Russell Investments

Decarbonization 3.0 capturing transition activities

A sustainable investing solution for the low carbon transition

Invest without boundaries™

Contents

Introduction and background

Historically, many investment strategies focused on what we refer to as “standard decarbonization”, which reduces exposure to carbon emissions and fossil fuel reserves. However, while this approach lowers a portfolio’s carbon footprint, it may unintentionally reduce exposure to companies that are enabling the energy transition. Not capturing such companies may lead to lower aggregate sustainability outcomes.

At Russell Investments, our Decarbonization 2.0 framework addressed some of these issues by introducing exposure to renewable energy, reducing coal involvement, and integrating environmental, social, and governance (ESG) factors. Building on that foundation, we now present Decarbonization 3.0—a strategy that improves how portfolios align with the low carbon transition.

The 3.0 framework replaces renewable energy exposure with a broader and more investable measure: climate solutions revenue.

This shift not only improves data coverage but also captures the full range of companies that are manufacturing the essential goods and services to support decarbonization. By continuing to reduce exposure to carbon-intensive assets while reallocating capital toward climate solutions, Decarbonization 3.0 provides a more targeted and opportunity-aware approach to sustainable investing.

Strategy overview

Decarbonization 1.0 (2015)

Russell Investments originally launched its decarbonization strategy in 2015 with the goal of reducing carbon exposure while maintaining close alignment to the client portfolio’s benchmark. This first-generation approach, Decarbonization 1.0, targeted a 50% reduction in both carbon footprint and carbon reserves, while managing tracking error to under 1%. It was designed in response to growing investor demand for climate-aware investment solutions, particularly among signatories to the United Nations-supported Principles for Responsible Investment (PRI).

This strategy addressed both current carbon intensity (via footprint reductions) and future carbon risk (via lower exposure to fossil fuel reserves). Compared to simple fossil fuel divestment or footprint-only approaches, Russell Investments' optimization method was developed to minimize unintended consequences, such as sector bias or increased tracking error, by integrating carbon reduction objectives with robust portfolio risk controls.

Decarbonization 2.0 (2018)

In 2018, we introduced Decarbonization 2.0 which expanded the original framework with additional sustainability insights. These included an explicit reduction in coal exposure, increased emphasis on renewable energy production through our Green Energy Score, and the integration of financially material sustainability indicators.

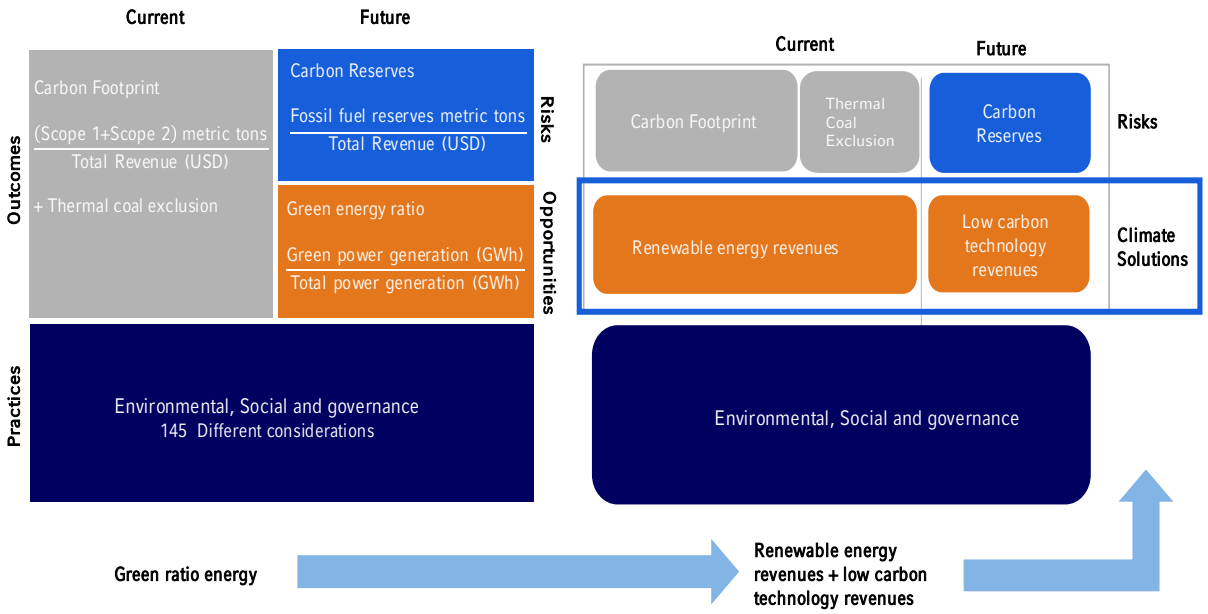
Decarbonization 3.0 (2025)

Now, with Decarbonization 3.0 we further evolve the framework by replacing the renewable energy score with a more comprehensive, investable, and globally available metric: climate solutions revenue. This shift broadens the scope of the framework by capturing companies across all sectors that contribute to the transition through climate-aligned products and services. Our systematic portfolio construction process is designed to achieve all key objectives: reducing current emissions exposure, mitigating stranded asset risk, and increasing alignment with climate solutions. This process identifies the optimal combination of securities that meets sustainability targets while minimizing active share and transaction costs and maintaining benchmark-like performance.

