Carbon Accounting for Climate Aware Commodity Indexing

Contributor

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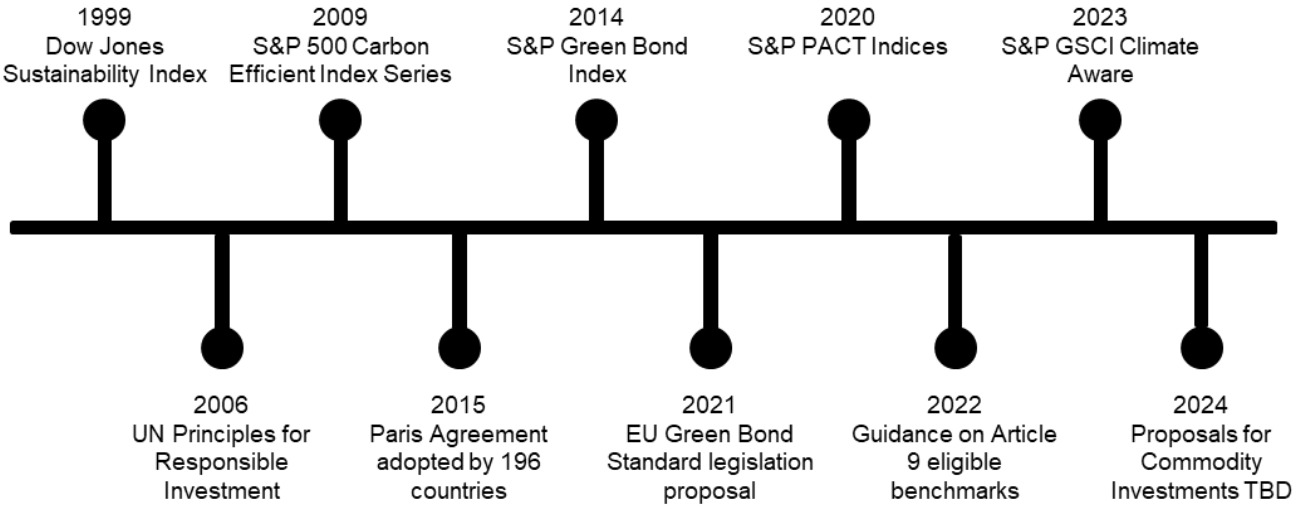
Introduction

Commodities have largely remained outside the purview of environmental investment frameworks, creating a gap in investing across all asset classes. The global investment landscape is witnessing a transformative shift toward sustainability, in part driven by increasing awareness of the environmental impact of commodity production and the clean energy transition. According to the latest S&P GSCI® world production average, over 25 billion barrels of oil are produced each year. Combining that with the S&P Global Trucost estimate that one barrel of oil produces over 400 kilograms of CO_2 equivalent ($kgCO_2e$), the total carbon emissions for oil are over 10 trillion $kgCO_2e$.

Investors in commodities primarily access the market through derivatives, such as oil futures. These derivatives serve as vital tools for commodity producers, consumers and investors. This paper explores how index-based commodity investing could be seen through a sustainable investing lens and examines the challenges and opportunities in integrating environmental considerations across asset classes. It also delves into the role of commodity derivatives in financial markets and outlines a framework for carbon accounting to measure environmental impact. Additionally, it highlights how the S&P Global Commodity Environmental dataset can be leveraged to measure carbon intensity for commodity indices.

Finally, this paper highlights the significance of benchmarks for environmental investing, offering an introduction to the S&P GSCI Climate Aware as a forward-thinking approach to climate-focused commodity investments. The S&P GSCI Climate Aware is a prominent example in the past quarter century of incorporating environmental, social and governance (ESG) considerations into leading benchmarks before policy makers and regulators adopt similar rules into investment practices (see Exhibit 1).

Exhibit 1: Index-Based Climate Solutions Have Often Led Government Efforts to Apply Sustainability to the Investment Landscape



Source: S&P Dow Jones Indices LLC. Chart is provided for illustrative purposes.

