

Corporate Sustainability Performance: Introducing an SDG Score and Testing its Validity relative to ESG Ratings

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Jan Anton van Zanten*

Robeco, j.van.zanten@robeco.nl

Rotterdam School of Management, vanzanten@rsm.nl

Joop Huij

Robeco, j.huij@robeco.nl

Rotterdam School of Management, jhuij@rsm.nl

***Corresponding author**

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Abstract

Although sustainable investing is becoming a mainstream ambition, investors disagree on how to best measure corporate sustainability performance (CSP). Environmental, Social, and Governance (ESG) ratings are the dominant CSP metric in the market, but they focus on financial materiality rather than sustainability impact. In this paper we introduce a novel alternative CSP metric that measures companies' impact on the Sustainable Development Goals (SDGs). We then develop three tests to gauge the construct validity of this SDG score and assess if it enjoys discriminant validity relative to ESG ratings of four providers. We find that, unlike ESG ratings, the SDG score: (i) captures investors' revealed sustainability preferences; (ii) aligns with the emerging EU taxonomy; and (iii) contributes to climate change mitigation ambitions. We conclude that as a CSP metric the SDG score has high, and ESG ratings low, construct validity. We caution against using concepts like ESG, sustainability, and impact interchangeably.

Keywords: Sustainable investing; ESG; impact investing; Sustainable Development Goals (SDGs); sustainable finance; EU taxonomy; climate change

1. Introduction

Investors are critical for creating a more sustainable future. According to the United Nations (UN) investors can help finance the Sustainable Development Goals (SDGs) and make financial flows more consistent with limiting global warming (UN, 2015a; 2015b). Scholars likewise contend that the financial sector can promote social and environmental sustainability (Betti, Consolandi & Eccles, 2018; Crona, Folke, & Galaz, 2021; Krosinsky, 2013; Stephenson, Hamid, Peter, Sauvart, Seric, & Tajoli, 2021; Zhan & Santos-Paulino, 2021). This message resonates with members of pension funds, who seem to want their fund to expand its engagement with SDGs, even if this hurts financial performance (Bauer, Ruof, & Smeets, 2021). It is therefore not surprising that investors are increasingly engaging with sustainability. Estimates suggest USD 35.3 trillion, or 36% of total assets under management, is now invested sustainably (GSIA, 2021).

While sustainable investing is becoming a mainstream ambition, there are different interpretations as to what sustainable investing ought to achieve (Sandberg, Juravle, Hedesström & Hamilton, 2009). We define sustainable investing as “*a generic term for investments that seek to contribute toward sustainable development*” (Busch, Bauer & Orlitzky., 2016:304).¹ This implies that sustainable investors need to determine the environmental and social impacts of the companies they may invest in. With corporate sustainability performance (CSP) metrics that determine companies' contributions to sustainable development, investors can allocate financing to those with positive impact and away from companies with negative impact.

But do investors have access to CSP metrics that adequately reveal which companies are most conducive to sustainable development? This can be doubted. The dominant metric used in sustainable investing is an ESG rating that measures how companies perform on diverse Environmental, Social,

¹Similarly, the European Union defines a sustainable investment as “an investment in an economic activity that contributes to an environmental objective, [...], or an investment in an economic activity that contributes to a social objective, [...], provided that such investments do not significantly harm any of those objectives and that the investee companies follow good governance practices [...]” (European Union, 2019:8).

and Governance attributes (Fiaschi, Giuliani, Nieri & Salvati, 2020; Linnenluecke, 2022; Popescu, Hitaj & Benetto, 2021; Scheitza, Busch, & Metzler, 2022). To illustrate, ESG-integration accounts for 71% of the USD 35.3 trillion in sustainably invested assets, contrasting the 6%, 4%, and 1% using sustainability themed investing, positive/best-in-class investing, and/or impact/community investing (GSIA, 2021).² Yet despite their prominence, ESG ratings have attracted criticism.

For one, anecdotal evidence suggests that ESG ratings fail to capture companies' sustainability impacts. A recent list of the top five ESG-rated companies for instance includes British American Tobacco, mining giant Glencore, and soft drinks producer Coca-Cola HBC – stirring an intense debate on ESG rating's ignorance of these companies' adverse impacts (Responsible-Investor, 2021). Such results led Bloomberg to speak of an “*ESG mirage*”³ while the Economist dubbed ESG to be “*three letters that won't save the planet*”⁴. Another line of critique concerns the poor correlation between ESG ratings of different providers (Berg; Koelbel & Rigobon, 2022; Billio, Costola, Hristova, Latino & Pelizzon, 2020; Dimson, Marsh & Staunton, 2020a; Kotsantonis & Serafeim, 2019). This leads to surprising situations in which a company is rated strongly by one provider but weakly by another. The result is a situation of “*aggregate confusion*” about what it is that ESG measures (Berg et al., 2022). A final criticism concerns the biases in ESG ratings. Large companies have better ESG ratings than smaller ones (Akgun, Mudge & Townsend, 2021; Artiach, Lee, Nelson & Walker, 2010; Gallo & Christensen, 2011) and firms from developed countries do better than those from emerging markets (Arminen, Puumalainen, Pätäri & Fellnhofer, 2018; Ho, Wang, & Vitell, 2012). But this does not necessarily mean that larger companies, and those from developed markets, are more sustainable. Rather, larger companies have more resources for ESG data disclosure (Drempetic, Klein & Zwergel., 2019) while country-characteristics explain geographic differences in ESG ratings (Cai, Pan & Statman, 2016).

Such critiques indicate that there is confusion around the extent to which ESG ratings measure sustainability performance. The concept of ESG was originally motivated by the argument that “*a better consideration of environmental, social and governance factors will ultimately contribute to stronger and more resilient investment markets, as well as contribute to the sustainable development of societies*” (IFC, 2004:2). Despite this emphasis on sustainable development, in the past decade ESG assessments have increasingly focused on measuring companies' exposure to, and management ability to deal with, ESG risks that can have financially material implications (Giese, Lee, Melas, Nagy & Nishikawa, 2019; Popescu et al., 2021). With this focus, ESG ratings primarily assess if a firm's financial performance may be influenced by ESG factors (Amel-Zadeh & Serafeim, 2018). Less attention may be paid to if companies contribute to a better world.

This nuance has important implications for sustainable investing practice and research. If sustainable investors want to invest in companies that have positive impact but use CSP metrics that insufficiently measure this, then strategies based on those metrics will fall short of achieving these sustainability objectives (e.g., Dimson et al., 2020a). Likewise, as ESG ratings are now used in many areas of academic research, there is a need to measure the construct validity of such metrics: do they measure what is intended to be measured? Notwithstanding the rapidly growing academic interest in sustainable investing, few efforts have assessed how sustainability performance of investments is measured (Drempetic et al., 2019; Kölbel et al., 2020; Losse & Geissdoerfer, 2021; Popescu et al., 2021). This presents a significant gap in the literature (Capelle-Blancard & Monjon, 2012; Diaz-Rainey et al., 2017; Revelli, 2017; van Dijk-de Groot & Nijhof, 2015) and researchers have consequently been called upon to investigate what types of indicators the sustainable finance community needs in order to advance sustainability objectives (Drempetic et al., 2019).

²Note that some assets may be covered by multiple such approaches.

³ <https://www.bloomberg.com/graphics/2021-what-is-esg-investing-msci-ratings-focus-on-corporate-bottom-line/>

⁴ <https://www.economist.com/weeklyedition/2022-07-23>

This paper responds to these calls. We start by introducing the Robeco SDG score, which measures companies' contributions to the SDGs, as a novel CSP metric that is conceptually different from ESG ratings. We subsequently develop three complementary tests for gauging the construct validity of this SDG score (i.e., does it measure what it is supposed to measure?), while also assessing if this SDG score enjoys discriminant validity compared to prominent ESG ratings (i.e., is it sufficiently distinct from ESG ratings of Sustainalytics; Refinitiv; S&P; and MSCI?). First, we test if the SDG score and ESG ratings capture investors' revealed sustainability preferences. We do this by assessing if poor scores are assigned to companies that are on asset owners' exclusion lists and good scores are awarded to firms included in sustainable thematic funds. Second, we measure how well the SDG and ESG metrics correspond to the EU taxonomy, as an important sustainable investing regulation. This test surveys if poor scores are assigned to companies breaching the EU taxonomy's 'do-no-significant-harm' (DNSH) principle and if good scores are given to companies generating the majority of their revenues from activities that the taxonomy views as helping tackle climate change. Third, we test if these CSP metrics are supportive of climate change mitigation ambitions. We assess this by checking if the majority of companies with very severe greenhouse gas (GHG) emissions get poor ratings.

We find that the SDG score introduced in this paper does well on all three tests. Companies that are on exclusion lists, that breach the EU taxonomy's DNSH principle, and rank among the top contributors to climate change primarily get negative scores. At the same time, SDG scores for companies included in sustainable thematic funds and for companies generating most of their revenues from EU taxonomy-aligned activities, are overwhelmingly positive. Hence, the SDG score captures both companies' positive and negative impacts. In contrast, ESG ratings insufficiently capture companies' contributions to sustainable development, showing that the SDG score yields different results compared to ESG ratings. We conclude that the SDG score has high construct validity as a CSP metric and enjoys high discriminant validity compared to ESG ratings. This makes these metrics complementary: whereas the SDG score helps align investments with sustainable development ambitions, ESG ratings might help avoid financially material ESG risks. Based on these conclusions, we advise against using concepts like ESG, sustainability, and impact interchangeably.

The next section introduces the SDG score and ESG ratings that we use as CSP metrics in our study. Section 3 explains the empirical tests we develop to measure the construct validity of these CSP metrics and the divergent validity between them. Results are presented in section 4, followed by a discussion in section 5. The last section summarizes our findings and their importance.

Three terms are used throughout our paper: sustainable investing; sustainable development; and CSP. Table 1 offers definitions.

--- insert Table 1 ---

2. Data: SDG score and ESG ratings

This section first introduces the Robeco SDG score as a novel CSP metric (2.1). To assess the discriminant validity of this SDG score relative to well-established metrics, we use four ESG ratings (2.2). Section 2.3 compares these two different metrics.

2.1 Introducing the Robeco SDG score

Aligned with the objective of sustainable investing (cf., Busch et al., 2016), we define CSP as the extent to which a company contributes to sustainable development. Yet sustainable development, commonly understood as "*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*" (WCED, 1987), is a contested concept that comprises diverse topics (Leach et al., 2018; Redclift, 2005). CSP measurement is plagued by this lack of

consensus on what topics support sustainable development. ESG ratings are a case in point: the fact that different data providers use different E, S, and G metrics in their assessments is a key reason for divergence (Berg et al., 2022).

The SDGs help overcome this challenge. These 17 goals have 169 targets (UN, 2015). They were adopted by all UN member states, thereby creating a universal sustainable development agenda (Pattberg & Widerberg, 2016; Stevens & Kanie, 2016). They not only are relevant for governments (Sachs, 2015) but also for companies (Mio, Panfilo & Blundo, 2020; van Tulder, Rodrigues, Mirza & Sexsmith, 2021; van Zanten & van Tulder, 2018; 2021) and investors (Chen, Mussalli, Amel-Zadeh & Weinberg, 2021; Schramade, 2017). The SDGs thereby offer a global and detailed clarification of the objectives of sustainable development. Sustainable investing therefore requires knowing how companies that may be invested in contribute to the SDGs. But how can this understanding be obtained?