The strategy is designed to be flexible and can be applied across a wide range of portfolio types, including market-cap weighted indexes, smart beta strategies, and actively managed multi-manager portfolios. In this paper, we demonstrate the methodology and results using the MSCI World Index as a representative example.

What is new in Decarbonization 3.0?

Exhibit 1: The evolution of Decarb 2.0 to Decarb 3.0



Source: Russell Investments, for illustrative purposes only.

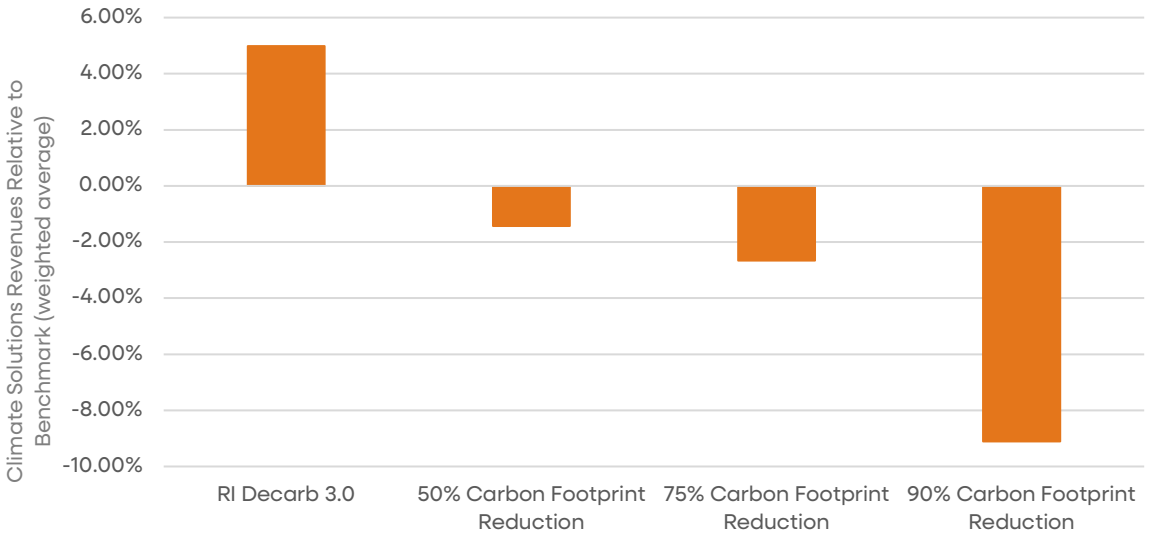
Let's start with the most material change: replacing the green energy ratio with the climate solutions metric. This substitution not only helps us significantly address the coverage challenges associated with the green energy ratio but also enables us to incorporate a more holistic perspective on the key economic sectors involved in the low-carbon transition.

What does this mean? The climate solutions metric can be further broken down into "renewable energy revenues" + "low carbon technology revenues", and each has a role to play. For companies involved in the utility sector, the correlation between the green energy ratio and climate solutions revenue is high. This is expected because a utility companies' primary line of business is generating power, and therefore, the proportion of power that it generates from renewables will align closely to the revenue earned from generating renewable energy. Where the new "climate solutions revenue" factor becomes more interesting is in the other sectors. For example, in Exhibit 2 we show how it is possible for low carbon strategies to unintentionally underweight high carbon firms who are responsible for manufacturing low carbon goods and services in the materials and industrials sectors.

For non-utility companies, it is possible to achieve a high renewable energy production ratio by installing a small amount of renewable energy generation. By switching to a revenue-based measure we are effectively applying a materiality lens. For example, Shell's 100% green energy ratio now turns to a 0.13% climate solution revenue exposure which more accurately quantifies its risk/opportunity exposure in a low carbon transition.

In our research, we found that decarbonizing a portfolio can reduce exposure to climate solutions if one does not include this factor directly in the optimization. Exhibit 2 compares the climate solutions exposure of the Decarbonization 3.0 strategy to a standard decarbonization optimization strategy, targeting various levels of carbon emissions reduction relative to the MSCI World Benchmark. Notably, the data shows that reducing portfolio emissions has an unintended effect: a decarbonization strategy focused solely on emissions reduction can lead to a lower climate solutions exposure than the benchmark. This counterintuitive outcome arises because companies driving climate solutions often operate in higher-emitting sectors such as industrials, materials, and utilities.

Exhibit 2: Decarbonizing a portfolio can potentially lead to lower climate solutions exposure if it is not accounted for in the optimization framework