Looking at Commodities through a Sustainable Investing Lens

The paradox in sustainable commodity investing lies in the fact that while there are extensive proposals affecting sustainable investments in stocks and bonds, commodities—one of the largest contributors to environmental degradation—remain largely untouched. Governments around the world have introduced several regulatory measures to enhance sustainable investing practices, but the scope of these regulations has mainly focused on equity and fixed income investment products. The European Union (EU) has led the march toward transparency and accountability for investors, asset managers and companies.

Commodity production and consumption is considered one of the leading causes of environmental degradation.[1] While the physical production of a commodity can have a direct impact on the environment, investing in commodity derivatives could be viewed in the same light as investing in equities and bonds. Buying stock in a company that emits carbon isn't the

[1] Please see the UN Climate Action website for more information.

same as emitting the carbon oneself, but there is an association. While such a throughline exists for stocks and bonds, financial instruments associated with commodities, like commodity derivatives, are not subject to specific sustainability regulations. We will discuss two elements used to create sustainability metrics in a commodity index. First, we look at the use of transparent data to measure the impact of commodity production, and second, the connection with the physical production of commodities and the financial instruments that support the commodities market.

How Environmental Considerations Are Implemented across Asset Classes

Implementing environmental considerations across asset classes involves designing measurable factors that account for the environmental impact of the issuer. For example, equity and debt issuers may disclose pertinent data related to their business activities that can be evaluated based on their environmental impact, contribution to greenhouse gas (GHG) emissions and resource utilization. U.S.-listed companies are required to file a form 10-K, which provides updated financials, including the disclosure of various risk factors, such as environmental risks. The management discussion and analysis section highlights trends or uncertainties, including environmental and climate risks. As disclosures increase, investors and data providers can measure the contribution to environmental externalities for a given company. The level of exposure can then be quantified relative to the firm's enterprise value or public equity and debt outstanding. An index or investor can then reduce exposure to the largest contributors to negative environmental externalities. An example directly relevant to fixed income securities involves the issuance of green bonds. Through this mechanism, companies can issue a green bond that is directly tied to environmentally focused projects such as renewable energy or pollution control. Hence, the investor plays a role by financing and potentially benefiting from these operations.

Bridging the Asset Class Gap: Carbon Accounting for Commodity Derivatives

Incorporating environmental considerations into commodity investments presents unique challenges. Commodity production involves complex global supply chains with publicly traded, privately held and government run institutions. The intersection of these participants and commodity investments is found in commodity derivatives markets. Banks and commodity exchanges facilitate the trading of commodities for producers, consumers and investors much in the same way the global stock and bond markets provide the flow of capital between

companies and investors. In the paper Carbon Accounting for Commodity Derivatives,[2] the authors link the financial benefit of commodity derivatives to these players.

Commodity producers and consumers look to derivatives to offset the price volatility inherent in a given market. Factors such as supply shocks, weather-related impacts and geopolitical turmoil often lead to market imbalances that could adversely affect producers' or consumers' profits. By limiting future price volatility through hedging, producers and consumers could mitigate risk and create a more stable stream of income. By acting as a counterparty, investors can obtain exposure to the commodity asset class in return for assuming the risk of future price changes. This risk transfer mechanism, made popular among investment communities through the works of Harry Markowitz, creates stability for producers while opening the door for investors. Corporations look to the equity and debt markets to raise capital most efficiently. In a similar manner, they look to hedge the price volatility of commodity products they plan to buy or sell in the future to efficiently manage business operations. The authors argue that derivative hedges have a measurable impact on the cost of capital for producers, producing an economic benefit. Utilizing data, including the Commodity Futures Trading Commission (CFTC) Commitment of Traders reports[3] to aggregate total positions, one can estimate the amount of risk transferred between producers, consumers and index-based investors. Small and medium companies generally hedge a portion of their exposure in an effort to stabilize profits. The paper demonstrates the potential economic benefit by building a model based on discounted cashflow analysis to quantify the cost of commodity price volatility and its relationship to hedging strategies. Running hundreds of thousands of scenarios that input the hedge size, direction and volatility of commodity prices produces the expected required rate of return on capital given the stated risks. Measuring the economic impact of commodity derivatives establishes a path to apply an environmentally focused investment framework via index-based commodity solutions.