Robeco's SDG score measures companies' contributions to the SDGs. It does so with a three-step SDG framework. The first step follows a rules-based approach to assess the impacts of a company's products or services. Key performance indicators (KPIs) determine which SDGs are impacted by particular products and services, whereby thresholds specify how strong that impact is. For example, a KPI for food companies is the percentage revenues generated from selling nutritious food products. If this exceeds a particular threshold the score on SDGs 2 and 3 (Zero Hunger; Good Health and Wellbeing) can become positive. The second step determines if the company's business conduct contributes positively or negatively to SDGs. Examples of factors that are assessed include gender equality, environmental management, and corporate governance. In this step sustainability analysts have the opportunity to incorporate their perspectives about companies' impacts in the assessment. The final step investigates if the company has been involved in controversies, like corruption, fraud, or environmental accidents. If there have been such controversies, analysts survey if the company took action to remedy the adverse impact that has occurred and to prevent similar occurrences in the future.

With this three-step assessment companies are scored on their contributions to each of the SDGs. Seven types of SDG scores are possible: low, medium, and high positive scores (+1; +2; +3); neutral scores (0); and low, medium, and high negative scores (-1; -2; -3). A company may thus impact multiple SDGs, whereby each of these impacts may be positive or negative at various levels. Once a company's impacts on the 17 SDGs has been scored, its overall SDG score is calculated. This is done according to what Robeco calls its 'min-max' rule: a company without any negative scores for any individual SDG is assigned the highest (max) score as its overall score. But if a company has a negative score for any of the SDGs, it will receive the lowest (min) score as its overall SDG score. This rule reflects the precautionary principle in sustainability that emphasizes the importance of avoiding harm. It also recognizes the indivisibility of the SDGs and the need to treat these goals as an interconnected whole, rather than as 17 isolated parts, since negative impact on one goal cannot be compensated by positive impacts on other goals (UN, 2015; van Zanten & van Tulder, 2021).

To provide an insight into this SDG score, tables 2 and 3 provide descriptive statistics for the companies in the MSCI All Countries World Index (ACWI). This index contains over 2,900 large- and mid-cap constituents from 23 developed and 25 emerging markets, across 11 sectors and some 85% of the free float-adjusted market capitalization in each market (MSCI, 2022). This provides a representative sample for assessing the sustainability performance of companies. Table 1 shows average SDG scores for companies operating in particular sectors and for companies from countries categorized according to their income levels. Table 3 shows how many companies contribute positively or negatively to individual SDGs. For detailed information on the methodology, see Robeco (2021).

--- insert table 2 ---

--- insert table 3 ---

2.2 ESG ratings

This SDG score measures companies' contributions to sustainable development, which is conceptually different from the focus of most ESG ratings. We want to test if these metrics also yield different results and thus if there is discriminant validity between the SDG score and ESG ratings. To do so, we include ESG ratings of four providers. Using multiple ratings is important due to their low correlation (Berg et al., 2022; Dimson et al., 2020a) and because investors or academics may use different ESG ratings (Eccles, Lee, & Stroehle, 2020).

2.2.1 Sustainalytics

The Sustainalytics Company ESG Risk Rating measures a company's exposure to, and management of, industry-specific, and financially material, ESG risks. The score ranges from 0 – 100, with 100 indicating the highest severity of ESG risk – i.e. the worst performance. Sustainalytics explains that corporate sustainability depends on “*accurate, independent data to evaluate and improve a company's ESG performance*” and that the ESG risk rating “*measures the degree to which a company's economic value is at risk driven by ESG factors*” (Sustainalytics, 2021).

2.2.2 Refinitiv ESG rating

Refinitiv's ESG score measures a company's relative ESG performance. The score ranges from 0 – 100, with 100 indicating top performance. The score accounts for industry materiality and company size biases, helping investors assess the risks and opportunities by companies' performance on ESG factors, in a way that is “*designed to help you make sound, sustainable investment decisions*” (Refinitiv, 2021).

2.2.3 S&P

S&P's ESG score is built on the Corporate Sustainability Assessment (CSA) (formerly RobecoSAM CSA). This annual evaluation of companies' sustainability practices focuses on industry-specific and financially material sustainability criteria. It ranges from 0 – 100, with 100 indicating the best performance. The score comprises the financial impact of ESG factors, as well as the societal impact of ESG factors, and can be used “*as KPI for sustainability-linked financing or to build thematic portfolios*” (S&P, 2021).

2.2.4 MSCI

MSCI's ESG rating ranges from AAA to CCC. This rating is designed to measure how resilient a company is to long-term, industry material ESG risks. Triple- and double-A scores signal leaders, B and triple-C scores identify laggards, and the middle A-BB range is average. MSCI explains that its ESG ratings aim to provide “*institutional investors with a more robust ESG integration tool designed to support ESG risk mitigation and long term value creation*” (MSCI, 2021).

2.3 Correlation between SDG scores and ESG ratings

Robeco's SDG score captures companies' contributions to the SDGs while ESG ratings, notwithstanding differences in focus among the various providers, measure companies' exposure to, and management of, financially material ESG risks. Hence, these are different concepts. How do these scores, SDG and ESG, compare to one another?

We gauge the correlation between a company's SDG score and its ESG rating using data from December 2021 for MSCI ACWI constituents. As expected, we find that a company's SDG score is uncorrelated to its ESG rating. Pearson correlation coefficients between these CSP metrics are on average 0.07. The correlation between the SDG score and the ESG scores of Sustainalytics, S&P, Refinitiv, and MSCI respectively are 0.16, 0.01, 0.03, and 0.08. This lack of correlation between a company's SDG score and its ESG rating is visualized in figure 3, which shows how ESG scores of the four providers are distributed (vertical) for companies with one of seven types of SDG scores

(horizontal). If a company's ESG rating would be positively related to its SDG score then we would have seen higher ESG scores for companies with positive SDG scores (in blue) compared to those with negative SDG scores (in pink).

--- insert figure 1 ---

3. Methodology: Testing the validity of corporate sustainability performance metrics

The previous section found that a company's SDG score is not related to its ESG rating. How might we measure whether a CSP metric adequately measures sustainability performance?

As there are no objective lists of which companies are (un)sustainable, we develop three complementary ways of investigating this question: we test if CSP metrics align with: (i) investors' revealed sustainability preferences; (ii) sustainable investing regulation; and (iii) climate science. Thus we seek to capture the perspectives of investors, regulators, and scientists on corporate sustainability performance. Throughout these three tests we seek to capture both companies' positive and their negative effects. Since sustainable development aims to prevent negative impacts (i.e., avoiding harm) while simultaneously promoting positive impact (i.e., doing good) (van Zanten & van Tulder, 2018), this combination is important. We create propositions that determine what an adequate CSP metric looks like in relation to each test.

3.1 Investors' revealed sustainability preferences

Our first test surveys if CSP metrics align with investors' revealed preferences in sustainable investing. We examine two dimensions of investors' actual sustainable investing strategies.

First, we assess if CSP metrics can identify companies that asset owners have excluded from their investment universe. Such exclusion lists contain companies that are severely misaligned with investors' values and therefore may not be invested in. Examples include firms selling controversial weapons, those violating human rights, or companies causing environmental destruction. Because excluding companies from the investment process reduces the investable universe, thereby limiting the opportunities for generating financial performance, exclusion is a rigorous measure that is reserved for the worst companies in the universe (see e.g., Blitz & Fabozzi, 2017; Blitz & Swinkels, 2020; 2021; Dimson, Marsh & Staunton, 2020b). On this basis we propose:

Proposition 1a: *Adequate metrics of sustainability performance assign poor scores to companies that investors exclude from their investable universe for sustainability reasons.*

To test this proposition, we collected exclusion lists from seven asset owners (Table 4) and compare these companies' SDG scores and ESG ratings to those of the benchmark companies. The sum of companies on these exclusion lists is 1,477. We removed duplicates, leading to 725 unique companies. For 672 companies we were able to collect SDG scores and ESG ratings.⁵ These were categorized into three groups based on the reason of their exclusion: (i) human rights violations and/or involvement in controversial weapons; (ii) manufacturing and/or distributing of tobacco and/or cannabis products; and (iii) involvement in thermal coal and/or causing other environmental damage.

--- insert table 4 ---

Second, we test if CSP metrics can identify companies that are included in market-leading sustainable thematic funds. Such funds are centered around a particular sustainability theme. The

⁵On average, a company is excluded by 1.5 asset owners. 73 companies are on the exclusion lists of three or more investors. We retain all companies in our study, rather than selecting those that are excluded by multiple investors, to avoid selection bias.

companies that are invested in by these funds can be seen as providing sustainability solutions according to the fund managers. We therefore test if CSP metrics can identify these companies. Our proposition is:

Proposition 1b: *Adequate metrics of sustainability performance assign good scores to companies that are included in sustainable thematic investment strategies.*

To test this proposition, we assess the SDG and ESG performance of companies included in leading sustainable thematic funds relative to the benchmark. We focus on three themes: energy, water, and health. We chose these because they comprise relevant environmental and social dimensions of sustainable development that are well established in the sustainable investing industry. We identified funds or ETFs with considerable track-records. In total, we analyzed the holdings of 17 funds/ETFs (Table 5). 1,082 companies were invested in by these funds. As different funds can invest in the same companies we removed duplicates. 598 firms are included in our study.

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3.2 Sustainable investing regulation: the EU taxonomy

Our second test investigates how well CSP metrics align with sustainable investing regulation. In recent years regulators have increasingly passed regulation governing sustainable investing (Ahlström & Monciardini, 2022). The EU taxonomy is a prime example.

The EU taxonomy is a classification system for sustainable economic activities. It establishes technical screening criteria that determine the conditions under which economic activities: (i) qualify as contributing to one or more of six environmental objectives⁶; and (ii) do not cause significant harm to one or more of those environmental objectives (European Commission, 2021). These screening criteria apply to economic sectors.⁷ To be aligned with the EU taxonomy, activities must furthermore comply with minimum social safeguards, such as those represented by major ILO conventions, OECD Guidelines for Multinational Enterprises, and the UN Guiding Principles on Business and Human Rights. With these technical screening criteria the EU has adopted into its regulatory framework definitions of which types of corporate activities provide solutions for promoting environmental sustainability, while simultaneously defining what types of behavior violate the ‘do no significant harm’ (DNSH) principle. With this taxonomy the EU wants to support investors to channel financing towards companies that help meet the EU’s 2030 climate and energy targets and attain the European green deal, while also reducing greenwashing in the financial sector, and helping companies to become more environmentally sustainable (European Commission, 2022).

The EU taxonomy thereby offers a tool for testing the validity of CSP metrics. On the one hand, it can be proposed that a good metric of sustainability performance should assign poor ratings to companies causing significant harm to environmental objectives (proposition 2a). On the other hand, it can be suggested that good ratings should be given to companies that provide solutions to promoting environmental objectives (proposition 2b). The fact that the EU taxonomy is integrated into the European Union’s institutional framework for sustainable finance indicates that this test validates if metrics of sustainability performance are in line with regulatory requirements.

Proposition 2a: *Adequate metrics of sustainability performance assign poor scores to companies that violate the EU taxonomy’s Do No Significant Harm principle.*

⁶The Taxonomy Regulation establishes six environmental objectives: (i) climate change mitigation; (ii) climate change adaptation; (iii) The sustainable use and protection of water and marine resources; (iv) the transition to a circular economy; (v) pollution prevention and control; (vi) the protection and restoration of biodiversity and ecosystems.