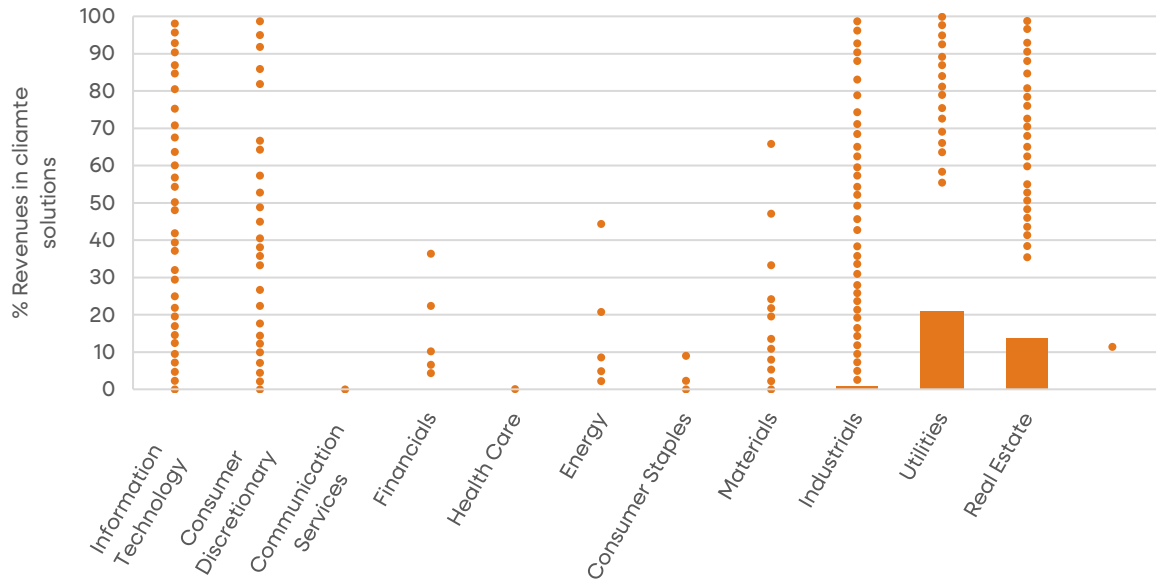
Source: Russell Investments, MSCI, Sustainalytics. Data as of 29 December 2023. This chart reflects a hypothetical back-tested scenario for illustrative purposes only and is not indicative of future results. Sample portfolios were optimized to reduce carbon footprint relative to the MSCI World Index, as noted above. Results will vary based on the specific constraints applied in the optimization. Finally, there is no guarantee that the outcomes shown will reflect those of any actual portfolio, which may differ materially.

While this result may appear unintuitive, it highlights that companies currently involved in producing goods or services that facilitate the low carbon transition are often underweighted in traditional decarbonization strategies due to their larger than benchmark carbon footprints. Our goal is to maintain the same aggregate reduction in standard carbon criteria[1] but use climate solutions as another consideration in evaluating which companies to underweight or overweight.

Finally, data coverage can be another significant challenge with highly specific metrics, such as renewable energy generation. This is because the factor is primarily relevant to the utility and energy sectors, given that renewable energy generation is a primary business activity in these sectors, whereas in most others it is either absent or non-material. This phenomenon can become problematic when a decarbonization framework is used as an overlay to multi-manager funds. If the manager composite only holds a few utility/energy names, the optimization is likely to struggle to find a solution where the highly specific factor meets the constraint level while also satisfying the strict risk controls at an asset level.

[1] See "Portfolio Carbon. Measuring, disclosing and managing the carbon intensity of investments and investment portfolios. UNEP Finance Initiative - Investor Briefing. 2013"

Exhibit 3: Distribution of climate solution revenues by sector



Source: Sustainalytics, Russell Investments. Data as of 30 June 2024. Based on the MSCI ACWI IMI universe, for illustrative purposes only and not intended as a guide to future performance.

We can now reallocate active share within carbon-intensive sectors not only to firms with lower carbon intensities but also toward those whose products directly enhance the carbon efficiency of other companies. Like carbon emissions, this skewness benefits our minimum active share optimization approach by allowing us to achieve above-benchmark exposure to climate solutions without the need for a large number of active positions. In other words, we can focus our investments on companies that help others cut emissions, without needing to make big changes to the portfolio.

This is particularly important as carbon-intensive sectors are often home to some of the leading firms developing carbon efficiency innovations, playing a critical role in advancing the low-carbon transition despite their emissions profiles.

Data sources informing the strategy

This model draws on five key data inputs: carbon footprint, carbon reserves, thermal coal involvement, climate solutions revenue, and underlying ESG data—all sourced from MSCI and Sustainalytics. The history available to us from each source is relatively limited with ESG metrics, coal, and carbon-related data available from 2012 and climate solution revenues from 2021. Because of data availability, our testing period begins in January 2015. ESG scores and carbon footprint data are used as they were available at each point in time. For climate solutions revenue, since the earliest data only starts in 2021, we apply those figures retroactively back to 2015 using the oldest available company-level data. This allows us to maintain consistent coverage over the full period. From 2021 onward, we use the reported values as is.

The rest of this section summarizes the data and key considerations for each of these items.

1. Carbon Footprint

There are a variety of carbon footprint techniques in use today. For our decarbonization strategy, the use of carbon intensity is defined as Scope 1 (direct) GHG emissions plus Scope 2 (electricity consumption) GHG emissions measured in metric tons of carbon dioxide equivalent (CO2e), divided by company revenue ($m USD).2

$$\text{Issuer's Carbon Intensity} = \frac{\text{Issuer's Scope 1 and Scope 2 GHG emissions}_i}{\text{Issuer's \$M revenue}_i}$$

The company-level carbon intensity is then rolled up to calculate a portfolio-level carbon intensity using the weighted average carbon intensity (WACI) approach. The WACI is defined as:

Portfolio Weighted Average Carbon Intensity =

$$\sum_i^n \left(\frac{\text{current value of investment}_i}{\text{current portfolio value}} \text{ X } \frac{\text{issuer's scope 1 and scope 2 GHG emissions}_i}{\text{issuer's \$M revenue}_i}\right.$$

Scope 3

The complete carbon emissions of a company's value chain, referred to as Scope 3, is currently not included in our calculation. This is primarily due to our lower confidence in Scope 3 data availability and reliability due to lower levels of company reporting and higher levels of estimation. Scope 3 emissions are also inherently more complicated to estimate because of the need to first identify and map a company's complete value chain. As data availability and robustness improves for measuring Scope 3 carbon emissions, we will continue to evaluate incorporating this data into our process. In the meantime, we take a targeted approach to addressing specific points in the value chain where carbon emissions are particularly substantial.