Measuring the Impact of Commodities on the Environment

Having established the link between the physical commodity markets and the investible commodity markets, we then look to measure the environmental impact on each good produced. S&P Global has developed unique datasets to evaluate the carbon, land and water intensities of commodity production. The creation and usage of raw materials found in the

[2] Ostrovnaya, Anastasiya, Julian Smart, Stephane Audran, Gwen Yu, Thomas Byuen and Brian Luke, "Carbon Accounting for Commodity Derivatives," Imperial College London Consultants, Imperial College Business School, June, 2024. For more information, see Boal, Fiona, Audran, Stephane, Bullock, Steven, Gallant, Kimberley, Denny, Adam, Yu, Gwen, "Incorporating Environmental Considerations into Commodity Indices," S&P Dow Jones Indices LLC, Feb. 21, 2023.

[3] For more information, please see the CFTC website.

earth produces an environmental impact—the creation of GHGs or consumption of land and water resources.

For example, the mining of minerals from the earth draws heavily on land resources and water to treat and refine the raw minerals into refined products. Smelting generates GHGs emitted into the atmosphere and the amount of energy required varies by the type of refined metal. Copper and nickel production is more land intensive than zinc and lead, though there are positive externalities associated with energy transition and the reliance on copper and nickel. Farming of grains (wheat, corn and soybeans) and other soft commodities (sugar, cocoa, coffee and cotton) all require unequal amounts of land and water resources. Soybean production has an impact on land similar to that of wheat but is less water intensive. Cattle has one of the largest demands on land resources. Employing a strategy that seeks to reduce environmental intensity requires quantifying the production of each commodity in an isolated context and then understanding the economic benefit as well as what commodities are viable substitutes (see Exhibit 2 for a sample of commodity production and intensity).

Exhibit 2: Commodity Valuation Intensity

Metric	Copper	Wheat	Cattle
Production volume (metric tons)	25,000,000	756,949,628	67,883,097
Average price per contract (USD)	8,430	7.25	1.65
Total GHG emissions ($kgCO_2e$)	162,522,500,000	521,817,531,095	1,182,402,858,813
Total land use (square meters)	70,963,155,000	2,048,219,261,303	3,330,576,156,002
Total water consumption (cubic meters)	4,962,000,000	241,180,401,792	4,972,953,131
Total commodity valuation (USD)	31,407,412,124	345,466,218,154	658,621,485,971
Commodity valuation intensity (USD per unit of production)	1,256	456	9,702

Source: S&P Dow Jones Indices LLC. Chart is provided for illustrative purposes.

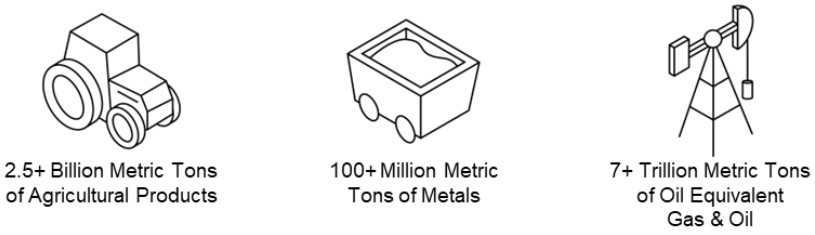
Applying Commodity Environmental Metrics to Financial Products

In this section, we look at designing ways to access this asset class through an environmental lens. The S&P GSCI Climate Aware methodology seeks to reduce exposure to the largest contributors to carbon emissions, land usage and water consumption by calculating the impact of various commodities on the environment. A monetary value is assigned based on the impact per unit of commodity produced, or commodity valuation intensity. For example, the GHG commodity valuation intensity of oil is the product of global production volume in metric tons and the environmental externalities of each commodity in kilograms of CO_2 equivalent. Volume data encompasses the depth of assessment regarding factors such as market supply and demand dynamics, production costs and geopolitical influences. Essentially, it reflects the

extent to which investors delve into understanding the intrinsic worth of commodities beyond surface-level price movements. Multiplying that by a lifecycle impact analysis and natural capital valuation produces a metric that can be applied across all commodities.

