enabling

carbon-intensive sectors to narrow the efficiency gap. Future research should examine causal mechanisms and assess how CSRD-aligned reporting may strengthen the financial relevance of environmental performance.

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**Appendix A. Additional empirical results****Table A1. Cross-sectional correlations between ESG, carbon efficiency, and financial indicators, 2024**

	ESG	Market Capital	EVIC per tonne CO <sub>2</sub>	Revenues per tonne CO <sub>2</sub>	EBIT	EBITDA	Net Income	CAPEX	Total Debt
ESG	1	0.05	-0.017	-0.12	0.197	0.193	-0.062	-0.167	-0.12
Market Capital	0.05	1	-0.087	-0.117	0.893	0.828	0.706	-0.717	0.049
EVIC per tonne CO <sub>2</sub>	-0.017	-0.087	1	0.808	-0.054	-0.064	0.099	0.111	0.925
Revenues per tonne CO <sub>2</sub>	-0.12	-0.117	0.808	1	-0.023	-0.007	0.047	0.164	0.68
EBIT	0.197	0.893	-0.054	-0.023	1	0.984	0.985	-0.768	0.698
EBITDA	0.193	0.828	-0.064	-0.007	0.984	1	0.957	-0.786	0.784
Net Income	-0.062	0.706	0.099	0.047	0.985	0.957	1	-0.478	0.384
CAPEX	-0.167	-0.717	0.111	0.164	-0.768	-0.786	-0.478	1	-0.007
Total Debt	-0.12	0.049	0.925	0.68	0.698	0.784	0.384	-0.007	1

Notes: This table reports Pearson correlation coefficients for 2024.

Source: author's calculations in Python

Received on: 10th of December, 2025

Accepted on: 07th of February, 2026

Published on: 10th of April, 2026