Our approach to Decarbonization 3.0 takes into account the broader context of carbon emissions by targeting key areas of a company's value chain that are particularly carbon intensive. Specifically, we focus on reducing exposure to fossil fuel reserves and coal while simultaneously increasing exposure to low carbon technology and renewable energy. These factors are material to the overall carbon impact of the portfolio, both directly and indirectly, across the value chain.

While Scope 3 emissions data remains outside our current optimization framework, our research shows that focusing on carbon reserves and energy transition drivers such as renewable energy and coal exposure can effectively address many of the most significant value chain emissions. As the availability and accuracy of Scope 3 data improves, we will continue to monitor developments and consider incorporating it into our process. In the meantime, our targeted approach ensures we are addressing material sector-specific risks while maintaining high data quality standards.

Carbon intensity is highly skewed with a small number of companies responsible for the vast majority of a portfolio's carbon footprint. The skewness of the data is observed not only at an asset level but also when grouped categorically by sector and, to a lesser extent, by country.

This highlights a key opportunity of working with carbon data: high skewness makes it possible to dramatically reduce carbon footprint and reserve characteristics while maintaining low benchmark-relative exposures. In other words, we can achieve significant decarbonization by adjusting a relatively small portion of the portfolio.

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[2] The relative carbon footprint, reserves and climate solution revenue formulas presented in this paper refer to security-level characteristics.

To generate a portfolio-level score we take the sum product of portfolio weight and security-level scores.

The fact that this skewness is observed across multiple dimensions (security, sector, industry, and country-levels) also highlights a key risk associated with many approaches to standard decarbonization: without controlling for the size of active bets made across these dimensions, simply divesting from the largest emitters will lead to large sector, industry and country bets relative to the benchmark. In the methodology section below, we will outline our approach for addressing the issue.

2. Fossil fuel reserves

We refer to fossil fuel reserve intensity as the potential emissions (CO2e) of a company's fossil fuel reserves relative to total assets. Specifically, it is defined as:

$$\text{Issuer's fossil fuel reserve intensity} = \frac{\text{Fossil fuel reserves (m tonnes of potential } CO_2e)}{\text{Total assets (\$b USD)}}$$

Similar to the WACI for carbon emissions, we also take the weighted average of the fossil fuel reserve intensity to arrive at a portfolio metric. Potential emissions from fossil fuel reserves are also sourced from MSCI. Whereas carbon footprint data is theoretically applicable to the entire universe, reserves data only applies to the subset of companies holding reserves, implying that reserves data will be even more concentrated than carbon footprint data.

3. Climate solution revenues

Following the Paris Climate Agreement, consensus is coalescing around a global warming target of less than 2°C. If the low carbon transition takes place, demand for carbon- intensive products would decline in favor of low/zero carbon products, which would put carbon-intensive companies and industries (for example, coal-based power generation, coal mining, and fossil fuel-powered automobile manufacturers) at risk of having stranded assets. Conversely, a company may be exposed to low carbon transition opportunities through two transmission channels:

1. Exposure through involvement in carbon-efficient operations, and;
2. Exposure through involvement in low carbon products and services

The metric is a weighted average of the revenue that meets the definitions of a climate solution, divided by total revenue in USD. A typical range for the metric at the portfolio level is anywhere between 2% to 10%, depending on the universe. This translates to saying a portfolio has a weighted average revenue from climate solutions between 2% and 10%. No coverage-related scaling is required (like we do with WACI) since any missing coverage assumes the company earns 0% of its revenues from climate solutions.

$$\text{Weighted Average Climate Solutions Revenue} = \sum_i w_i * climate\ solutions\ revenue_i$$

$$= \sum_i w_i * \frac{\text{Climate Solution Qualified Revenues}_i}{\text{Total Revenue}_i}$$

This dataset is provided by Sustainalytics. The novel aspect introduced with this approach is that research is conducted at the level of a companies' individual business activities. In doing so, this dataset interprets a company as a portfolio of (potentially multiple) business activities, rather than a monolithic entity (as would be the case if an industry-based classification was used).

In essence, the climate solution revenue methodology delivers two fundamental assessments: firstly, an involvement call (i.e., a conclusion as to whether a company is involved in each activity), described as a Business Activity Research Assessment; and secondly, an alignment call (i.e., a conclusion regarding whether the activity is conducted in a climate-focused or sustainable manner), described as a Sustainability Research Assessment. The outcome of both calls is represented in the revenue-share-based metric.