This concept is crucial because, unlike stocks or bonds, commodities lack cash flows or earnings streams, making their valuation inherently more complex. Instead, their value is derived from physical attributes such as scarcity, utility and global demand. Valuing commodities requires a comprehensive understanding of the underlying market fundamentals, including production trends, consumption patterns, regulatory changes and geopolitical risks, among others. Furthermore, the notion of valuation intensity extends beyond mere financial metrics to encompass environmental factors. In today's investment landscape, there's a growing awareness of the environmental implications of commodity production and trade. Thus, investors are increasingly assessing not only the economic viability of commodities but also their sustainability and impact on society and the environment.

Exhibit 3: Measuring the Impact on the Environment as It Relates to Commodity Investments



Source: S&P Dow Jones Indices LLC. Chart is provided for illustrative purposes.

Designing Benchmarks for Commodity Investing

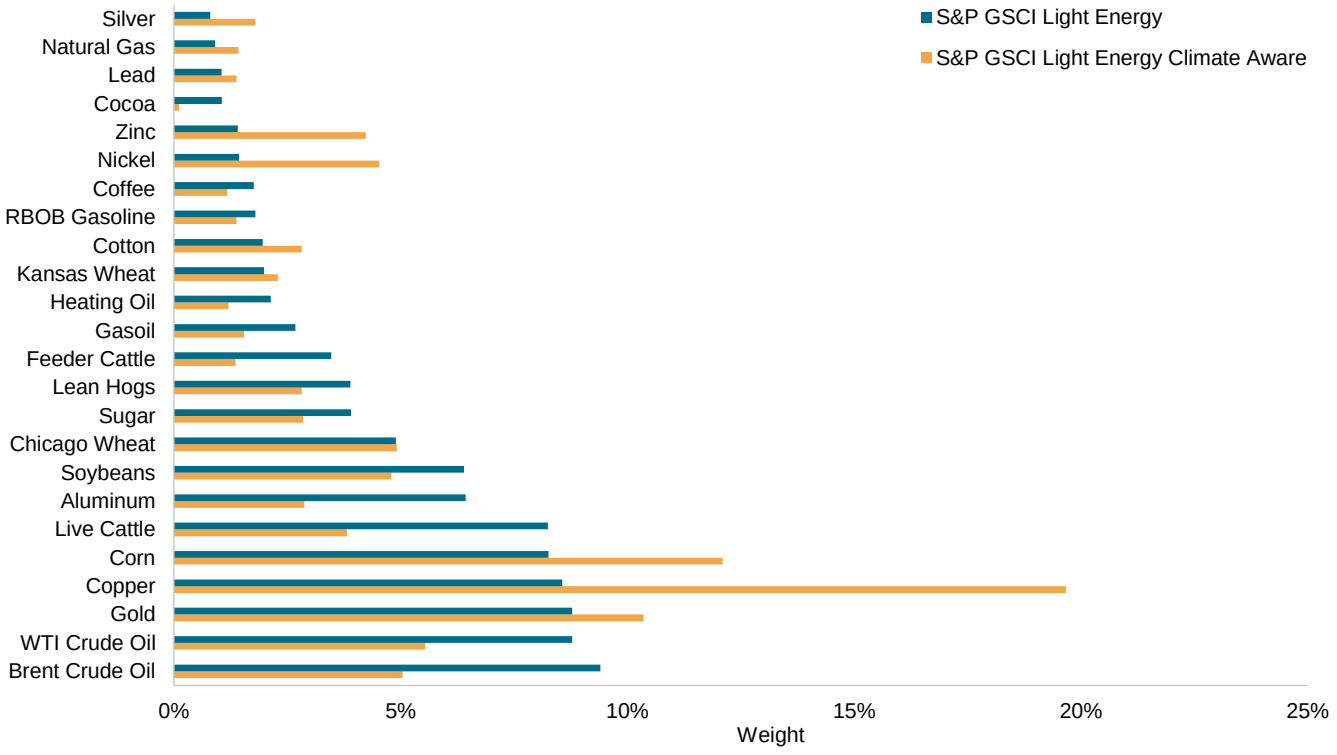
The S&P GSCI applies a production-weighted approach as well as incorporating liquidity metrics. A production-weighted approach to commodity benchmarks offers a robust and meaningful representation of the global commodity market, aligning with economic

fundamentals and providing a valuable tool for building a strategy and risk management. Commodities with higher production levels typically have greater importance in global markets and economies. Therefore, by weighting commodities based on production, the benchmark better mirrors the overall composition and significance to the global economy. Pure market capitalization-weighted approaches can be heavily influenced by price distortions, leading to heightened volatility in the benchmark's performance. Considering the actual production levels of various commodities can potentially offer diversification across the commodity spectrum. This approach aligns more closely with the real economy, reflecting the commodities that are produced and consumed globally. As a result, the S&P GSCI may provide investors with insights into the underlying supply and demand dynamics of the physical commodity markets.

