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Market Returns at Half the Emissions? Using Carbon Data for Sector Peer Comparisons and Carbon-Efficient Indexing

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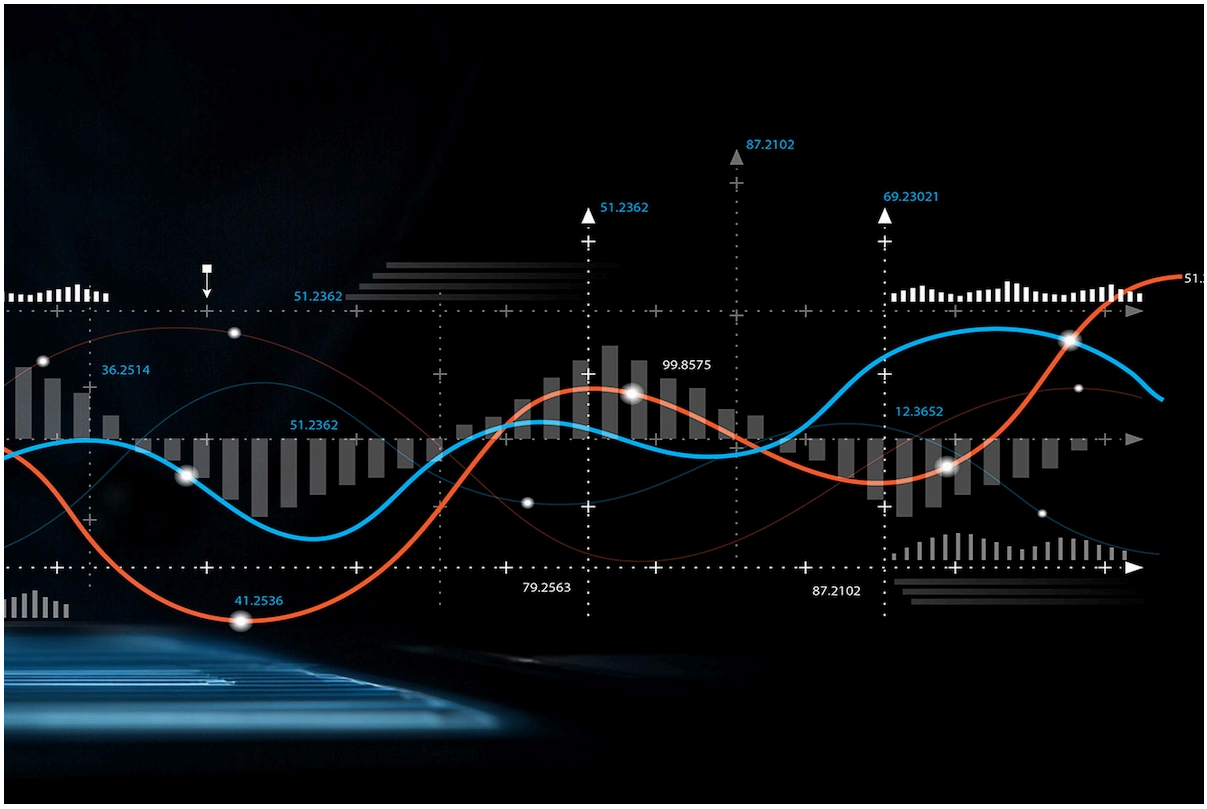

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How emissions are scaled is just as important as the emissions themselves.

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Starting Point: Corporate Emissions and Firm Scale

Investors are increasingly interested in incorporating corporate carbon emissions into their decision-making. They typically use carbon data to compare firms within sectors, since cross-sector comparisons are not very meaningful due to differences in production technologies. However, emissions are closely tied to firm scale: larger firms generally have higher absolute emissions. Therefore, to compare the carbon efficiency of firms of different sizes, it is crucial to normalize emissions per unit of production output—a metric known as carbon intensity.