Exhibit 4: Climate solution revenues methodology overview

Business activity research	Sustainability research	Climate solutions
Solar PV energy generation	N/A (auto-aligned)	Solar PV energy generation
Building construction	BREEM, LEED, Energy star, EDGE	Energy efficient building construction
Semiconductor manufacturing	Qualitative review	Energy- efficient materials
Consumer products	Qualitative review & energy star	Energy efficient consumer products

Source: Sustainalytics, Russell Investments, for illustrative purposes only.

To evaluate the 'sustainable' nature of a company's activities, we need an evaluation of the involvement against a set of sustainability requirements. For example, evaluating whether buildings built by a construction company are LEED certified. This two-step assessment is done by Sustainalytics analysts. When they perform this quantification, they focus on company disclosure and, where possible, match reported quantities to the pre-defined activities. Where this is not possible, different estimation techniques are used for pure play and non-pure play companies. Depending on the level of information provided by the company, the accuracy of the estimate will vary. For a full description of the process, including all the assumptions underpinning Activities Based Research, involvement models and revenue estimations, refer to the Sustainalytics EU Taxonomy Solution methodology document.

Some activities are inherently sustainable, such as renewable energy activities. For example, electricity generation from solar photovoltaic or wind, naturally have life cycle GHG emissions lower than a commonly accepted threshold coherent with the Paris Agreement. Sustainalytics labels these activities as Default Inclusion or Auto Aligned; whereby any revenue associated with activities related to these activities is directly classified as 'sustainable'.

4. Material ESG score

The strategy also incorporates an ESG rating score. This metric is designed to capture a company's performance on the sustainability issues that are financially material to the company's business.

Unlike carbon data that is highly skewed, ESG ratings from various providers tend to follow a more bell-shaped distribution. This is because ESG scores are based on many characteristics, which are standardized and aggregated, leading to an averaging effect in the overall score. As a result, it is not feasible to achieve improvements at the same magnitude as the carbon objectives without dramatically changing the investment outcomes. For example, while a 50% reduction in carbon intensity generates approximately 30 basis points (bps) of tracking error, it takes only a 3% improvement in ESG rating to incur 30bps of tracking error.

It would be reasonable to guess that a dramatic reduction in reserves and relative carbon footprint would result in an upward shift in environmental metrics and, ultimately, the aggregate ESG score of a portfolio, rendering this constraint redundant. However, our analysis of the data showed this is rarely the case[3]. Low carbon strategies have a natural tendency to overweight companies in sectors that are less carbon-intensive, such as financials and technology. These sectors have their own ESG risks that are not well measured by the carbon characteristics. Our goal with the inclusion of this more industry-balanced ESG metric is to ensure that when we overweight companies in a low carbon strategy, we are doing so in an informed way and are not inadvertently loading up on other sustainability risks.

In addition to offering an industry-aware materiality lens, the ESG score also adds value by providing insight into company practices and serving as a forward-looking indicator. We strive to strike a balance between the inclusion of forward-looking information such as company targets and momentum in indicators, while still maintaining high standards for data quality.

5. Coal exclusions

The four criteria outlined above are used to tilt the portfolio; our enhanced decarbonization strategy also includes a coal exclusion.

Coal usage is already decreasing in its share of energy mix, and projections indicate an even steeper drop. In the U.S., coal production is projected to decline by 47% between 2022 and 2040[4]. Beyond the economic outlook, there is also a recognition that coal contributes disproportionately to climate change. While exclusions are black and white in terms of outcome, names on the list are not. We start by defining coal companies as companies with more than 10% of their revenue derived from mining thermal coal and coal power generation.

Next, we also consider forward-looking information about a company's overall positioning for an energy transition. Specifically, companies who produce a significant share of their power generation from renewable sources may be exempt from the exclusion list, as well as companies who have made public commitments to divest from their coal-related activities and have made net zero emission targets which are deemed to be credible. We find that these additional forward-looking considerations, while more time consuming to produce, are critical aspects of identifying which companies in the very high-stakes utility sector are actively seeking to facilitate the transition to a low carbon economy.

Methodology

The strategy we have developed builds directly on insights gained from our previous research on decarbonization strategies and existing client mandates. Specifically, we have previously argued and continue to maintain that an active share minimization approach is more relevant than the standard decarbonization alternatives[5] in that it allows us to meet multiple objectives while maintaining benchmark-like returns without introducing a risk model or covariance matrix.

For decarbonization and ESG-related strategies, we believe that it is extremely important to have a direct relationship between a company's exposure and the subsequent weight in the portfolio. The use of a risk model can compromise this direct relationship and provide unintuitive positions at the company level. To avoid the pitfalls of using a risk model we have focused on maximizing the commonality (minimising active share) of the strategy.[6]

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[3] Materiality Matters: Targeting the ESG issues that impact performance – the Material ESG Score. (Steinbarth, Bennett, 2022).

[4] U.S. Energy Information Administration, World Energy Projection System (2023), Annual Energy Outlook 2023 (March 2023), www.eia.gov/aeo

[5] "The Russell Investments Decarbonization Strategy: Investigating different approaches to reducing the carbon footprint of an equity portfolio without materially impacting performance", (Smith, Bennett, Velvadapu 2016).

[6] See Appendix A for a further discussion of active share or our earlier research for an analysis of its benefits relative to other Decarbonization methodologies.

The portfolio construction process begins with the parent benchmark or underlying strategy as the starting universe for our optimization process. The optimization methodology and objective function are the same regardless of whether the starting universe is a market-cap weighted benchmark, a smart beta strategy, or another active strategy.