Index-Based Solutions: The S&P GSCI Climate Aware

Combining the commodity valuation intensity metrics with a production-weighted benchmark like the S&P GSCI allows investment professionals to measure the performance of the commodity market while incorporating sustainability screens. Exhibit 4 compares the weighting of the S&P GSCI Light Energy Climate Aware to the light energy benchmark. Within energy systems, there is shift away from petroleum and into copper, nickel, zinc and silver. Within the food sources, the climate aware index has a larger weight in corn and underweights cattle.

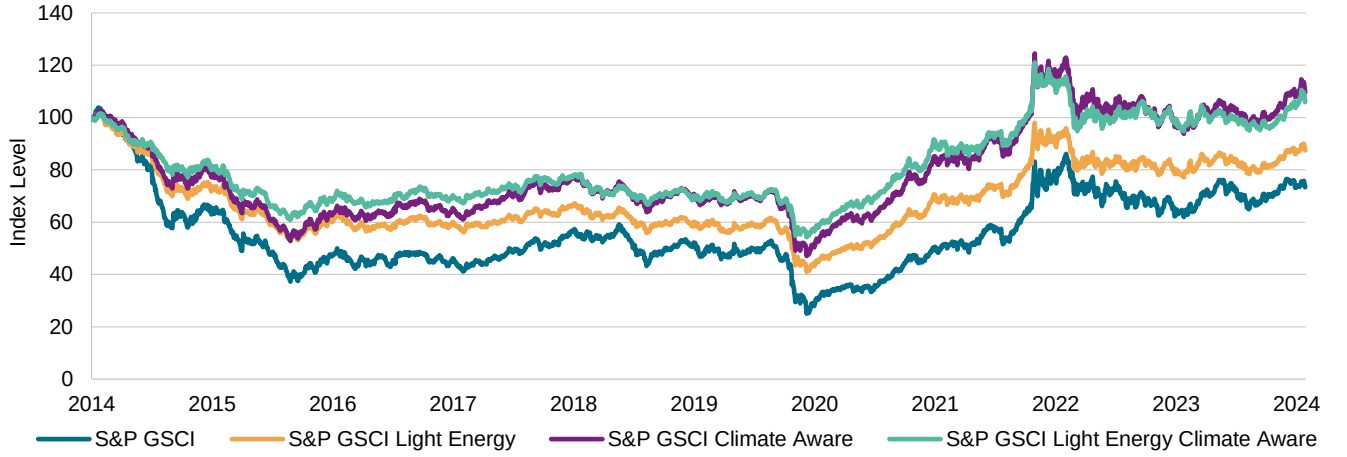
Exhibit 4: Comparison of the Commodity Weights for the S&P GSCI Light Energy and S&P GSCI Light Energy Climate Aware



Source: S&P Dow Jones Indices LLC. Data as of Jan. 31, 2024. Chart is provided for illustrative purposes.

Overall, the S&P GSCI Climate Aware Series represents a forward-thinking approach to commodities that acknowledges and addresses climate-related risks and opportunities. By incorporating climate-conscious criteria into index construction, this series aims to provide a more resilient and sustainable framework for navigating the evolving landscape of the commodity market. The key feature of the series takes the S&P GSCI production weights and the S&P Global Sustainable1 Commodity Environmental dataset and builds a decarbonization glide path via S&P DJI's glass-box optimization method. Similar algorithms are used across S&P DJI's methodologies in equities and fixed income. Outperformance of a benchmark is not the objective, though a 10-year back-test demonstrated historical returns that exceeded both the S&P GSCI and the S&P GSCI Light Energy. Taking volatility into account, the climate aware versions had higher Sharpe ratios than their benchmarks over the five-year period (see Exhibit 5).