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Consider two automakers. Firm A emits 1,000 tons of carbon dioxide equivalent (CO_2e)—a standardized unit that expresses all greenhouse gases in terms of the warming impact of an equivalent amount of CO_2—while producing 100,000 vehicles, resulting in a carbon intensity of 0.01 tons CO_2e per vehicle. Firm B emits 500 tons of CO_2e while producing only 5,000 vehicles, resulting in a carbon intensity of 0.10 tons CO_2e per vehicle. Despite lower total emissions, Firm B is less carbon efficient than Firm A once scaled by output.

Using carbon intensity for emissions comparisons is analogous to "common-size analysis" in financial statement analysis, where items are expressed relative to a base, allowing comparisons across companies of different sizes. In practice, one of the biggest difficulties with carbon intensity metrics is that measures of production output are not comparable across industries. For example, carmakers may report output as the number of vehicles produced, chip manufacturers use surface area of silicon wafers, and oil and gas companies rely on barrels of oil equivalent.

The challenge is even greater in sectors where production is less tangible. In technology, for instance, output might be expressed in terms of software applications, data storage capacity, or cloud services delivered. Indicators such as user counts, volume of data processed, or services provided capture only part of the picture and do not offer a consistent basis for comparison across firms.

The Use of Financial Metrics of Scale

In the absence of universal production measures, financial metrics are widely used to calculate carbon intensity. Revenue is the most common, followed by enterprise value, with other metrics—such as cost of sales, assets, and employee count—also in use. This raises a fundamental question: how does the way we scale corporate emissions affect sector peer comparisons and investment decisions?

Our work addresses this often-overlooked issue in emissions analysis: the choice of financial metric used to scale emissions. The choice of scaling metric is not merely a technical detail—it shapes how carbon efficiency is measured, disclosed, and ultimately used by investors to compare firms within sectors, build portfolios, and allocate capital.

Regulatory Fragmentation in Scaling Choices

Regulators have increasingly recognized the importance of scaling choices, but their recommendations vary. In 2019, the European Commission's Technical Expert Group on Sustainable Finance (TEG) recommended enterprise value over revenue for carbon intensity reporting, arguing that revenue-based metrics tend to favor high-emitting sectors such as coal by overlooking market-assessed risks of stranded assets. The European Commission adopted this recommendation in 2020, making enterprise value the standardized denominator for carbon intensity reporting in the EU.

At the same time, other bodies highlight important trade-offs. The Organization for Economic Cooperation and Development (OECD), for example, notes that revenue-based scaling—though widely used—can favor firms with higher prices, while enterprise value may reflect market volatility rather than genuine improvements in carbon efficiency.

This regulatory fragmentation underscores a broader challenge: without a consistent denominator, peer comparisons and portfolio decisions can vary widely depending on which standard is applied. For companies, this means their perceived carbon efficiency depends not only on their emissions, but also on the scaling metric chosen by regulators and investors.

Systematic Carbon Intensity Reshuffling

We document that carbon intensity rankings are highly sensitive to the choice of scaling metric. Using alternative denominators leads to significant shifts in firms' positions relative to their sector peers—a phenomenon we term carbon intensity reshuffling. If different scaling choices yielded consistent results, one would expect near-perfect correlations across rankings. In reality, we find that the average correlation between revenue-based rankings and those based on alternative metrics is just 59%, indicating substantial reshuffling.

We also show that this reshuffling is not random. It systematically reflects within-sector differences in fundamental firm characteristics such as gross profit margins, valuation multiples, and asset or labor utilization rates. For example, we find that low-margin firms appear *less efficient* when emissions are scaled by cost of sales rather than revenue. Firms with high asset or labor utilization rates appear *more efficient* when emissions are scaled by assets or employees. And firms with higher valuation multiples appear *more efficient* when emissions are scaled by market cap or enterprise value.

From Sector Peer Comparisons to Carbon-Efficient Indexing

To evaluate the capital market implications of carbon intensity reshuffling, we develop a methodology for constructing carbon-efficient indices—variants of a standard market index that tilt weights away from higher-intensity firms and toward lower-intensity firms within each sector. By design, these indices are sector-neutral: they preserve the original sector weights of the benchmark market index, but reshuffle the portfolio weights across peers inside each sector based on their relative carbon intensity.