⁷The European Commission created an online tool that allows users to assess the technical screening criteria applicable to economic sub-sectors. See: https://ec.europa.eu/sustainable-finance-taxonomy/tool/index_en.htm

Proposition 2b: *Adequate metrics of sustainability performance assign good scores to companies that have significant shares of EU taxonomy-aligned revenues.*

To test these propositions, we collect data on companies' alignment with the EU taxonomy from Sustainalytics. Our sample is MSCI ACWI. In order to assess proposition 2a, we use the Sustainalytics datapoint 'overall DNSH breach flag'. This metric gauges whether an individual company is breaching the taxonomy's DNSH principle. 23 companies are flagged. To assess proposition 2b, we use the Sustainalytics datapoint 'overall percentage of aligned revenue', which describes the percentage of a company's revenues that can be considered to be aligned with the EU taxonomy's climate change mitigation and adaptation objectives.⁸ From this list, we select the 82 companies that generate over 66% of their revenues from activities that help tackle climate change in line with the EU taxonomy's technical screening criteria.⁹ These can be considered to be companies providing environmental sustainability solutions. For both groups, we compare their SDG and ESG performance relative to the scores of the companies in the benchmark.

3.3 Climate science: Greenhouse gas emissions

Our final test surveys how well CSP metrics capture companies' greenhouse gas (GHG) emissions. The aim is to determine if such metrics can identify the companies that are the major drivers of climate change.

This test is important from a climate science perspective. It is well established that anthropogenic GHG emissions cause global warming (IPCC, 2021). Compared to pre-industrial levels, global average temperatures have risen by 1.1°C (IPCC, 2021). The dire consequences of climate change are already noticeable in the degradation of ecosystems, erosion of biodiversity, disruption of food production systems, and an increase in frequency and severity of natural hazards – like storms, droughts, and floods (IPCC, 2022). These effects, especially if left unmitigated, will make life on Earth much less hospitable to human wellbeing, likely in irreversible ways (Rockström et al., 2009; Steffen et al., 2015). To avoid the worst impacts of climate change, most governments have adopted the Paris Agreement on Climate Change, which aims to limit global warming to ideally 1.5°C and maximum 2°C. Companies emit greenhouse gases and thereby play an important role in meeting this ambition. A handful of companies can be linked to the worst impacts on climate change: just 100 companies have been responsible for over 70% of GHG emissions since 1988 (Carbon Disclosure Project, 2017). Hence, it can be expected that sustainable investors want to avoid the majority of firms with high GHG emissions (Galaz, Crona, Dauriach, Scholtens & Steffen, 2018). On this basis, we propose:

Proposition 3a: *Adequate metrics of sustainability performance assign poor scores to the majority of companies that have high greenhouse gas emissions.*

To test this proposition, we apply an absolute and a relative perspective.¹⁰ First, we collect GHG emissions data from TruCost for the companies in the MSCI ACWI. We focus on scope 1 (direct

⁸ At the time of writing, the EU has adopted technical screening criteria for two of its six environmental objectives, which are climate change mitigation and climate change adaptation.

⁹ 406 companies in the MSCI ACWI benchmark that are under coverage by Sustainalytics generate more than 0% revenues from EU taxonomy aligned activities and thus provide products that contribute to climate change mitigation. It is interesting to note that out of these 406 companies, 98 generate less than 1% of revenues from such activities. 125 companies have anywhere between 1% and 10% of EU taxonomy aligned revenues; 65 companies generate between 10% and 33% of their sales from climate change mitigation products; 33 firms have between 33% and 66% of their revenues from EU taxonomy aligned activities; and 82 firms generate more than two-thirds of their sales from these activities. It therefore appears that climate change mitigation either is a side-activity for companies – accounting for a small share of overall revenues – or that it requires specialization and thus accounts for the majority of companies' revenues. In between these ends we find far fewer companies that generate moderate to significant shares of taxonomy aligned revenues.

¹⁰ Understanding companies' impacts on climate change first of all requires an absolute view on corporate emissions. The reason is that the carbon budget for keeping global warming below 2°C is absolute. However, focusing on absolute emissions introduces a size bias, whereby companies of larger sizes are expected to have higher emissions compared to smaller sizes. It also overlooks how efficient companies are at increasing revenues while decreasing emissions, which is an important metric for companies to manage their impacts on climate change. We therefore also provide a relative perspective, looking at emissions per unit of revenue (GHG intensity).

emissions from operations, including owned or controlled sources), scope 2 (indirect emissions from purchased consumed energy), and scope 3 (indirect emissions that occur up- and downstream in the value chain). We sum each company's scope 1 and 2 emissions and keep scope 3 as a separate category. Then we assess how much of the benchmark's absolute emissions are covered by a negative SDG score and a poor ESG rating (a high or severe ESG risk rating from Sustainalytics; an ESG laggard classification from MSCI; or being rated in the bottom-25% by Refinitiv and S&P). This gives us an insight into how well CSP metrics capture absolute GHG emissions.

Secondly, we collect data on companies' revenues. By combining companies' emissions and their revenues, we calculate each company's GHG intensity. This way, we know which companies have the highest emissions per unit of revenues, allowing us to compare companies of different sizes. We calculate two types of GHG intensities: one for companies' summed scope 1 and 2 emissions; and one for companies' scope 3 emissions. With these GHG intensities we create two samples of companies. The first sample includes the 100 companies with the highest scope 1 and 2 intensity, the second comprises the 100 firms with the largest scope 3 intensity.¹¹ We compare the SDG and ESG performance of these two groups to the rest of the companies in the benchmark. We use 2019 as a baseline, to avoid any abnormal fluctuations in companies' GHG emissions caused by the Covid-19 pandemic.

Other data on companies' environmental footprint is available, such as water use, waste creation, and recycling. We chose to focus only on companies' GHG emissions as, despite facing challenges itself (especially concerning scope 3), this is the most mature metric available and as it is comparable across borders.

3.4 Cause and effect: A note on the potential for mechanical correlation

We aim to avoid finding mechanical correlations that reflect the methodologies, rather than the outcomes, of the CSP metrics in our study. Our tests focus as much as possible on dimensions that are not directly taken into account in the CSP metrics' designs. First, the SDG score does not explicitly assess investors' exclusion policies (although it aligns with Robeco's exclusion list, which is why we did not include this in our tests), it does not directly link to how sustainable thematic funds are built, it does not directly integrate the EU taxonomy, and it does not steer on companies' GHG emissions. Second, as far as we are aware, the ESG ratings included in our study do not directly capture investors' exclusions, sustainable thematic investments, the EU taxonomy, or GHG emissions.

4. Results

This section presents how the SDG score and ESG ratings do on each of our propositions and subsequently offer company examples that illustrate these results.

4.1 Do CSP metrics align with investors' revealed sustainability preferences?

4.1.1 SDG score

Figure 2 shows how SDG scores are distributed for companies on asset owners' exclusion lists (pink) and for companies held by sustainable thematic funds (blue). We also show how SDG scores are distributed for the MSCI ACWI constituents as a relevant benchmark (grey).

--- insert figure 2 ---

The majority (87%) of excluded companies gets a negative SDG score, with 3% and 10% respectively receiving neutral and positive scores. The median SDG score of excluded companies is -2,

¹¹We find that the 100 highest emitting companies from a summed scope 1 and 2 intensity perspective account for 67% of MSCI ACWI's absolute scope 1 and 2 emissions. The 100 highest emitting companies from a scope 3 intensity perspective account for 63% of the benchmark's absolute scope 3 emissions. This implies that companies that have high GHG emissions per unit of revenue (i.e. high GHG intensity) also account for the lion share of absolute emissions.

indicating that these firms exert negative-medium impact on the SDGs. In contrast, we find that most companies in sustainable thematic funds obtain a positive SDG score. 86%, 6% and 7% of these companies get positive, neutral, and negative SDG scores. The median SDG score of these companies is +2, signaling that they make medium-positive contributions to sustainable development. These findings are similar for companies in different exclusion categories, as well as across companies in differently themed sustainable funds, indicating that the results are consistent for different dimensions of sustainability performance. The distribution of SDG scores of excluded companies is significantly lower ($U = 223999; p < .001$), and the SDG scores of sustainable thematic firms are significantly higher ($U = 557073; p < .001$) than the scores of the companies in MSCI ACWI (median SDG score = +1).

4.1.2 ESG ratings

Figure 3 shows the same assessment for the ESG scores of the four providers. We find no strong distinction in ESG performance between excluded companies, sustainable companies, and those in the benchmark.

--- insert figure 3 ---

Excluded companies show diversity in the extent to which they get a poor ESG rating. MSCI rates 21% as ESG laggards. Refinitiv and S&P respectively rank 27% and 41% in the bottom quartile (compared to MSCI ACWI). And Sustainalytics states that 65% faces high or severe ESG risks. The rest of the companies are average (65%) or leading (14%) ESG companies according to MSCI; have medium (28%) or low (8%) ESG risk according to Sustainalytics; or respectively rank in the mid-50% (23%; 42%) or top-25% (50%; 17%) according to Refinitiv and S&P. Although there is some variation in ESG performance across the exclusion themes, no provider unequivocally gives poor scores to the majority of these firms. Sustainalytics gives worse average ESG ratings to excluded companies than to those in the benchmark whereby these differences are statistically significant ($z = 16.372; p < .001$). S&P gives slightly lower ESG ratings to excluded companies than benchmark firms S&P ($z = 5.336; p < .001$). MSCI assigns a median rating of 0 (or BBB in the alphabetical rating) to excluded companies as well as those in the benchmark, yet the distribution in ratings is found to differ between these groups ($z = 3.667; p < .001$). Excluded companies receive better ratings than firms in the benchmark in Refinitiv's assessment ($z = -2.772; p = .003$).

We find similar diversity in ESG performance among companies in sustainable thematic funds. MSCI rates 38% of these companies as an ESG leader, 58% as average, and 4% as laggards. According to Sustainalytics, 30%, 45%, and 25% of these companies respectively face low, medium, and high ESG risk. Refinitiv and S&P rate 29% and 28% of the companies in these funds in the top-quartile compared to the benchmark. These two agencies furthermore respectively rate 43% and 55% in the middle two quartiles, and 28% and 17% in the bottom quartile. The results are relatively comparable for each of the three sustainable themes. No statistically significant differences were found between the ESG ratings for sustainable thematic companies and the companies in the benchmark for the ratings of Sustainalytics ($z = -0.874; p = .191$), Refinitiv ($z = -0.173; p = .431$) and S&P ($z = -0.415; p = .339$). With a median rating of 1 (A – or average in the alphabetical rating), the MSCI ESG rating is slightly higher for sustainable thematic companies than the benchmark companies, whose ESG rating is 0 (BBB – or average in the alphabetical rating), which is a statistically significant difference ($z = -12.385; p < .001$).

4.2 Do CSP metrics align with sustainable finance regulation?

4.2.1 SDG score

Figure 4 displays the distribution of SDG scores for companies that violate the EU Taxonomy's DNSH principle in pink. In blue, it shows how SDG scores are distributed for companies generating different

proportions of their revenues from activities that are aligned with the EU Taxonomy. These activities are considered to help mitigate and/or adapt to climate change. The SDG scores of the benchmark are shown in grey.

--- insert figure 4 ---

All 23 companies that are seen to breach the EU Taxonomy's DNSH principle, and that thus cause harm, have a negative SDG score. The median score for these firms is -2, signaling that they have medium negative impact on the SDGs. This is significantly lower than the +1 median SDG score of the benchmark companies ($U = 31513; p < .001$). Among the companies with EU Taxonomy-aligned revenues we find more diverse SDG scores. Firms generating a relatively low share of revenues from activities that help tackle climate change (<33%) show dispersed SDG scores. In contrast, companies generating over 66% of their revenues from activities aligned with the EU taxonomy generally receive positive SDG scores. The median SDG score of the 81 firms in this category is +3, indicating that these companies have highly positive impact on the SDGs. Again, this is significantly higher compared to the benchmark's SDG scores ($U = 107853; p < .001$). We also test the correlation between a company's SDG score and its percentage of taxonomy aligned revenues, with our sample being the 405 companies in the benchmark with more than 0% revenues from taxonomy aligned activities. The Pearson correlation coefficient is 0.41.

