

# Greenwheel Insights

## Counting Carbon (Part 2): Dynamic baselines & targets for portfolio emissions

This is Part 2 of 2 of the 'Counting Carbon' Insights note. Part 1 outlines the challenges with tracking portfolio-level emissions. Part 2 sets out options for investors to address these challenges.



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### Executive Summary

- **Investors may seek to reduce portfolio emissions in different ways, for different reasons.** Some may prioritise reducing transition risk, while other may prioritise developing transition opportunities and impact.
- **Guidelines suggest portfolio emissions should be 'rebaselined' once the influence of external drivers** that may sit outside of an investor's emissions-related objectives, such as large changes to portfolio composition, **become significant.**
- **Investors require practical approaches** to do this, but **little guidance is available on how rebaselining should be conducted.**
- **This paper addresses this gap by outlining rebaselining methods aligned to four different 'Objective Tiers' with which investors may align.** Objective Tiers progressively narrow their range of 'legitimate' drivers of portfolio emissions, and shift in focus from reducing transition risk toward driving transition opportunity.
- Each method comes with:
  - **(a) clear 'trigger' metrics** to monitor the need for rebaselining
  - **(b) Flexible 'significance thresholds'** for these trigger metrics
  - **(c) no need for complex analytics**, such as attribution analysis which may be difficult to conduct and communicate.
  - **(d) inherent adjustments for net flows and other movements in financial metrics**, which may otherwise cloud emissions trends.
- Where required, **guidance is offered for setting and rebaselining portfolio emissions targets**, linked to each Objective Tier. However, setting portfolio-level emissions targets comes with a range of challenges.
- **Recommendations to reduce the impact of emissions data idiosyncrasies**, such as changing methods or error corrections, are also outlined.

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## Preface: The Investor Need

*“What seems straightforward quickly becomes highly complex. While AI may eventually simplify this, understanding the challenges of tracking portfolio emissions and setting targets helps investors place these efforts within their broader objectives, ranging from a broad reduction in risk through declining emissions exposure, to driving value and impact through engagement”*



**John Teahan**

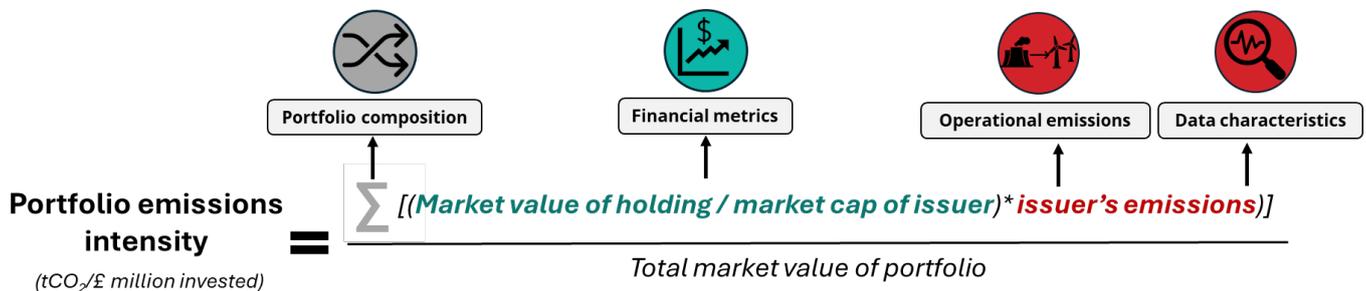
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## Introduction