Exhibit 5: Back-Tested Performance



Period	S&P GSCI	S&P GSCI Climate Aware	S&P GSCI Light Energy	S&P GSCI Light Energy Climate Aware
Annualized Returns (%)				
1-Year	18.37	16.74	13.22	11.73
3-Year	13.74	9.25	8.25	5.79
5-Year	8.91	10.18	8.50	8.99
Annualized Volatility (%)				
1-Year	15.30	10.92	9.45	9.05
3-Year	18.93	15.17	12.69	12.68
5-Year	24.88	17.98	15.72	14.23
Risk-Adjusted Return				
1-Year	1.20	1.53	1.40	1.30
3-Year	0.73	0.61	0.65	0.46
5-Year	0.36	0.57	0.54	0.63

Source: S&P Dow Jones Indices LLC. Data from June 2, 2014, to May 31, 2024. Index performance based on total return in USD. The S&P GSCI Climate Aware was launched Feb. 21, 2023. The S&P GSCI Light Energy Climate Aware was launched June 20, 2023. All data prior to index launch date is back-tested hypothetical data. Past performance is no guarantee of future results. Chart and table are provided for illustrative purposes and reflect hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

Glass-Box Optimization and Glide Path to Decarbonization

The S&P DJI glass-box optimization algorithm is a systematic and transparent approach to constructing indices. This process aims to deliver indices that meet decarbonization objectives while providing clarity and insight into the index construction methodology.[4]

The process begins with defining the objective of the index. In this case, the S&P GSCI and S&P GSCI Light Energy constituents are measured for their GHG, land and water intensity—Commodity Valuation Intensity (CVI). The first objective is to reduce total CVI by 25% compared to the benchmark. The immediate effect is a reduction in both energy commodities and livestock, and an increase in energy transition commodities such as copper and nickel. This helps inform allocation decisions and optimize the index for achieving the desired weight across commodities to ensure that secondary objectives are met. These constraints may include limits on sector exposure, component weights and liquidity factors. The methodology provides clear visibility into the optimization process, allowing for understanding of how index constituents are selected and weighted. Once the index is constructed, it is regularly monitored to ensure that it continues to meet its objectives and remains aligned with market conditions. Periodic rebalancing may be conducted to adjust asset weights to maintain optimal index characteristics. Throughout the process, comprehensive documentation is provided to market participants, detailing the methodology, assumptions and inputs used in constructing the index. This can help market participants to assess the index's construction and performance with confidence.

Following the 25% reduction of both total CVI and GHG CVI, it then aims for a 5% year-over-year decarbonization target while maintaining total food supply component weights and ensuring that land and water CVIs per dollar invested are no higher than those of the benchmark. This is achieved by minimizing an objective function combining penalties for weight and sector deviations from the benchmark.

The sector definitions used for the optimization combine the S&P GSCI sectors with newly defined Energy Systems and Food Supply economic sectors. This encourages a shift from fossil fuels to metals required to create renewable energy and from meat to plant-based foods. Additionally, the index applies tilted weights to the fossil fuel group and food supply sector to enhance environmental efficiency on a per-unit production basis.

[4] For more information on S&P DJI glass-box optimization, please see Cabrer, Leonardo M, and Akash Jain, "Glass-Box Optimization: Bringing Clarity to Sustainability Indices," S&P Dow Jones Indices LLC, Jan. 3, 2024.

Conclusion

The intersection of regulatory frameworks, environmental considerations and commodity investments underscores the need for a holistic approach to sustainable investing. While governments and regulatory bodies have taken significant steps to promote transparency and accountability in financial markets, there remains a gap in addressing the environmental impact of commodities. By bridging this gap and incorporating environmental metrics into investment decision-making, investors can better assess the risks and opportunities associated with commodity investments. The introduction of the S&P Global Commodity Environmental dataset and the S&P GSCI Climate Aware represents important advancements in this direction, offering investors transparent, rules-based tools for navigating the evolving landscape of commodity markets while incorporating climate considerations. Moving forward, a concerted effort from all stakeholders will be essential in accelerating the transition toward a low carbon economy and achieving meaningful environmental outcomes in commodity investments.