4.2.2 ESG ratings

The same test is done for each of the four types of ESG ratings in this study. Figure 5 shows the ESG performance of companies violating the EU taxonomy's DNSH principle (pink), for firms with particular shares of taxonomy-aligned revenues (blue), and for the benchmark (grey).

--- insert figure 5 ---

The ESG performance of companies that cause harm, and are thus seen to breach the DNSH principle, varies depending on the rating agency. Of the 21 firms covered by Sustainalytics, 16 are rated as having high or severe ESG risks, 4 have medium risk, and 1 firm is seen to be low-risk. These companies' ratings are lower than the average Sustainalytics ESG rating of the companies in the benchmark ($t = 3.997; p < .001$). Out of 23 companies, MSCI rates 11 as ESG laggards, 1 as ESG leader, and 11 as average ESG performers, leading companies that cause significant harm to have slightly poorer ESG performance than the benchmark (median score of -1 compared to 0; $t = 3.628; p < .001$). Refinitiv rates 8 of the 17 companies it assesses within the top-25% of ESG rated companies in the benchmark, and just 1 company in the bottom-25%. Companies causing harm thereby have better Refinitiv ESG ratings than the companies in the benchmark ($t = -2.77; p = .006$). Similarly, S&P rates 14 of the 21 companies within its scope in the top-25% of ESG rated companies in the universe, with only 2 companies being rated in the bottom-25%. The companies violating the DNSH principle thereby have a better S&P ESG profile compared to the benchmark ($t = -4.056; p < .001$).

The ESG rating of companies generating over two-thirds of their revenues from activities in line with the EU taxonomy is rather similar to the ESG performance of the benchmark. Sustainalytics classifies 45%, 37.5%, and 17.5% of these companies as having low, medium and high ESG risk. This is the only provider giving slightly better ratings to these companies compared to the distribution of ESG ratings in MSCI ACWI ($z = -3.236; p = .001$). These companies receive similar ratings compared to the companies in the benchmark in the ratings of Refinitiv ($z = 0.05; p = 0.959$), S&P ($z = 0.333; p = 0.738$), and MSCI ($z = -0.414; p = 0.339$). For instance, MSCI rates 24% of these firms as ESG leaders and 19% as ESG laggards, while the median rating is BBB, which is the same as the median rating for the benchmark. Refinitiv and S&P similarly and respectively rate 31% and 22% of these companies in the top-25% of ESG performers compared to the benchmark. 24% and 20% are

in the bottom-25%, with the middle-50% making up 46% and 58% of Refinitiv's and S&P's ESG ratings. Adding to this, we also test whether a company's ESG rating is correlated to its degree of taxonomy-aligned revenues. We respectively find Pearson correlation coefficients of 0.22, -0.12, -0.22, and -0.06 describing the relations between the ESG ratings of Sustainalytics, Refinitiv, S&P and MSCI, and companies' shares of EU taxonomy-aligned revenues.

4.3 Do CSP metrics align with climate science?

4.3.1 SDG score

First, we find that companies with a negative SDG score (-1; -2; and -3) account for 62% of all absolute scope 1 and 2 emissions in the MSCI ACWI benchmark. Similarly, negative scoring companies represent 60% of the benchmark's total scope 3 emissions. Second, we show the distribution of SDG scores for the 100 companies with the highest scope 1 and 2 emissions, and those 100 firms with the biggest scope 3 emissions, in figure 6.

--- insert figure 6 ---

The 100 highest polluting companies in terms of their scope 1 and 2 emissions have a median SDG score of -3, indicating they have high-negative impact on the SDGs. The distribution of SDG scores for these companies differs from the distribution of scores for the benchmark, which sees more positive scores ($U = 72024; p < .001$). The 100 firms that have the largest scope 3 emissions have a median SDG score of -1, which indicates low-negative SDG impact. This distribution is lower than the distribution of SDG scores in the benchmark ($U = 119760; p < .001$). As the figure shows, both the biggest emitters in terms of scope 1 and 2 emissions, and especially those with high scope 3 emissions, show diversity in SDG scores. In the former, we find 62 companies with negative SDG scores, 16 with a neutral score, and 22 that have a positive SDG score. In the latter, 51, 7, and 42 companies respectively have negative, neutral, and positive SDG scores.

4.3.2 ESG ratings

We first find that ESG raters have varying views on GHG emissions. The companies that Sustainalytics rates as facing high or severe ESG risks account for 64% of the benchmark's scope 1 and 2 emissions, and for 55% of total scope 3 emissions. In the MSCI rating, ESG laggards generate 33% of the benchmark's scope 1 and 2 emissions and 16% of scope 3 emissions. Of the benchmark's scope 1 and 2 emissions, 15% and 11% is respectively caused by companies with a bottom-25% rating from Refinitiv and S&P. Of all scope 3 emissions, 12% and 9% receive a bottom quarter ESG rating from these two agencies.

Second, in figure 7 we show how the 100 companies with the highest scope 1 and 2, and scope 3, emissions fare on each of the four ESG ratings and how this relates to the ESG performance of the benchmark.

--- insert figure 7 ---

First, Sustainalytics assigns poorer ratings to high emitting companies than the benchmark, both for scope 1 and 2 emissions ($z = 9.615; p < .001$) and for those with high scope 3 emissions ($z = 8.863; p < .001$). It respectively assesses 88 and 89 companies of the 100 companies with the highest emissions in these two groups. 58 of the 88 companies topping the benchmark's scope 1 and 2 emissions, and 64 of the 89 companies with the highest scope 3 emissions, are rated as having high ESG risk. 2 and 7 companies that are among the top scope 1 and 2, and scope 3, emitters have low ESG risk, with the remaining 28 and 17 companies having medium ESG risk. Second, Refinitiv has a similar rating for companies with high scope 1 and 2 emissions and companies in the benchmark ($z = 0.962; p = .168$), as well as to the highest scope 3 emitters ($z = -0.382; p = .351$). Third, S&P ESG ratings of the benchmark are similar to those of the highest scope 1 and 2 emitters ($z = -1.192; p =$

.117) and to those of the highest scope 3 emitters ($z = 0.944; p = .173$). Finally, MSCI gives slightly better ratings to companies in the benchmark than to those top scope 1 and 2 emitters ($z = 7,243; p < .001$), as well as to the highest scope 3 emitters ($z = 3,145; p = .002$). Among the 92 companies that MSCI covers among the highest scope 1 and 2 emitters, 40 are rated as ESG laggards, 47 as average ESG performers, and 2 as leaders. Out of 86 top scope 3 emitters, 30, 44, and 13 are seen as ESG laggards, average, and leaders.

4.4 Company examples

Which companies explain these results? Table 6 shows ten companies' SDG scores and ESG ratings to illustrate each proposition. Explanations for these companies' SDG scores and (some of their) ESG ratings are provided to help understand why a particular company's CSP metric is (mis)aligned with our propositions.

--- insert table 6 ---

5. Implications

5.1 Corporate sustainability performance based on the SDGs

Sustainable investors need to know how companies impact societies and the environment. In this paper we introduced the Robeco SDG score as a novel CSP metric that measures companies' positive and negative contributions to the SDGs. We then developed three tests for gauging the construct validity of this novel CSP metric. We tested if this SDG score aligns with: (i) investors' revealed sustainability preferences; (ii) sustainable investing regulation; and (iii) climate science. The results were compared to ESG ratings, which are the dominant metric used in sustainable investing (Fiaschi et al., 2020; Linnenluecke, 2022; Popescu et al., 2021; Scheitza et al., 2022) although they focus mostly on financial risk rather than sustainability impact (Amel-Zadeh & Serafeim, 2018; Giese et al., 2019). This comparison was made to assess if the SDG score is distinct from, and therefore contributes something new to, existing CSP metrics (discriminant validity).

We find that the SDG score aligns with these propositions. First, the SDG scores for excluded companies are significantly lower, and those for sustainable thematic firms are considerably higher, than the scores of the companies in the benchmark (propositions 1a, 1b). Second, SDG scores of companies breaching the EU taxonomy's DNSH principle all are negative and significantly lower, while the SDG scores of companies generating substantial revenues from taxonomy-aligned climate change activities are mostly positive and significantly higher than the scores in the benchmark (propositions 2a, 2b). Third, supporting proposition 3a, we reveal that companies with negative SDG scores count for over 62% of scope 1 and 2 emissions and for 60% of scope 3 emissions, whereby the 100 most polluting companies in these two groups receive significantly lower scores than companies in the benchmark.

As expected, the picture is different for ESG ratings. Despite divergence among individual ratings, all fall short of meeting these propositions. First, Sustainalytics and S&P have alignment with proposition 1a as they assign (somewhat) poorer ratings to excluded firms compared to the benchmark. MSCI and Refinitiv give similar or better ratings to these firms and thus do not meet proposition 1a. The MSCI ESG rating is somewhat better for sustainable thematic firms than the benchmark, thus having some agreement with proposition 1b, while the other ratings do not align with this proposition. Second, Sustainalytics and MSCI assign slightly poorer ratings to companies breaching the EU Taxonomy's DNSH principle compared to the benchmark, while Refinitiv and S&P give better ratings to these firms. Hence, the former two have some alignment with proposition 2a while the latter two do not. Adding to that, whereas Sustainalytics gives somewhat higher scores to companies aligned with the EU taxonomy's climate change objectives, the other three raters score these companies on par with

the benchmark. Hence, the Sustainalytics rating only slightly, and those of Refinitiv, S&P, and MSCI not at all, align with proposition 2b. Finally, Sustainalytics gives poorer ratings to high GHG emitting companies – in line with proposition 3a – while the other three rating agencies give similar (Refinitiv; S&P) or better ratings (MSCI) to the most polluting companies – thus being misaligned with this proposition.

Based on these findings, we conclude that an SDG score like the one introduced in this paper can be used to create sustainable investing strategies that align with sustainable development objectives. Given ESG ratings' dominant focus on financial risk, it is no surprise that these ratings do not align with our propositions. Although many investors and scholars equate them with how good a company is for the world – constituting considerable ambiguity (e.g., Scheitza et al., 2022) – our results underscore that an ESG rating is not to be understood as measuring companies' contributions to sustainable development. Hence, we caution against using concepts like ESG, sustainability, and impact interchangeably. This is not to say that ESG ratings cannot be part of (sustainable) investing strategies. As the European Commission (2021) argues with its concept of 'double materiality', investors do well to identify how sustainability considerations affect financial performance, as well as how investments influence the real world. An ESG rating may inform the former dimension, while a CSP metric like the SDG score can shed light on the latter. Because our results show that these different types of scores yield distinct results, they could complement one another.