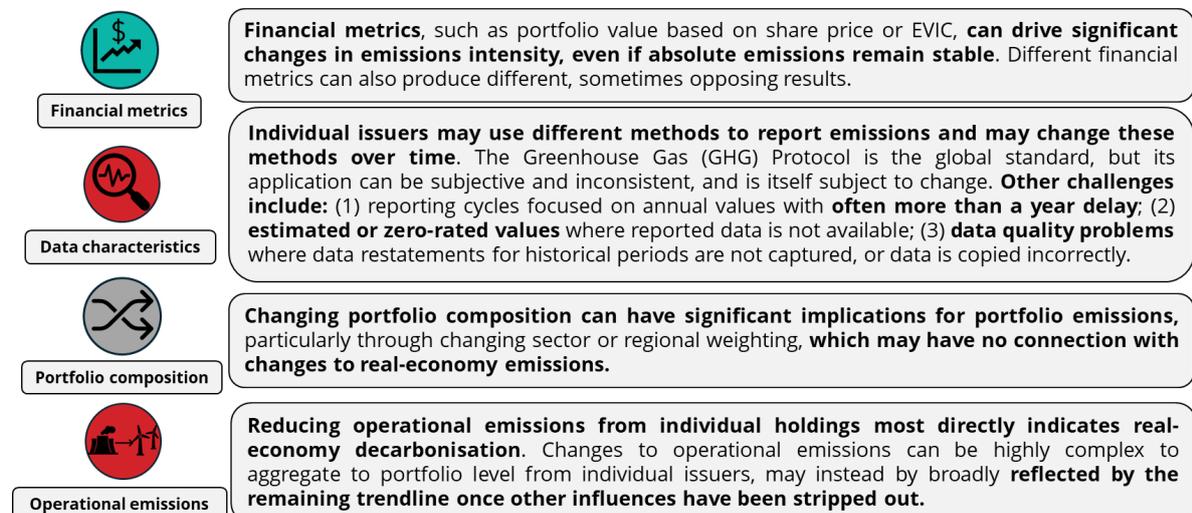
This paper – Part 2 of 2 – offers recommendations to tackle the challenges associated with measuring and managing the emissions profile of a portfolio of listed equities, as described in Part 1. This includes methods for ‘dynamic rebaselining’ of portfolio emissions based on investor objectives, how emissions targets could be set, and when and how to adjust them over time.

### Summary of the problem (explored in Part 1)

Figure 1 illustrates the formula for tracking the emissions intensity of a portfolio of listed equities, and the four key drivers of change. Figure 2 outlines the key challenges associated with each of these drivers.



**Figure 2** - Formula for emissions intensity for portfolio of listed equities. Graphic created by Greenwheel.



**Figure 1** – Key challenges associated with each driver of portfolio emissions. Graphic created by Greenwheel.

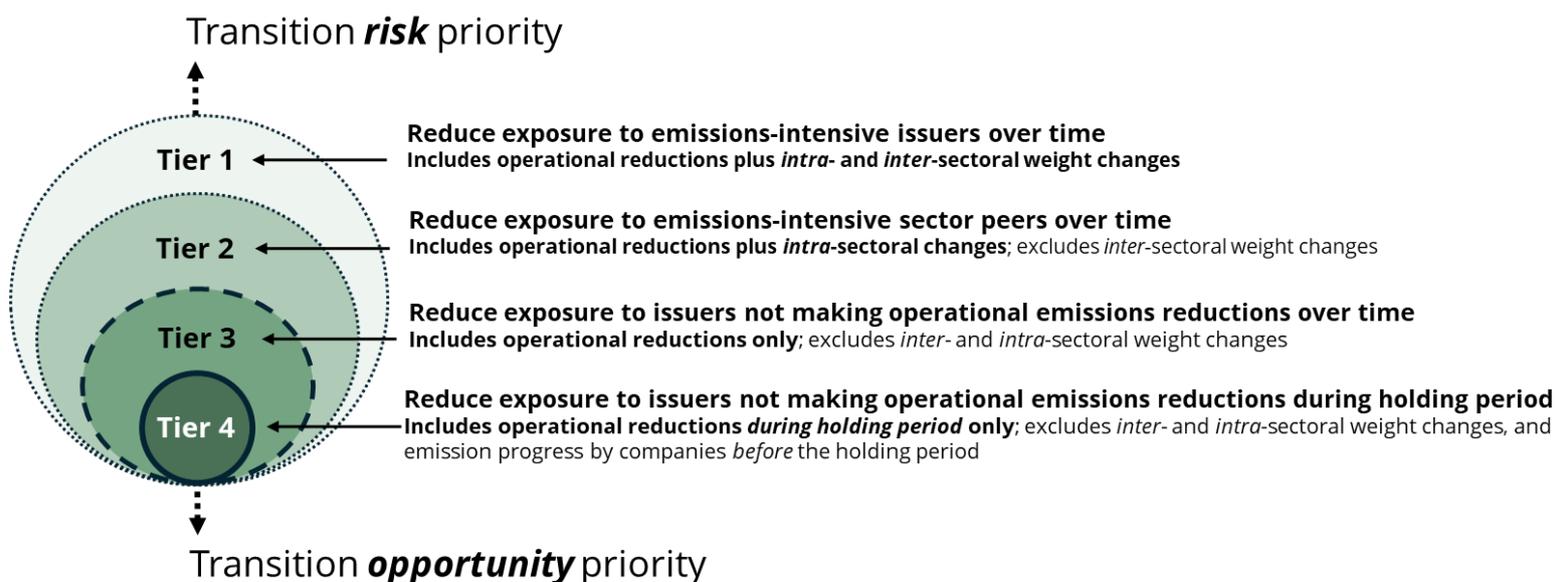
Investors managing portfolios of listed equities require practical approaches to address these issues, including methods to adjust portfolio emissions pathways to focus on those drivers that align most closely to their investment objectives.