Performance Disclosure/Back-Tested Data

The S&P GSCI Climate Aware was launched February 21, 2023. The S&P GSCI Light Energy Climate Aware was launched June 20, 2023. All information presented prior to an index's Launch Date is hypothetical (back-tested), not actual performance. The back-test calculations are based on the same methodology that was in effect on the index Launch Date. However, when creating back-tested history for periods of market anomalies or other periods that do not reflect the general current market environment, index methodology rules may be relaxed to capture a large enough universe of securities to simulate the target market the index is designed to measure or strategy the index is designed to capture. For example, market capitalization and liquidity thresholds may be reduced. Complete index methodology details are available at www.spglobal.com/spdji. Past performance of the Index is not an indication of future results. Back-tested performance reflects application of an index methodology and selection of index constituents with the benefit of hindsight and knowledge of factors that may have positively affected its performance, cannot account for all financial risk that may affect results and may be considered to reflect survivor/look ahead bias. Actual returns may differ significantly from, and be lower than, back-tested returns. Past performance is not an indication or guarantee of future results. Please refer to the methodology for the Index for more details about the index, including the manner in which it is rebalanced, the timing of such rebalancing, criteria for additions and deletions, as well as all index calculations. Back-tested performance is for use with institutions only; not for use with retail investors.

S&P Dow Jones Indices defines various dates to assist our clients in providing transparency. The First Value Date is the first day for which there is a calculated value (either live or back-tested) for a given index. The Base Date is the date at which the index is set to a fixed value for calculation purposes. The Launch Date designates the date when the values of an index are first considered live: index values provided for any date or time period prior to the index's Launch Date are considered back-tested. S&P Dow Jones Indices defines the Launch Date as the date by which the values of an index are known to have been released to the public, for example via the company's public website or its data feed to external parties. For Dow Jones-branded indices introduced prior to May 31, 2013, the Launch Date (which prior to May 31, 2013, was termed "Date of introduction") is set at a date upon which no further changes were permitted to be made to the index methodology, but that may have been prior to the Index's public release date.

Typically, when S&P DJI creates back-tested index data, S&P DJI uses actual historical constituent-level data (e.g., historical price, market capitalization, and corporate action data) in its calculations. As ESG investing is still in early stages of development, certain datapoints used to calculate S&P DJI's ESG indices may not be available for the entire desired period of back-tested history. The same data availability issue could be true for other indices as well. In cases when actual data is not available for all relevant historical periods, S&P DJI may employ a process of using "Backward Data Assumption" (or pulling back) of ESG data for the calculation of back-tested historical performance. "Backward Data Assumption" is a process that applies the earliest actual live data point available for an index constituent company to all prior historical instances in the index performance. For example, Backward Data Assumption inherently assumes that companies currently not involved in a specific business activity (also known as "product involvement") were never involved historically and similarly also assumes that companies currently involved in a specific business activity were involved historically too. The Backward Data Assumption allows the hypothetical back-test to be extended over more historical years than would be feasible using only actual data. For more information on "Backward Data Assumption" please refer to the FAQ. The methodology and factsheets of any index that employs backward assumption in the back-tested history will explicitly state so. The methodology will include an Appendix with a table setting forth the specific data points and relevant time period for which backward projected data was used.

Index returns shown do not represent the results of actual trading of investable assets/securities. S&P Dow Jones Indices maintains the index and calculates the index levels and performance shown or discussed but does not manage actual assets. Index returns do not reflect payment of any sales charges or fees an investor may pay to purchase the securities underlying the Index or investment funds that are intended to track the performance of the Index. The imposition of these fees and charges would cause actual and back-tested performance of the securities/fund to be lower than the Index performance shown. As a simple example, if an index returned 10% on a US $100,000 investment for a 12-month period (or US $10,000) and an actual asset-based fee of 1.5% was imposed at the end of the period on the investment plus accrued interest (or US $1,650), the net return would be 8.35% (or US $8,350) for the year. Over a three-year period, an annual 1.5% fee taken at year end with an assumed 10% return per year would result in a cumulative gross return of 33.10%, a total fee of US $5,375, and a cumulative net return of 27.2% (or US $27,200).

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