This approach allows us to isolate the effect of scaling choices on portfolio construction. In other words, our methodology makes it possible to see how different denominators—revenue, enterprise value, cost of sales, assets, or employees—change which firms are favored within a sector and how effective alternative carbon-efficient index designs are at reducing financed emissions.

Market Returns at Half the Emissions

We find that all of the carbon-efficient index variants deliver financial returns comparable to the benchmark market index. However, they incur higher transaction costs due to increased turnover. Their primary advantage lies in substantially reducing financed carbon emissions, though the degree of carbon savings varies by scaling choice. Indices that scale emissions by market cap or enterprise value achieve the largest reductions—nearly 50% lower than the benchmark—by overweighting lower-emitting firms with higher

valuation multiples. Yet these savings come at a cost: such indices exhibit higher turnover, reflecting greater year-over-year variability in firm rankings when market-based metrics are used.

Identifying a Distinct Trade-Off for Investors

These results highlight a clear trade-off between carbon savings and transaction costs. For investors seeking carbon-efficient alternatives to the standard market index, the decision ultimately depends on their willingness to accept higher transaction costs in exchange for a lower portfolio carbon footprint. Our methodology provides a framework to quantify this trade-off for any stock market benchmark.

Carbon-Efficient Tilting Strategy vs. Blanket Exclusions

It is important to contrast carbon-efficient tilting with the conventional approach of excluding companies in high-emitting sectors such as energy. Compared to blanket exclusions, tilting is often viewed as a more effective way to encourage best-in-class companies in carbon-intensive sectors to improve their practices and mitigate negative externalities.

Our methodology preserves the sector weights of the underlying market index, reshuffling portfolio weights only among peers within each sector based on their carbon intensity rankings. This design offers a major advantage over exclusion strategies: investors do not have to sacrifice diversification or make sector bets. Instead, they can maintain broad exposure to the market while shifting capital toward cleaner firms within every sector. It is a simple yet powerful way to integrate carbon considerations into portfolio construction.

Market Recognition and Industry Adoption

Carbon-efficient tilting is increasingly recognized as an effective strategy for encouraging cleaner performance among companies in carbon-intensive sectors. Our methodology—developed and published in *Energy Economics*—has attracted attention from academics, asset managers, and institutional investors. Leading index providers such as Standard & Poor's (S&P), Morgan Stanley Capital International (MSCI), and FTSE Russell are launching carbon-efficient variants of benchmark indices that combine broad diversification and market returns with lower portfolio emissions. This trend underscores both the practicality of our approach and the timeliness of our contribution to financial innovation.

At the same time, regulatory momentum is reinforcing the importance of consistent carbon data. The International Sustainability Standards Board (ISSB) has introduced corporate sustainability reporting standards that are increasingly being adopted across jurisdictions worldwide. In the United States, California has stepped into the regulatory void left by the Securities and Exchange Commission's rollback of its climate disclosure rules. Senate Bill (SB) 253 mandates full-scope emissions reporting, and SB 261 requires disclosure of climate-related financial risks. Together, these developments create strong incentives for companies to report reliable, comparable, and consistent carbon data, and for investors to use that data in carbon-efficient strategies.

Managers should recognize that scaled emissions metrics often matter more to investors than absolute emissions, since rankings based on carbon intensity are used to identify leaders and laggards within each sector. It is therefore essential for managers to understand their firm's relative position across different financial metrics of output and to reassess their disclosure practices with an emphasis on relative carbon performance. By understanding their ranking among sector peers, managers can identify gaps versus competitors, uncover opportunities to improve operating efficiency, and ultimately reduce emissions per unit of output.

Author's Note

This synthesis is based on our original study, *Fundamentals of Carbon Emissions Scaling: Implications for Sector Peer Comparisons and Carbon-Efficient Indexing*, prepared in response to practitioner interest in a concise overview of our key findings and practical implications. The full study is published in ***Energy Economics***, and a working paper version is available on **SSRN**.

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