## Measuring what matters

Investors tracking portfolio emissions are often seeking to reduce them. However, there may be differences in *how* investors seek to reduce them.

The *how* may be driven by *why*. For example, some investors may prioritise managing their *transition risk* exposure by moving away from emission-intensive issuers or sectors to over time. Others may instead prioritise driving *transition opportunities* or impact through their investments, by holding issuers that are likely to reduce their operational emissions or may be encouraged to do so through investor engagement, delivering shareholder value and real-economy emissions reductions.

These differences in priority may be broadly reflected by four 'Objective Tiers', illustrated below (Figure 3). The Tiers are progressively more stringent in what are considered 'legitimate' actions to influence changes to portfolio emissions.



**Figure 3** – Four 'Objective Tiers' for portfolio emissions reductions. Graphic created by Greenwheel. The information shown above is for illustrative purposes only.

Transition opportunities usually refer to the potential for competitive advantage, lower costs or improved resilience for early- or fast-movers transitioning to low-carbon operations or products.<sup>ii</sup> However, in this context it can also refer to the opportunity for investors to deliver impact by using engagement to drive down the operational emissions of holdings more quickly than otherwise might be achieved, with a focus on generating value that may have otherwise gone unrealised.

Engagement is a central tool under Objective Tier 4 but can be valuable across all Tiers by helping to minimise transition risks and realise opportunities. It refers not just

to engagement with holdings, but also policymakers and other stakeholders to help establish an enabling ecosystem and reduce dependencies that may otherwise constrain actions by individual companies or sectors. It also helps maintain flexibility for investors seeking to reduce their portfolio emissions by widening transition incentives and opportunities across their investment universe.

**Although engagement can deliver results, it is often difficult to capture its impact.**<sup>iii</sup>

It can be even harder to understand the impact of engagement if its effect plays out over time, influencing outcomes and decisions beyond an investor’s own holding period. However, the reverse can also be true, where the impact of decisions taken prior to an investor’s holding period (whether due to investor engagement or not) act to reduce an issuer’s emissions during an investor’s holding period, for which they might claim credit.

### Managing data characteristics

Regardless of Objective Tier, most investors will be keen to reduce the effect of data quirks, as described above. Figure 4 outlines key actions for issuers and data aggregators or vendors to tackle these issues. Investors may use their influence and engagement with both issuers and data vendors to encourage these actions.