These results have research implications. Scholars frequently use ESG ratings to measure CSP. Some use ESG as an independent variable, in order to explain how sustainability performance influences dependent variables, such as financial performance (e.g., Friede, Busch, & Bassen, 2015), access to capital (e.g., Cheng, Ioannou & Serafeim, 2014; El Ghoul, Guedhami, Kwok & Mishra, 2011), or stakeholder management (e.g., Fu, Boehe & Orlitzky, 2021). Others use ESG as a dependent variable and investigate how sustainability performance is affected by independent variables, like a firm's home country (e.g., Ioannou & Serafeim, 2012; Linnenluecke, 2022), its degree of internationalization (e.g., Attig, Boubakri, El Ghoul & Guedhami, 2014), or its board composition (e.g., Arayssi, Jizi, & Tabaja, 2020; Manita, Bruna, Dang & Houanti, 2018). ESG ratings can be very useful in such research yet deserves reflection. As we show ESG ratings to inadequately capture companies' contributions to sustainable development, we advise researchers to carefully consider if the CSP metrics they use measure what they intend to measure.

Finally, our results link to a paradox in sustainable investing: although sustainable investing is reaching significant scale and attracts major attention, a real shift towards more sustainable business practices is not taking shape (Busch et al., 2016; Dyllick & Muff, 2016). However, if ESG ratings, the dominant metric used in sustainable investing, do not gauge a company's impacts on human and planetary wellbeing, as this paper demonstrated, then it cannot be expected that strategies incorporating ESG support sustainable development.

5.2 Sustainable investing implications

A practical implication is that sustainable investors do well to target positive sustainable development contributions beyond avoiding ESG risks. Not making this shift is risky: sustainable investment strategies that solely integrate ESG ratings are likely to invest in companies with negative impacts, while missing investments in companies with positive contributions. This makes them likely to fall short of meeting their – and their clients' – sustainability objectives.

Table 7 illustrates these risks. We create two hypothetical sustainable investing scenarios, using MSCI ACWI as investment universe. Scenario one excludes the worst scoring companies. Scenario two retains the best performers. The table describes how these scenarios might be applied to each of the CSP metrics used in our study, whereby we set exclusion and inclusion thresholds based on the providers' definitions of what is good/bad performance (Robeco; Sustainalytics; MSCI) or based on

their relative scores in the benchmark (Refinitiv; S&P). We show investment implications, i.e., the percentage of companies that are excluded from the investment universe. We also shows sustainability implications, including: (i) how many companies with negative impact still are *included* in the investment universe, whereby a low number indicates that adverse impacts are avoided; (ii) how many companies with positive impact are *excluded* from the investment universe, whereby a low number signals that positive impacts are prioritized; and (iii) what proportion of the universe's GHG emissions is *avoided*.

To explain, using an SDG score for the first scenario reduces the investment universe by 25%. In the remaining universe, we find 12% of companies excluded by asset owners and 0% of companies breaching the EU taxonomy's DNSH principle. At the same time, 9% and 4% of companies included in sustainable thematic funds and those generating over two-thirds of revenues from taxonomy-aligned solutions fall outside of this universe. Moreover, the remaining universe avoids some 60% of GHG emissions. The table underscores that ESG ratings lead to results that are much less aligned with sustainable development ambitions, which can be explained by their focus on financial materiality rather than sustainability impact.

--- insert table 7 ---

5.3 Limitations

Three limitations merit discussion. First, although there are only few SDG-type scores on the market, there is a risk that there is divergence among SDG scores – similar to the divergence among ESG ratings. While some variance will be inevitable, we expect divergence among SDG scores to be lower than among ESG ratings. The reason is that an SDG assessment will have the SDGs as a North Star for assessing impact. Such a universal blueprint against which sustainability is being assessed is lacking for ESG assessments, which is one source of their divergence (Berg et al., 2022). It would be interesting to test for the correlation between SDG scores of different providers. Second, in assessing if CSP metrics align with investors revealed sustainability preferences we had to rely on information from Western investors which may introduce a cultural bias. Investors from other regions may employ different exclusion lists and might deploy other sustainable thematic funds. Third, in gauging CSP metrics' construct validity we assessed if companies with relatively clear positive or negative impacts are identified. The companies in the middle between these outliers, those with less significant impacts on the world, remained out of scope of these tests.

5.4 Future research

We offer suggestions for future research along two lines. First, testing which ESG ratings are best able to identify financially-material risks could clear the confusion caused by the divergence of ESG ratings (cf. Berg et al., 2022). That there is divergence among these ratings is important knowledge. A follow-up question asks which of these ESG ratings best measures what they are supposed to. The tests presented in this paper reveal that none of the ratings adequately assess companies' contributions to sustainable development. Similar types of tests can gauge if risks that stem from ESG factors are adequately identified by different ratings – which tend to be the promise of ESG ratings.

Second, research on how investors impact the real is important and draws increased interest (Kölbl et al., 2020). Scholars have recently differentiated between impact-aligned investing and impact-generating investing (Busch et al., 2021). The former seeks to allocate capital away from companies with negative impacts and towards those providing positive solutions, while the latter sees investors actively create change, for instance through active ownership. Research on how these two types of strategies may lead to changes in the real world is in its infancy. For impact-aligned investing, it seems that unsustainable firms do not have lower access to financing than more sustainable firms (Blitz, Swinkels, & van Zanten, 2021) and divesting from stocks with negative impact is seen to have only a small, if any, effect on a company's cost of capital (Berk & van Binsbergen, 2021). These

findings may change if sustainable investing reaches a larger scale, and divestment still gives an important signal to markets, regulators, and other stakeholders on how investors assess sustainability (Kölbel et al., 2020). For impact-generating investing, scholarship on how investors may influence companies' sustainability policies is increasing (Barko, Cremers & Renneboog, 2021; Bauer, Derwall, & Tissen, 2022; de Groot, de Koning, & van Winkel, 2021; Dimson & Karakas, 2015; Doidge, Dyck, Mahmudi & Virani, 2019; Dyck, Lins, Roth & Wagner, 2019), whereby early evidence suggests that active ownership may drive sustainability performance (Kölbel et al., 2020). Investigations into the strategies that investors may employ to promote sustainable development, and the impact that this has on the real world, is worthwhile.

6. Concluding Remarks

Sustainable investors seek to contribute to sustainable development, and are increasingly seen as having significant power promoting progress. Creating sustainable investing strategies requires knowing how much the companies that might be invested in advance or deteriorate sustainable development. However, investors disagree on how corporate sustainability performance (CSP) is best measured.

This paper introduced a novel CSP metric that measures companies' contributions to the Sustainable Development Goals (SDGs). It then developed three tests for gauging the construct validity of CSP metrics. Our findings showed that the SDG score: (i) captures investors' revealed sustainability preferences by assigning poor scores to companies on asset owners' exclusion lists and giving good scores to companies in sustainable thematic funds; (ii) aligns well with the EU taxonomy by giving poor scores to companies breaching the 'do-no-significant-harm' principle and good scores to firms generating significant revenues from taxonomy-aligned activities; and (iii) contributes to climate change mitigation ambitions by assigning poor scores to the majority of companies with very high emissions. We found that ESG ratings, which aim to measure financial risk coming from sustainability issues rather than sustainability impact, do not score well on these dimensions. Thus, the SDG score enjoys discriminant validity compared to ESG ratings.

Overall, our results create clarity around interpreting the variety of CSP metrics that are used in sustainable investing. We contend that metrics designed to capture the positive and negative impacts that companies have on sustainable development, like the SDG score introduced in this paper, are needed to help investors pursue sustainable development.

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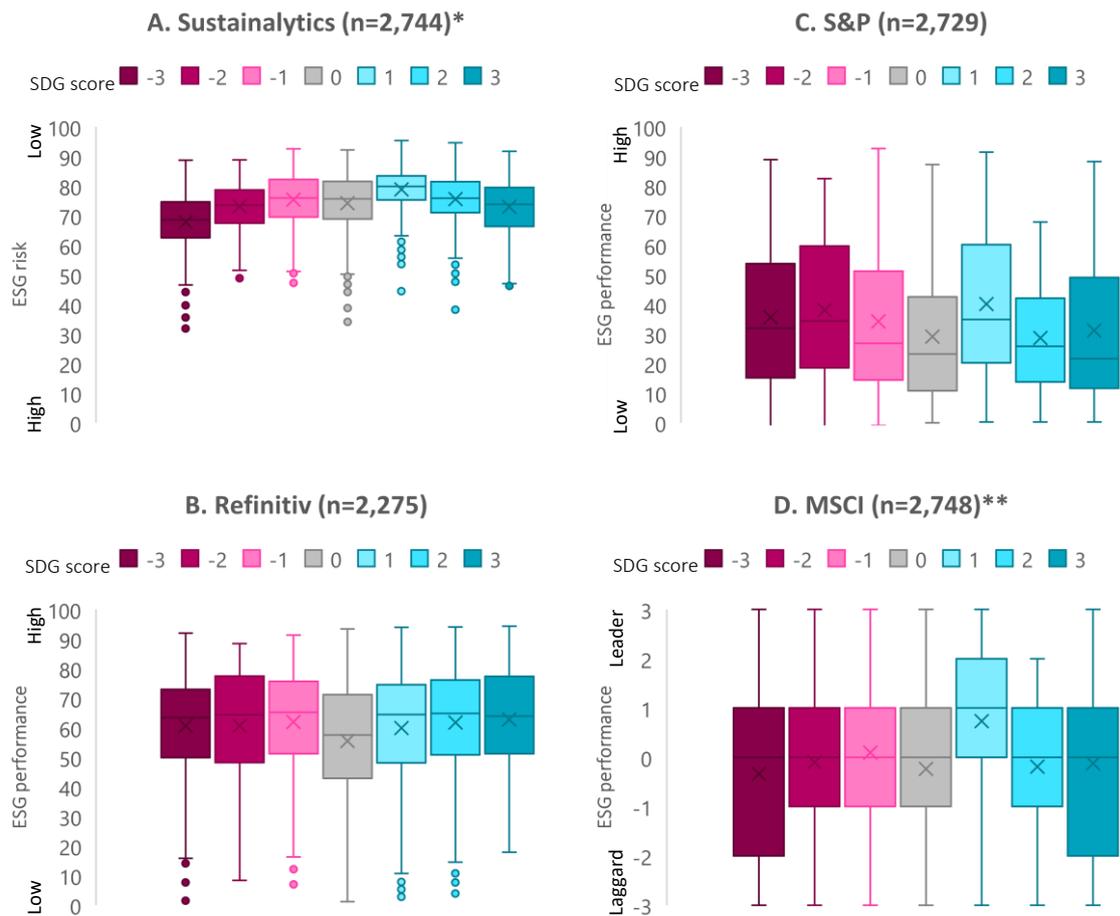
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Figure 1 – Distribution of ESG ratings for companies with each of seven types of SDG scores



*Sustainalytics ESG ratings rank from 0 (low ESG risk) to 100 (high ESG risk). To align with the results of the other rating agencies, who assign higher ratings to better performing companies, the Sustainalytics ESG ratings have been reversed in this graph by subtracting them from 100.

** MSCI assigns seven types of ESG ratings to companies, varying from AAA (leader) to CCC (laggard). The ratings were converted to a numerical scale, ranging from +3 (leader, AAA) to -3 (laggard, CCC).