Our optimization process solves for the combination of securities that achieves the aggregate carbon footprint, carbon reserves, climate solution revenues, and ESG profile targets with the minimum amount of active share and transaction costs. We employ several risk-related constraints including maximum asset, country, sector and industry deviations. Unlike the objective function, carbon and ESG criteria, the portfolio risk constraints will differ depending on the starting universe. Typically for narrower and more concentrated universes, we will utilize broader risk constraints and for broader and more diversified universes, we will utilize narrower constraints.

Framework flexibility and customization

While the Decarbonization 3.0 framework is built around a robust baseline of carbon reduction and ESG integration, it is designed to be inherently flexible. Using a range of key metrics, the framework can be tailored to align with specific client objectives. For example, investors may choose to target a higher or lower carbon footprint reduction or increase their exposure to companies generating revenue from climate solutions. Through our Customized Portfolio Solutions team, we work closely with clients to assess the potential trade-offs to active risk, ensuring that any adjustments are thoughtfully implemented. This allows us to preserve the integrity of the framework while delivering strategies that reflect each client's unique priorities and constraints.

Results

We evaluate the strategy on the basis of its ability to meet the carbon and ESG objectives while maintaining low levels of active risk relative to the underlying portfolio. These results are summarized in the table below, using the MSCI World index as our starting point for the testing period of January 2015 to April 2024. Throughout this paper, results refer to a back-tested simulation of the described strategy over the testing period.

Objectives:

Factor	Objective
Carbon emissions	50% reduction
Carbon reserves	50% reduction
Coal related exclusions	Zero holding of companies with significant involvement in coal
Climate solutions revenue	Greater than benchmark
ESG	Greater than benchmark
Active risk	Less than 1%

Source: Russell Investments. The table above outlines the primary objectives targeted in the portfolio optimization used to generate the results that follow. These inputs are for illustrative purposes only and may not reflect actual investment strategies.

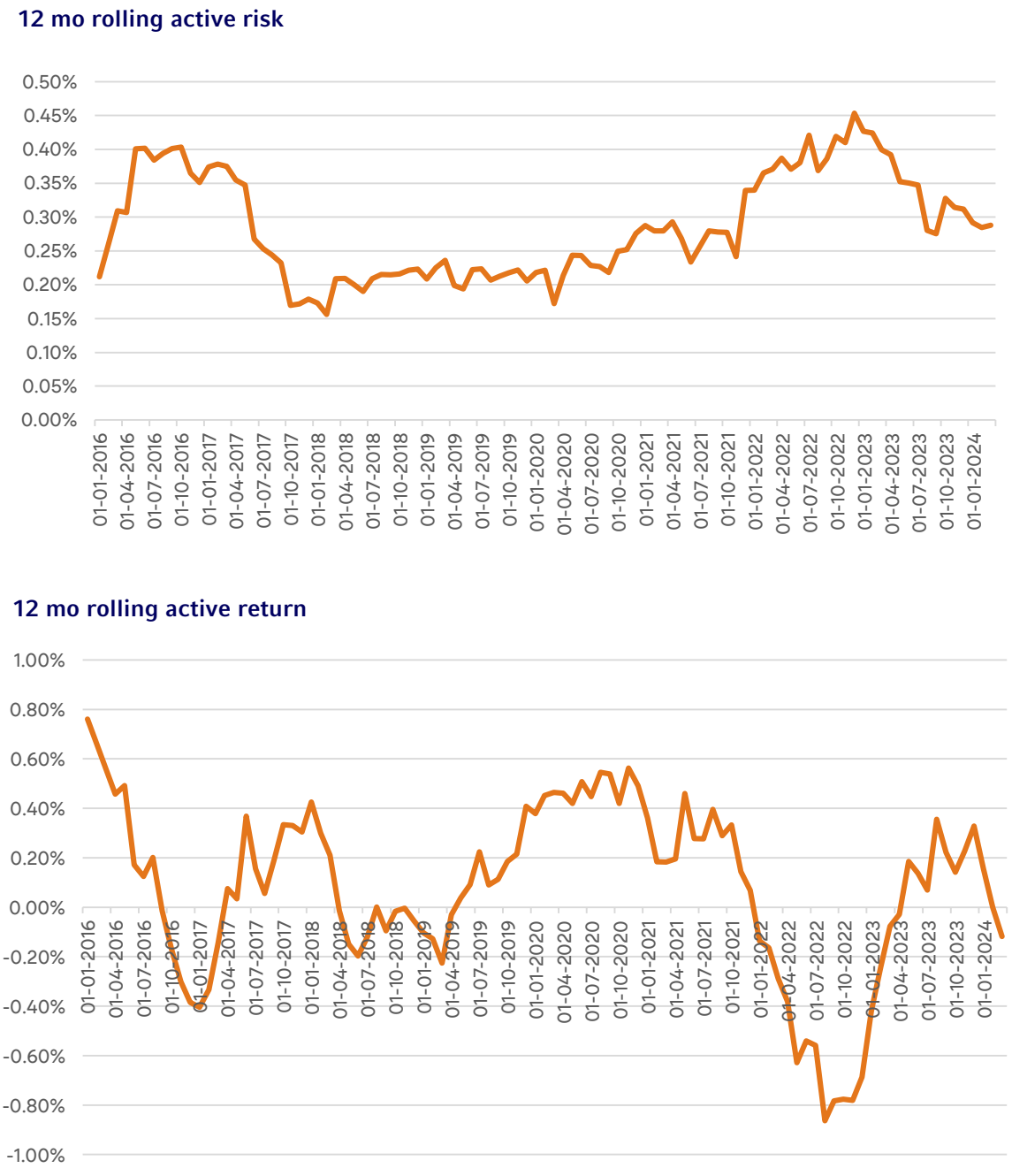
Over the period the strategy displayed low levels of active risk with tracking error well below 1%. Given a goal of replicating the return profile of the underlying strategy, we do not have excess return expectations for the strategy. During the period January 2015 – Apr 2024, the annualized return was higher than the benchmark, largely due to small underweights to the energy sector, which underperformed during this period. Despite the outperformance observed during this period, we do not hold a return expectation or target for this strategy.