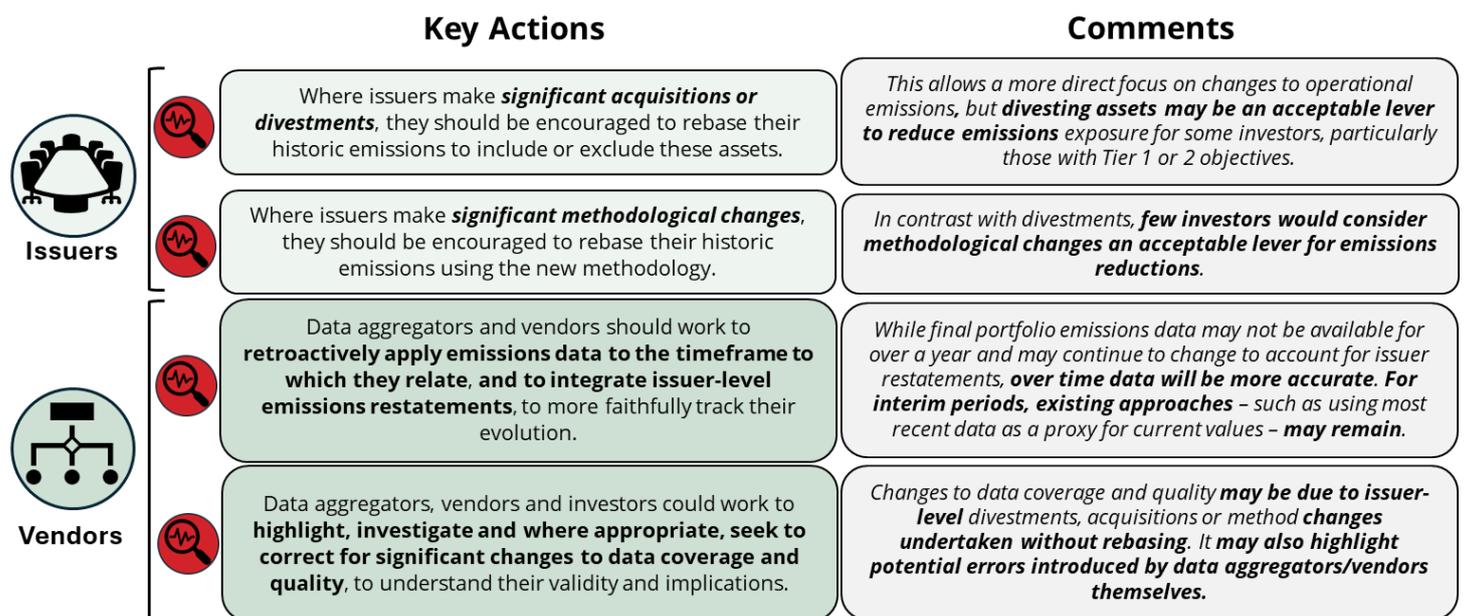


Figure 4 – Actions to reduce the influence of changing data characteristics on portfolio emissions. Graphic created by Greenwheel.

The GHG Protocol is the most widely used global standard for measuring and reporting emissions. It **requires issuers to ‘rebaseline’ their historic emissions** to a base year (fixed or rolling), when significant structural changes (e.g. divestments or mergers), methodological changes, or data errors occur.<sup>iv</sup> The Science Based Targets initiative

(SBTi), which draws on the GHG Protocol, requires rebaselining if these changes alter emissions by 5% or more of the base year's emissions.<sup>v,1</sup>

While this means most issuers should already rebase their emissions, **data vendors could flag when this guidance may not have been followed. Vendors could also ensure rebaselined data is included in their offering to investors.** However, challenges will remain. For example, issuers in complex sectors may continue to make different methodological choices, limiting direct comparability.

### **'Dynamic rebaselining' under each Objective Tier**

**Under some guidelines, a rebaselining of *portfolio* emissions is required or recommended once excluded factors** – such as changes to financial metrics, data characteristics and portfolio composition – **exceed a predefined 'significance threshold'**.<sup>2</sup> However, **limited guidance is available on how rebaselining should actually be conducted.**<sup>iv,3</sup>

**'Attribution analysis' can track emissions drivers against significance thresholds,** and various methods are available.<sup>4</sup> While useful, **such analysis can be complex to implement, and their results difficult to clearly communicate.**<sup>vi</sup>

**This paper attempts to address these limitations. It describes methods for 'dynamic rebaselining' of portfolio emissions** and suggests 'trigger' metrics to monitor, against which significance thresholds may be set without the need for attribution analysis.

The approach to rebaselining depends on the investor's Objective Tier. **Figures 5-8, below, suggest rebaselining methods for each Objective Tier, and trigger metrics.**

Even for investors with a focus on emissions intensity, **tracking absolute emissions of a portfolio allows an understanding of its emissions profile unclouded by financial metrics<sup>5</sup>, and provides a simpler and more transparent dataset to rebase.**

Absolute emissions may also connect more directly to any emissions-related targets set for a portfolio, and methodologies for setting them (discussed below). As such, **each rebaselining methodology focuses on *absolute* emissions,** but connections to emissions intensity metrics are also described.