Figure 2 – Distribution of SDG scores for companies on exclusion lists, in sustainable thematic funds, and the benchmark

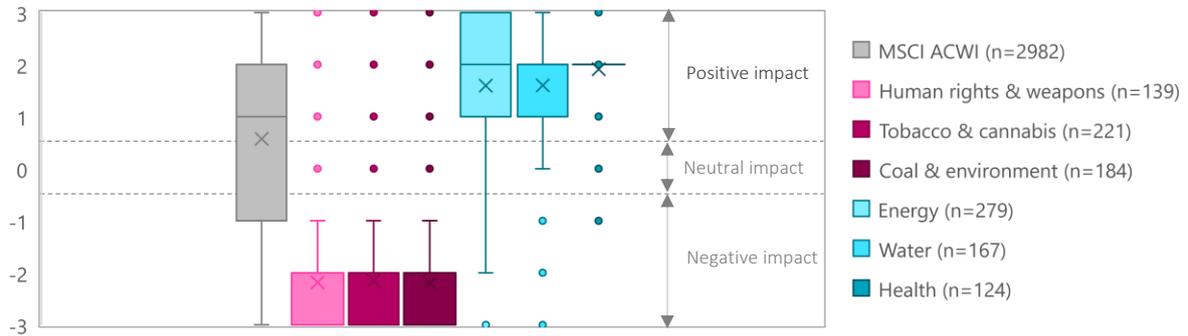
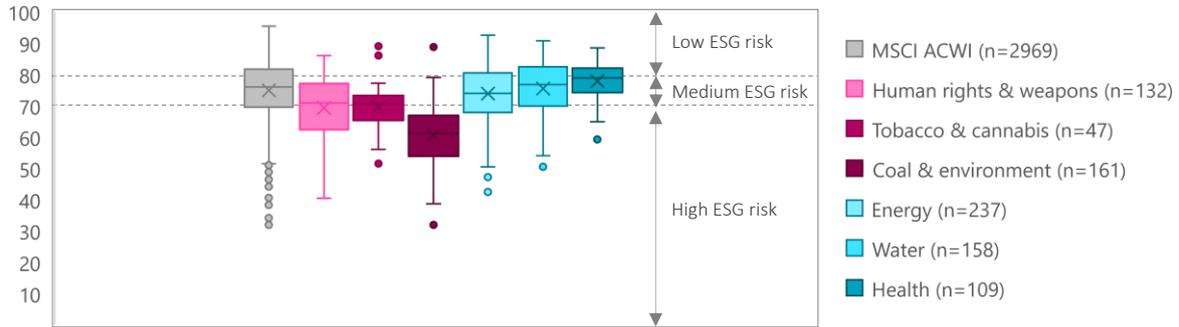
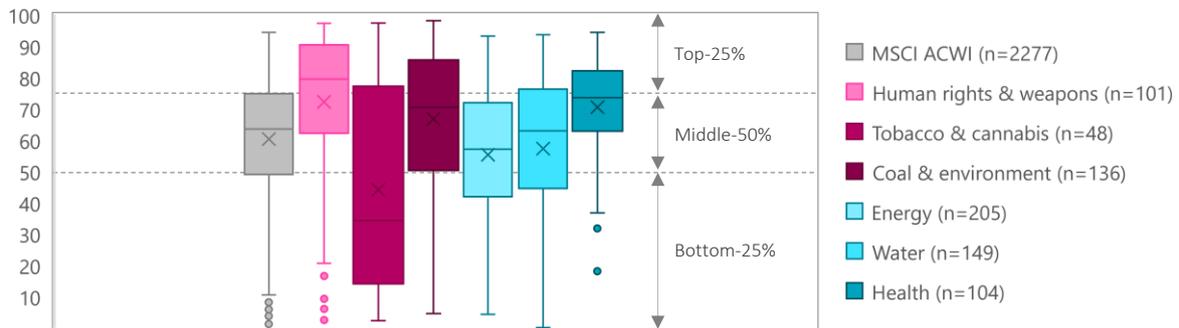


Figure 3 – Distribution of ESG ratings for companies on exclusion lists, in sustainable thematic funds, and the benchmark

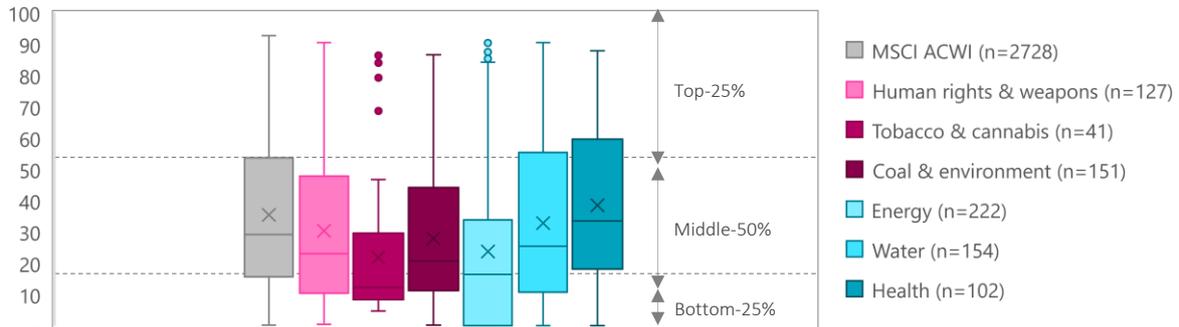
A. Sustainalytics*



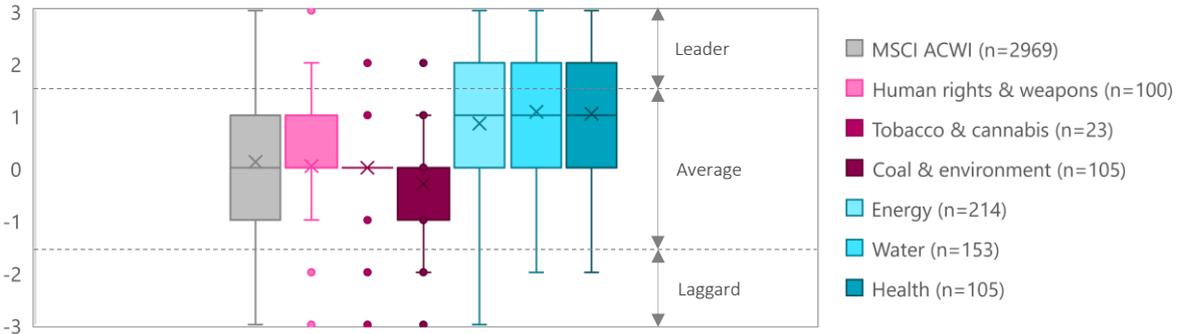
B. Refinitiv



C. S&P



D. MSCI*



*Sustainalytics ESG ratings rank from 0 (low ESG risk) to 100 (high ESG risk). To align with the results of the other rating agencies, who assign higher ratings to better performing companies, the Sustainalytics ESG ratings have been reversed in this graph by subtracting them from 100.

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Figure 4 – Distribution of SDG scores for companies breaching the EU Taxonomy’s Do No Significant Harm principle, for companies with particular shares of EU Taxonomy aligned revenues, and the benchmark

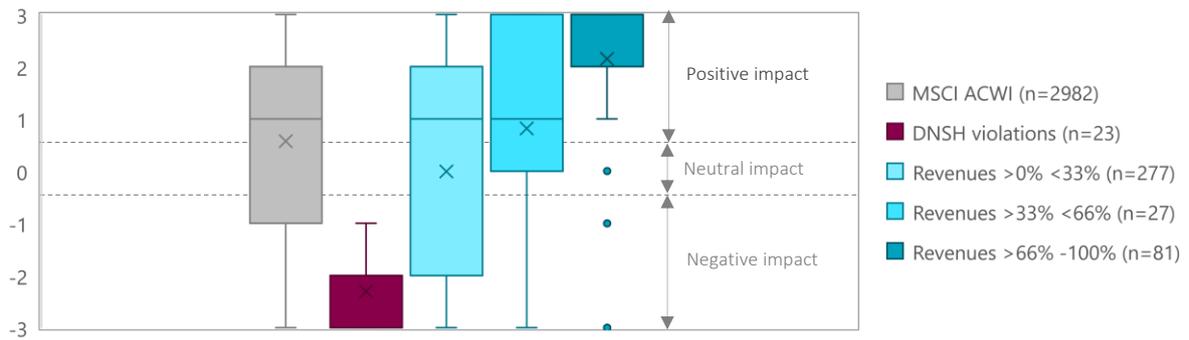
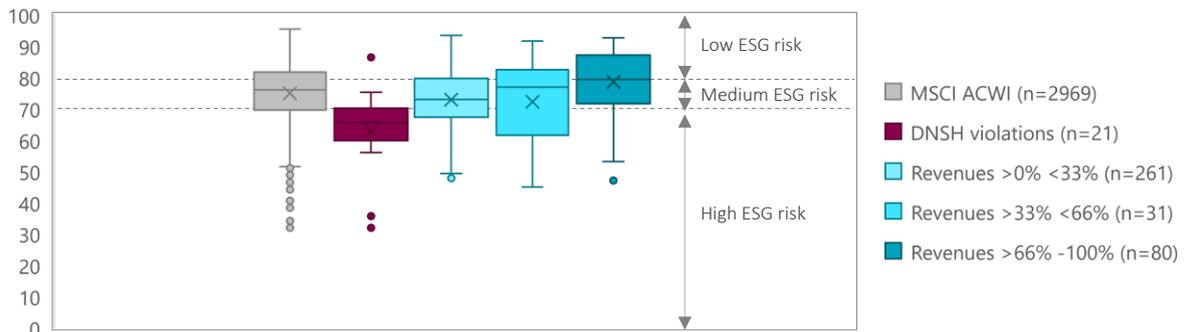
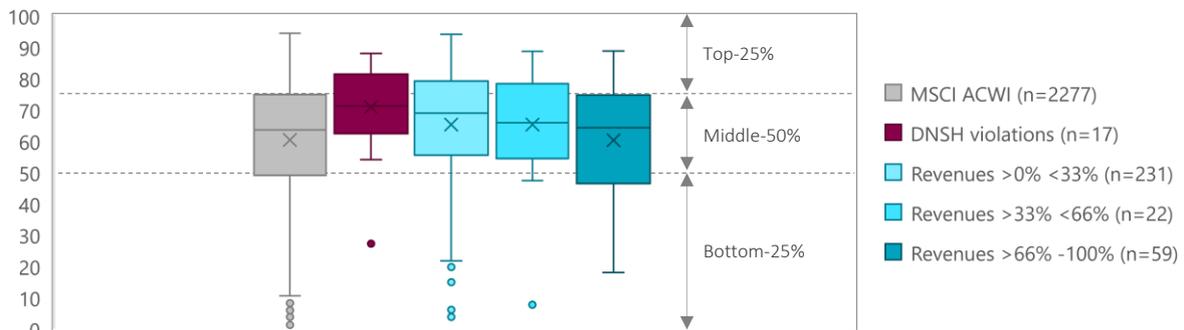


Figure 5 – Distribution of ESG ratings for companies breaching the EU Taxonomy’s Do No Significant Harm principle, for companies with particular shares of EU Taxonomy aligned revenues, and the benchmark