Active return and active risk

As stated previously, an objective of the strategy is to offer a return profile similar to the underlying benchmark. Here we report the rolling one-year active return of the strategy, the difference between the benchmark and the actual return. From these results we can tell the strategy is effective in matching the return pattern of the underlying portfolio.

Unlike other decarbonization strategies that focus on minimizing tracking error, our approach explicitly targets low active share. As our results show, this helps keep actual tracking error in line with expectations and avoids consistent overshooting of predicted levels. In effect, even without directly targeting tracking error, the strategy still delivers tracking error outcomes comparable to those of tracking error–optimized approaches.

Exhibit 5: Rolling active return (12 months) and active risk (12 months) of Decarbonization 3.0 Strategy vs. MSCI World Index

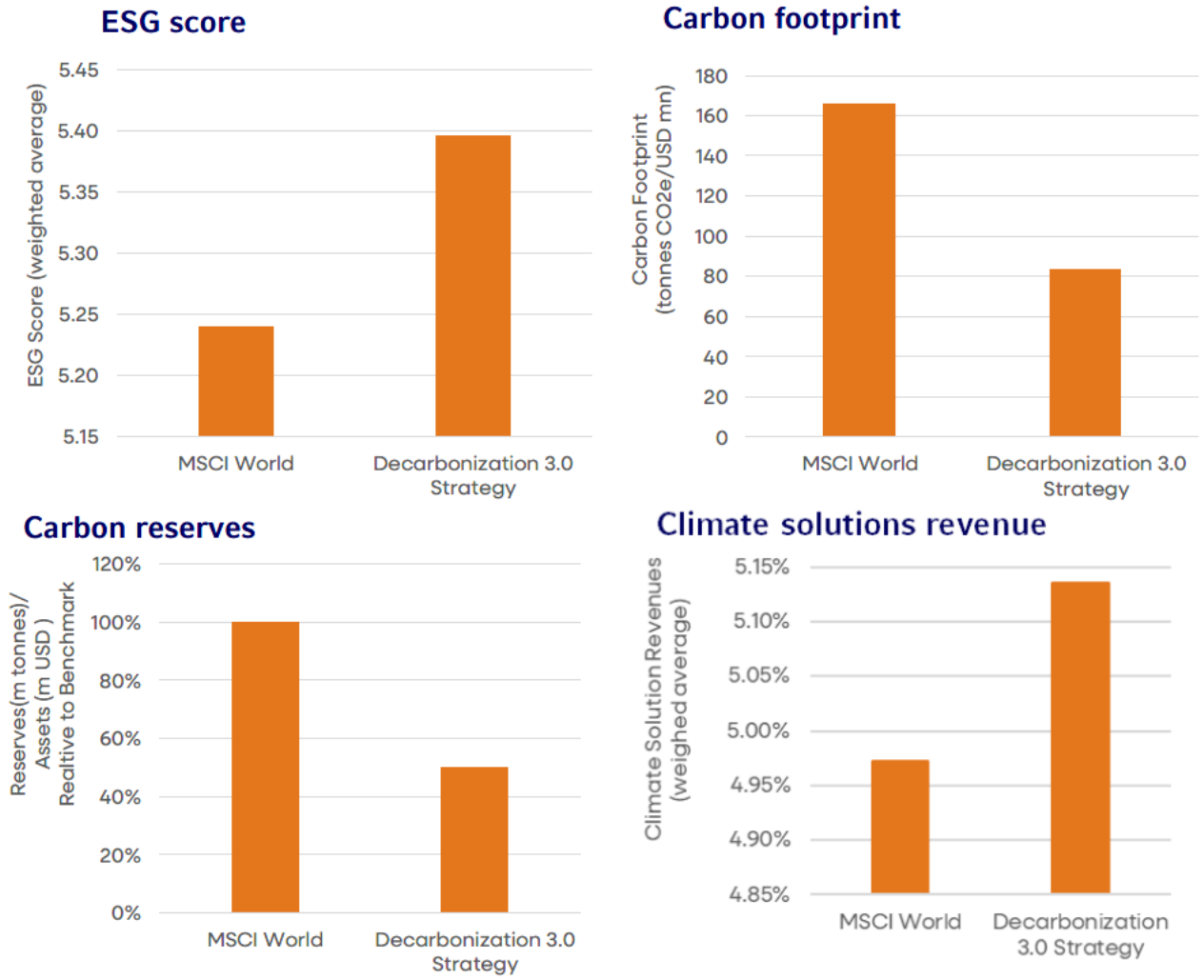


Source: Russell Investments. Data as of 30 June 2024. These charts reflect hypothetical back-tested performance for illustrative purposes only and are not indicative of future results. Simulated outcomes are based on a limited time period and rely on specific constraints and objectives, as outlined above; results may vary if different constraints are applied. Performance and risk are shown relative to the MSCI World Index, using a risk model for estimation. There is no guarantee that the outcomes shown will reflect those of any actual portfolio, which may differ materially.