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<sup>1</sup> While the GHG protocol sets a guideline 5% threshold for data errors and methodological changes, it does not account for the impacts of investments, divestments and mergers.

<sup>2</sup> The GHG protocol requires rebaselining for Scope 3 (financed) emissions, while the Partnership for Carbon Accounting Financials (PCAF) requires adherents to set a base recalculation policy with significance thresholds stated. The IIGCC's Net Zero Investment Framework (NZIF) follows PCAF requirements ([IIGCC, 2024](#); [Greenhouse Gas Protocol, 2025](#); [PCAF, 2022](#))

<sup>3</sup> PCAF offers a methodology, but focuses on emissions intensity only ([PCAF, 2022](#))

<sup>4</sup> These include the Partial Equilibrium Approach, Three-Layer Approach, the Logarithmic Mean Divisa Index, the Index Decomposition Approach ([IIGCC, 2024](#); [MSCI, 2023](#); [Bouchet, 2025](#)).

<sup>5</sup> Both the PCAF and IIGCC NZIF recommended that absolute emissions are measured and reported, alongside emissions intensity ([PCAF, 2022](#); [IIGCC, 2024](#))



## Objective Tier 1: Reduce exposure to emissions over time

### Aim

**Remove** the effects from net portfolio flows but **retain** the effects of *inter-* and *intra-*sector weight changes, and issuer-level operational changes, before and during holding period.

### Method

Calculate *current* emissions from the *current* portfolio, at ownership rates *prior* to the net flow (i.e. base year or period of previous adjustment). The proportional difference between this counterfactual and actual emissions for the current period forms the **adjustment factor to be applied to emissions reported for all prior periods**, back to the base year, for each rebaselining.

### Trigger metric

**An ideal metric would focus on the change in ownership share** of the investible universe, avoiding interference from fluctuating stock prices. **However, net flows may be more practical indicator.**

### Link to emissions intensity

**Historic emissions intensities should not be adjusted.** Net flows should produce a similar change in both ownership rates and total portfolio value (the numerator and denominator in Figure 1), largely cancelling each other (although this excludes the effect of changing stock values between periods, and changing ownership shares due to buybacks and new issuance).

Figure 5 – Objective Tier 1 rebaselining method. Graphic created by Greenwheel.



## Objective Tier 2: Reduce exposure to emissions-intensive peers over time

### Aim

**Remove** the effects from net portfolio flows and *inter-*sectoral weight changes but **retain** the effects of *intra-*sector weight changes, and issuer-level operational changes, before and during holding period.

### Method

**Base period emissions should be set using the average emissions per share for each sector ('sector-share')**, across all issuers in the benchmark or investible universe. **This prevents 'gaming' emissions reductions** through holding emissions-intensive issuers in the base period and subsequently reallocating intra-sector holdings.

**When rebaselining, base period emissions can be recalculated using current sector-share weighting** (i.e. the number of shares owned by sector, irrespective of financial value), **and base period emissions per sector-share**. For intervening periods, for sectors *actively* de-weighted, emissions to be removed from the baseline should be sector-share average rather than issuer-specific. For sectors *actively* up-weighted, *actual* historic emissions from new or increased holdings should be used. This removes the impact of prior intra-sector weight changes in the de-weighted sector but adds it for sectors with increasing weight.

### Trigger metric

**An ideal metric would focus on the change in ownership shares between sectors**, avoiding interference from fluctuating stock prices. Although **a change in the value of ownership between sectors may act as a rebaselining trigger**, ownership shares must still be calculated to allow rebaselining. **Net flows may also act as a rebaselining trigger.**

### Link to emissions intensity

**Historic emissions intensities can be recalculated using net flows, once absolute emissions have been rebaselined.** The method above adjusts the numerator in Figure 1 (absolute emissions) for changing sector weight *and* net flows, for all historic periods. The denominator (total portfolio value) must also be adjusted by net flows. This can be done using an adjustment factor, calculated as the value of net flows as a proportion of current portfolio value. This reflects changing values of issuers with ownership shares held constant or reduced since the last rebaselining but exclude the values of increased or new holdings.