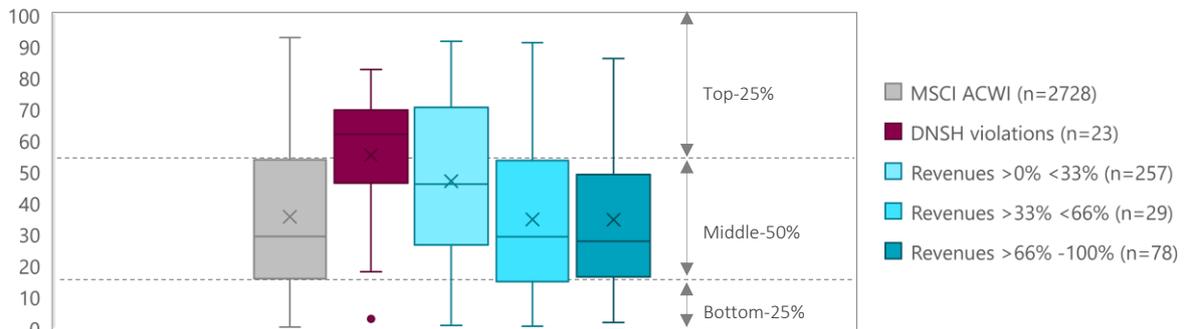
A. Sustainalytics*



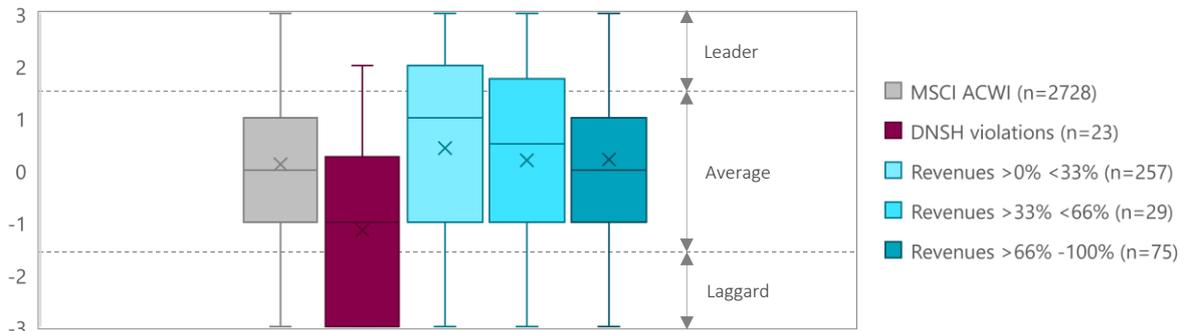
B. Refinitiv



C. S&P



D. MSCI*



*Sustainalytics ESG ratings rank from 0 (low ESG risk) to 100 (high ESG risk). To align with the results of the other rating agencies, who assign higher ratings to better performing companies, the Sustainalytics ESG ratings have been reversed in this graph by subtracting them from 100.

** MSCI assigns seven types of ESG ratings to companies, varying from AAA (leader) to CCC (laggard). The ratings were converted to a numerical scale, ranging from +3 (leader, AAA) to -3 (laggard, CCC).

Figure 6 – Distribution of SDG scores for the 100 companies with the highest scope 1 and 2 emissions, the 100 companies with the highest scope 3 emissions, and the benchmark

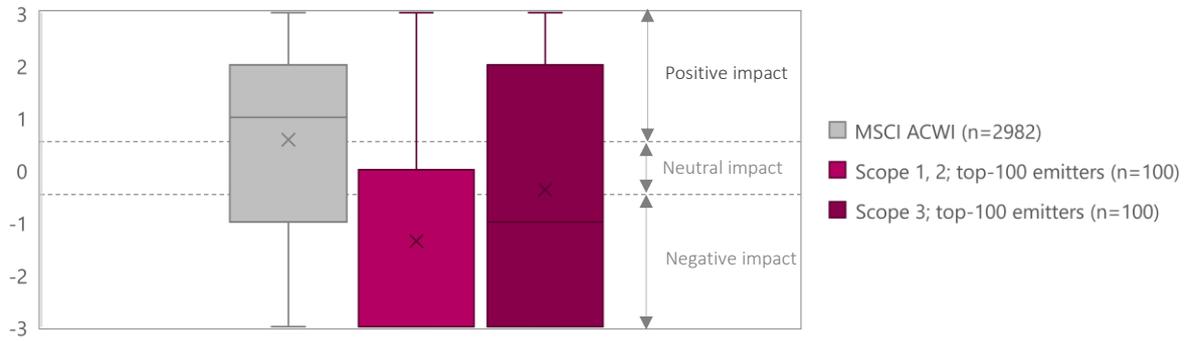
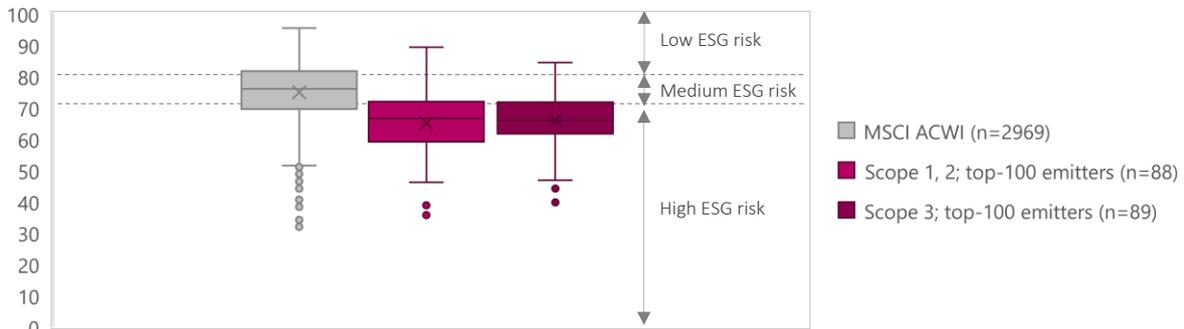
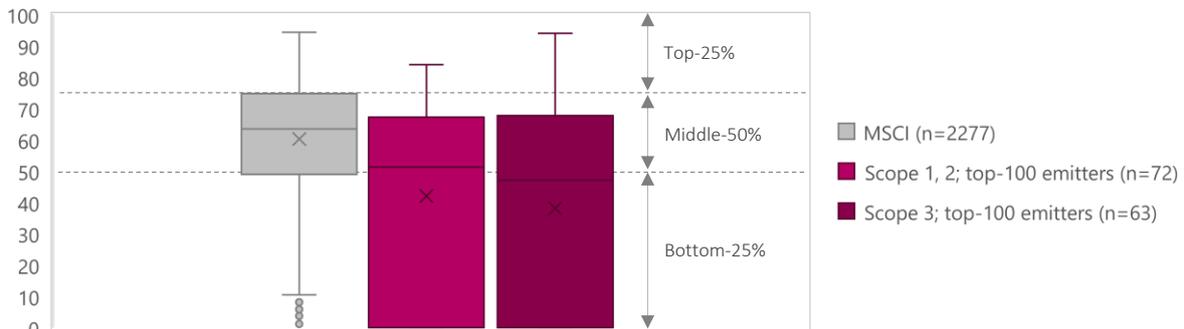


Figure 7 – Distribution of ESG ratings for the 100 companies with the highest scope 1 and 2 emissions, the 100 companies with the highest scope 3 emissions, and the benchmark

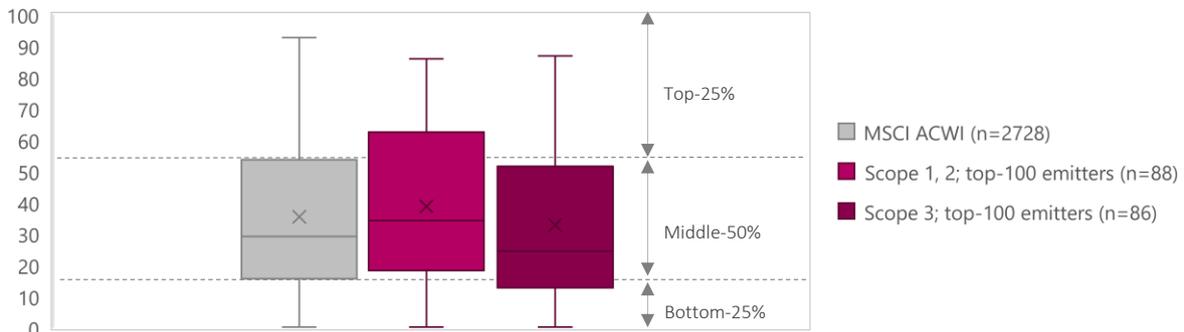
A. Sustainalytics*



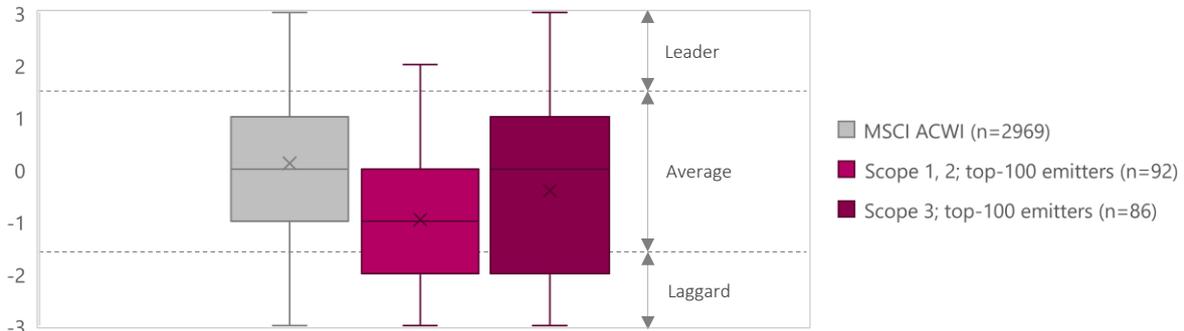
B. Refinitiv



C. S&P



D. MSCI*



*Sustainalytics ESG ratings rank from 0 (low ESG risk) to 100 (high ESG risk). To align with the results of the other rating agencies, who assign higher ratings to better performing companies, the Sustainalytics ESG ratings have been reversed in this graph by subtracting them from 100.

** MSCI assigns seven types of ESG ratings to companies, varying from AAA (leader) to CCC (laggard). The ratings were converted to a numerical scale, ranging from +3 (leader, AAA) to -3 (laggard, CCC).

Table 1 – Glossary of key concepts

Sustainable investing: a generic term for investment strategies that seek to contribute toward sustainable development (cf. Busch et al., 2016:304).

Sustainable development: development that meets the needs of the present without compromising the ability of future generations to meet their own needs (cf. WCED, 1987), whereby specific sustainable development objectives are conceptualized by the 17 Sustainable Development Goals (SDGs) and their 169 underlying targets.

Corporate sustainability performance (CSP): the extent to which a company positively or negatively contributes to sustainable development.

Table 2 – Average SDG scores per sector and across countries

Sector	Average SDG score
Communication Services (n=176)	0,3
Consumer Discretionary (n=305)	-0,1
Consumer Staples (n=242)	-0,8
Energy (n=108)	-1,8
Financials (n=463)	1,2
Health Care (n=275)	2,3
Industrials (n=421)	0,7
Information Technology (n=365)	1,0
Materials (n=297)	-0,1
Real Estate (n=152)	0,8
Utilities (n=135)	-0,2
Country income status*	
Lower middle-income (n=149)	0,25
Upper middle-income (n=971)	0,50
High income (n=1822)	0,57

*Country income status is determined by the World Bank and based on the company's country of domicile.

Table 3 – Proportion of companies with positive and negative contributions to individual SDGs (n=2,981)*

Sustainable Development Goals	Negative contribution (SDG scores of -3, -2, -1)	Positive contribution (SDG scores of +1, +2, +3)
1. No Poverty	-	4%
2. Zero Hunger	3%	3%
3. Good Health and Well-being	7%	16%
4. Quality Education	-	1%
5. Gender Equality	0%	2%
6. Clean Water and Sanitation	0%	2%
7. Affordable and Clean Energy	7%	7%
8. Decent Work and Economic Growth	1%	28%
9. Industry, Innovation and Infrastructure	0%	33%
10. Reduced Inequalities	0%	-
11. Sustainable Cities and Communities	1%	13%
12. Responsible Consumption and Production	4%	3%
13. Climate Action	11%	2%
14. Life below Water	2%	0%
15. Life on Land	2%	1%
16. Peace, Justice and Strong Institutions	6%	4%
17. Partnerships for the Goals	0%	-

*Companies may contribute to multiple SDGs, both positively and negatively. The percentages shown in this table therefore do not sum to 100%. A company that has both positive and negative scores on individual SDGs will get the lowest (negative) score as its final SDG score.