Sustainability results summary

In addition to meeting risk and return objectives, the strategy is also successful in consistently improving the aggregate ESG score, carbon footprint, carbon reserves, and climate solutions revenues to the targeted levels. Below we report the average ESG outcomes of the Decarbonization 3.0 Strategy relative to benchmark through the testing period.

Exhibit 6: Decarbonization 3.0 Strategy



Source: Russell Investments, MSCI, Sustainalytics. These charts reflect hypothetical back-tested results for illustrative purposes only and are not indicative of future performance. Values represent the average over the testing period from January 2015 to April 2024, using the constraints and objectives specified above. Results will vary depending on the timeframe, optimization constraints, and universe applied.

Conclusion

Global decarbonization initiatives aim to mobilize institutional capital to reduce carbon exposure in the financial economy while accelerating the decarbonization of the real economy. Achieving this requires more than simply reducing a portfolio's carbon footprint. It calls for a forward-looking, research-driven approach that actively supports the low-carbon transition through meaningful capital reallocation.

With Decarbonization 3.0 we take a more holistic view of what it means to align a portfolio with the energy transition. Our strategy goes beyond standard carbon reduction by integrating multiple signals that capture both climate risks and opportunities. Together, these form a comprehensive framework for understanding how a company contributes or is exposed to the energy transition. In doing so, we avoid common pitfalls that can arise from narrowly targeting emissions alone, such as the unintentional underweighting of renewable energy exposure or reducing allocation to transition-critical sectors.

We believe this more nuanced approach provides a better roadmap for investors looking to position portfolios for a decarbonizing world without taking on unintended risks. Importantly, it enables portfolios to remain invested in the sectors that matter most for change, while actively tilting toward solutions that drive progress.

As climate data continues to improve and regulatory frameworks evolve, our approach is designed to adapt. Ongoing developments such as the EU Climate Benchmarks, the IIGCC Net Zero Investment Framework, and innovations in company-level disclosures, are helping to reshape how investors understand climate alignment. We remain committed to continuous research, strategy refinement, and market engagement to ensure our solutions stay at the forefront of sustainable investing.

Decarbonization 3.0 represents the next step in that journey—one that more fully reflects the complexity of the energy transition and the need for practical, forward-looking investment solutions that work in the real world. We view this as an essential part of our role in supporting clients who are navigating the evolving landscape of climate-aware investing.

Appendix A: Active risk

While we monitor tracking error as part of our portfolio oversight, it is not a constraint we explicitly optimize for. There are several important reasons for this.

First, including tracking error as an optimization objective introduces complexity by incorporating the full risk model's covariance matrix. This means that differences in security weights would be influenced not only by carbon emissions (or some other sustainability-related constraint) but also by how each stock interacts with others in terms of return and risk. As a result, two companies with identical carbon footprints could receive very different portfolio weights based purely on their statistical relationships to other stocks. For example, risk-based optimizations often result in large underweights to several energy names (like Shell, Total, and Chevron), while concentrating a significant overweight in another (like Exxon Mobil) to offset risk. These decisions are primarily driven by covariance, not by carbon data, leading to outcomes that may conflict with the core goal of a decarbonization strategy.

Second, the risk models that drive these covariance matrices can be unstable over time. This instability can cause large shifts in portfolio positions, even when the underlying carbon profile hasn't changed.

Third, because our strategy directly targets a lower carbon footprint, and this objective often isn't strongly correlated with other traditional risk model factors, the model may treat the reduction in carbon exposure as "risk-free." This leads to what's known as the alignment problem (Ceria, Saxena, and Stubbs, 2012), where the model underestimates the actual tracking error of the portfolio.

Instead of relying on tracking error within the optimization, we manage active risk in a more practical way. We focus on maintaining high overlap with the benchmark (i.e., low active share) and apply conservative constraints across assets, sectors, industries, and countries. These controls help ensure that the strategy stays aligned with the benchmark while still delivering on its low-carbon objectives, keeping realized tracking error both low and predictable.

Appendix B: Material ESG Score

Our strategy uses a Material ESG Score to evaluate how companies manage the environmental, social, and governance issues that are most financially relevant to their business. The score ranges from 0 to 10 and is based on the SASB Materiality Map, with data sourced from Sustainalytics and MSCI. This score provides a focused view of financially material ESG factors and helps distinguish between companies addressing the issues most likely to impact long-term performance.

That said, we recognize that ESG preferences and requirements can vary. Our framework is designed to be flexible so that we can incorporate more widely recognized ESG ratings, such as the Sustainalytics ESG Risk Rating, in place of the Material ESG Score to align with specific client objectives or meet regulatory expectations.

Using either score allows us to maintain a consistent focus on understanding ESG-related risks and opportunities in a way that supports transparent and adaptable portfolio construction.

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