Table 4 – Overview of exclusion lists

Asset owner / fund	Country	Description	Assets (billion USD)	Topics on exclusion list	Number of companies on exclusion list
Norway Government Pension Fund Global	Norway	National Norwegian pension fund	1.344,3	Coal; Nuclear; Tobacco; Human rights; Environment; Weapons	181
ABP	Netherlands	Pension fund for government and education professionals	586,3	Weapons; Nuclear; Tobacco	298
Pensioenfonds Zorg en Welzijn (PFZW)	Netherlands	Pension fund for health care and social work professionals	294,7	Tobacco; Coal; Weapons; Tar sands	207
Sjunde AP-fonden (AP7)	Sweden	Swedish premium pension system	83,9	Nuclear; Human rights; Cannabis; Environment; Labor rights; Weapons	86
NZ Super Fund	New Zealand	New Zealand Government savings vehicle	42,0	Cannabis; Tobacco; Nuclear; Weapons	291
Beroepsvervoer over de Weg	Netherlands	Pension fund for transport and logistics sector	41,8	Tobacco; Coal; Weapons; Human rights; Tar sands; Environment	225
Medische Specialisten (SPMS)	Netherlands	Pension fund for health care professionals	16,0	Tobacco; Nuclear; Controversial weapons	189

Table 5 – Overview of sustainable thematic funds

	Fund name	Inception	Number of holdings	Assets under management (million US\$)
Energy	First Trust Global Wind Energy ETF	2008	48	351
	First Trust Nasdaq Cln Ed	2017	70	27
	First Trust NASDAQ® Clean Edge® Green Energy Index Fund (QCLN)	2007	60	3.015
	Invesco Global Clean Energy ETF	2007	141	358
	Invesco WilderHill Clean Energy ETF	2005	72	1.725
	iShares Global Clean Energy	2007	76	5.818
	RobecoSAM Smart Energy Equities*	2006	62	4.198
Water	Allianz Global Water	2018	41	1.024
	Calvert Global Water	2008	118	563
	Ecofin Global Water ESG IndexCo	2017	42	67
	First Trust Water ETF	2007	37	1.532
	Invesco S&P Global Water Index ETF	2007	58	1.248
	Invesco Water Resources ETF	2005	38	2.062
	RobecoSAM Sustainable Water Equities*	2001	74	3.775
Health	Fidelity Global Health Care Fund	2000	59	1.954
	RobecoSAM Sustainable Healthy Living Equities*	2007	46	917
	SPDR MSCI Europe Health Care	2014	40	842

*The RobecoSAM branded funds did not, at the time of analysis, systematically include Robeco SDG scores into the investment process.

Table 6 – Company examples of SDG scores and ESG ratings

Proposition	Company name	SDG score	Sustainalytics ESG*	Refinitiv ESG	S&P ESG	MSCI ESG	Explanation
1a - Tobacco exclusion	British American Tobacco	-3	73	97	86	BBB	Manufactures, distributes, and sells tobacco and cigarette products explaining the -3 SDG score. ESG ratings are average or good. For instance, Refinitiv gives it particularly high scores for governance, but also gives good ratings for the E and S pillars.
1a - Coal exclusion	CLP Holdings Limited	-3	72	92	77	AA	Generates about a third of its revenues from thermal coal, explaining the -3 SDG score. Whereas Sustainalytics says the company faces medium ESG risk, primarily due to climate change issues, Refinitiv gives it good scores across the E, S, and G dimensions.
1a - Human rights exclusion	Deutsche Telekom AG	1	83	94	90	BBB	On the exclusion list of an asset owner for labor rights violations in the US in 2016. SDG score maintains that the controversy is not significant enough to warrant a negative score. ESG ratings are good and average.
1b - Sustainable water	Evoqua Water Technologies Corp	3	73	48	12	A	Creates equipment and services for treating effluent water, explaining the +3 SDG score. ESG ratings are poor or average. E.g., Sustainalytics says the company faces medium ESG risk, especially in the areas of product governance, human capital and corporate governance.
1b - Energy	Eaton Corp PLC	-3	83	70	34	BBB	Produces electrical equipment related to power distribution, storage, and safety, but also is involved in military contracting, explaining the -3 SDG score. ESG ratings are average and good. For instance, the Sustainalytics rating concludes the company faces low ESG risk across all E, S, and G dimensions it assesses.
1b - Health	Siemens Healthineers AG	2	77	76	25	BB	Provides medical technology services leading to a +2 SDG score. Receives diverse ESG ratings. E.g., MSCI rates it as a laggard in areas like corporate governance and product safety and quality.
2a - EU taxonomy DNSH	Royal Dutch Shell PLC	-2	65	93	65	AA	Sustainalytics' EU taxonomy solution explains that Shell breaches the DNSH principle due to "severe environmental pollution in relation to oil spills over several decades" in Nigeria (Sustainalytics, 2022). Whereas the SDG score indicates the company's adverse environmental impact, some ESG raters assign it high scores. Refinitiv for instance gives it high ratings in all E, S, and G dimensions.
2b - EU taxonomy alignment	Daqo New Energy	3	71	46	17	B	Sustainalytics' EU taxonomy solution states 100% of the company's revenues to be aligned with the EU taxonomy. The SDG score reflects the company's high positive contributions to Climate Action. It gets average or poor ESG ratings. For instance, MSCI rates it as a laggard, primarily due to human capital development.
3a - Scope 1 and 2 GHG emissions	RWE AG	-3	77	68	69	A	Ranks among the 100 highest emitting companies in terms of scope 1 and 2. The -3 SDG score is explained by the coal it uses to generate power. It gets good and average ESG ratings. For instance, MSCI rates it as a leader for corporate governance and for opportunities in renewable energy.

3a - Scope 3 GHG emissions	Shaanxi Coal Industry Co Ltd	-3	53	38	2	CCC	Ranks among the 100 highest emitting companies in terms of scope 3. Its coal mining activities lead to a -3 SDG score. It gets poor ESG ratings. For instance, Refinitiv gives it moderate scores for the Environment dimension and poor scores for the Social and Governance dimensions
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**Sustainalytics ESG ratings rank from 0 (low ESG risk) to 100 (high ESG risk). To align with the results of the other rating agencies, who assign higher ratings to better performing companies, the Sustainalytics ESG ratings have been reversed in this graph by subtracting them from 100.*

The colors in this table correspond to the assigned scores. Robeco SDG scores that are negative are colored red while positive scores are colored green. Sustainalytics ESG ratings that indicate low, medium, and high risk are respectively colored green, yellow, and red. Refinitiv and S&P ESG ratings that are in the top-25%, middle-50%, and top-25% relative to the MSCI ACWI benchmark are respectively colored green, yellow, and red. MSCI ESG ratings that signal leaders, average, and laggards are respectively colored green, yellow, and red.

Table 7 – Implications of using an SDG score or ESG ratings in sustainable investing strategies

Sustainability metric	Indicator	Sustainable investing strategy	
		1. Negative screening	2. Positive screening
Robeco SDG score	SI strategy description	Excluding companies with negative (-1; -2; -3) SDG scores from the investment universe	Including companies with a positive (+1; +2; +3) SDG score in the investment universe
	Investment implications: % of companies excluded from MSCI ACWI	25%	44%
	Exclusion: % of companies excluded by asset owners <i>included</i> in the investment universe	12%	9%
	Sustainable thematic: % of companies in sustainable thematic funds <i>excluded</i> from the investment universe	9%	14%
	DNSH harm: % of companies violating the EU Taxonomy's 'do no significant harm principle' <i>included</i> in the investment universe	0%	0%
	EU taxonomy alignment: % of companies with >66% taxonomy aligned revenues <i>excluded</i> from the investment universe	4%	15%
	Climate change: absolute scope 1 and 2 emissions of the benchmark avoided	62%	76%
	Climate change: absolute scope 3 emissions of the benchmark avoided	60%	72%
Sustainalytics ESG rating	SI strategy description	Excluding companies with severe and high risk ESG ratings from the investment universe	Including companies with negligible and low ESG risk rating in the investment universe
	Investment implications: % of companies excluded from MSCI ACWI	27%	60%
	Exclusion: % of companies excluded by asset owners <i>included</i> in the investment universe	35%	8%
	Sustainable thematic: % of companies in sustainable thematic funds <i>excluded</i> from the investment universe	25%	70%
	DNSH harm: % of companies violating the EU Taxonomy's 'do no significant harm principle' <i>included</i> in the investment universe	24%	5%
	EU taxonomy alignment: % of companies with >66% taxonomy aligned revenues <i>excluded</i> from the investment universe	18%	55%
	Climate change: absolute scope 1 and 2 emissions of the benchmark avoided	64%	77%
	Climate change: absolute scope 3 emissions of the benchmark avoided	55%	74%
Refinitiv ESG rating	SI strategy description	Excluding companies with a bottom-25% ESG rating from the investment universe	Including companies with a top-25% ESG rating from the investment universe
	Investment implications: % of companies excluded from MSCI ACWI	25%	75%
	Exclusion: % of companies excluded by asset owners <i>included</i> in the investment universe	73%	50%
	Sustainable thematic: % of companies in sustainable thematic funds <i>excluded</i> from the investment universe	28%	71%

	DNSH harm: % of companies violating the EU Taxonomy's 'do no significant harm principle <i>included</i> in the investment universe	94%	47%
	EU taxonomy alignment: % of companies with >66% taxonomy aligned revenues <i>excluded</i> from the investment universe	31%	76%
	Climate change: absolute scope 1 and 2 emissions of the benchmark avoided	15%	71%
	Climate change: absolute scope 3 emissions of the benchmark avoided	11%	56%
S&P ESG rating	SI strategy description	Excluding companies with a bottom-25% ESG rating from the investment universe	Including companies with a top-25% ESG rating from the investment universe
	Investment implications: % of companies excluded from MSCI ACWI	25%	75%
	Exclusion: % of companies excluded by asset owners <i>included</i> in the investment universe	59%	17%
	Sustainable thematic: % of companies in sustainable thematic funds <i>excluded</i> from the investment universe	23%	73%
	DNSH harm: % of companies violating the EU Taxonomy's 'do no significant harm principle <i>included</i> in the investment universe	91%	17%
	EU Taxonomy alignment: % of companies with >66% taxonomy aligned revenues <i>excluded</i> from the investment universe	22%	79%
	Climate change: absolute scope 1 and 2 emissions of the benchmark avoided	12%	65%
	Climate change: absolute scope 3 emissions of the benchmark avoided	9%	63%
MSCI ESG rating	SI strategy description	Excluding ESG laggards (CCC and B rating) from the investment universe	Including ESG leaders (rating AAA; AA) in the investment universe
	Investment implications: % of companies excluded from MSCI ACWI	18%	77%
	Exclusion: % of companies excluded by asset owners <i>included</i> in the investment universe	79%	14%
	Sustainable thematic: % of companies in sustainable thematic funds <i>excluded</i> from the investment universe	4%	62%
	DNSH harm: % of companies violating the EU Taxonomy's 'do no significant harm principle <i>included</i> in the investment universe	54%	8%
	EU taxonomy alignment: % of companies with >66% taxonomy aligned revenues <i>excluded</i> from the investment universe	19%	76%
	Climate change: absolute scope 1 and 2 emissions of the benchmark avoided	33%	76%
	Climate change: absolute scope 3 emissions of the benchmark avoided	16%	72%