Figure 6 - Objective Tier 2 rebaselining method. Graphic created by Greenwheel.

Due to the complexity of the rebaselining method proposed for Objective Tier 2, an example is illustrated in Annex I.



### Objective Tier 3: Increase exposure to issuers making operational emissions reductions over time

<b>Aim</b>	Remove the effects from net portfolio flows and <i>inter-</i> and <i>intra-</i> sectoral weight changes but <b>retain</b> the effects of issuer-level operational changes, before and during holding period.
<b>Method</b>	<b>Absolute emissions in all prior periods should be adjusted to reflect issuer-specific emissions in those periods, using current period holdings and ownership shares.</b> This ensures the new baseline reflects only issuer-level operational changes across portfolio holdings (data characteristics notwithstanding).
<b>Trigger metric</b>	<b>An ideal metric would focus on the change in ownership share <i>between issuers</i>,</b> avoiding interference from fluctuating stock prices. Although <b>a change in the value of ownership between issuers may act as a rebaselining trigger</b> , ownership shares must still be calculated to allow rebaselining. <b>Net flows may also act as a rebaselining trigger.</b>
<b>Link to emissions intensity</b>	<b>Historic emissions intensities can be recalculated using net flows, once absolute emissions have been rebaselined.</b> The method above adjusts the numerator in Figure 1 (absolute emissions) for changing issuer weight <i>and</i> net flows, for all historic periods. The denominator (total portfolio value) must also be adjusted by net flows. This can be done using an adjustment factor, calculated as the value of net flows as a proportion of current portfolio value. This reflects changing stock values of continuously held and sold issuers but exclude those of new holdings.

Figure 7 - Objective Tier 3 rebaselining method. Graphic created by Greenwheel.



### Objective Tier 4: Increase exposure to issuers making operational emissions reductions during holding period

<b>Aim</b>	Remove the effects from net portfolio flows and <i>inter-</i> and <i>intra-</i> sectoral weight changes, and the effects of issuer-level operational changes before the holding period but <b>retain</b> issuer-level operational changes during the holding period.
<b>Method</b>	<p><b>The focus metric is the rolling-average <i>proportional change</i> in absolute emissions</b> over pre-defined periods (e.g. three or five years), <b>based on portfolio composition</b> (ownership shares) <b>at the beginning of the period.</b> Holdings present at the start but sold before the end of the period should be excluded.</p> <p><b>This measures only changes to holdings consistently held over a given period,</b> and at consistent ownership shares, to allow focus on the impact of changing operational emissions for these issuers (data characteristics notwithstanding). The rolling assessment period may set to allow sufficient time for the impact of engagement activities to show through.</p> <p><b>Each new rolling-average period automatically rebases for changing portfolio composition.</b> As the objective over time may be to dispose of issuers where emission reductions have been realised and rotate into high-emission issuers where they have not, measuring change to absolute emissions for the portfolio over time may not be reflective of progress against the Fund's objectives. To maintain a historically accurate picture, emissions restatements for disposed (as well as existing) holdings should be monitored and re-incorporated into calculations of past portfolio emissions performance.</p>
<b>Significance metric</b>	<b>No significance metric is required</b> as rebaselining takes place annually.
<b>Link to emissions intensity</b>	To connect to changes in emissions intensity, <b>the changing <i>actual</i> value of the portfolio held at the beginning of the period may be applied,</b> minus the value of any disposals within the period.

Figure 8 - Objective Tier 4 rebaselining method. Graphic created by Greenwheel.

**Regardless of Objective Tier, all rebaselining methods adjust for changing ownership rates of portfolio holdings** and thus changing allocation of an issuer's emissions. The most direct and significant driver of ownership changes is flows in and out of the portfolio, but reinvested dividends, along with share buybacks and new share issuance,

also have influence. If a rebaselining didn't account for this, portfolio managers would be disincentivised to attract new inflows or encourage share buybacks that may be value accretive or receive undue credit when share issuance dilutes ownership.

**Individual investors can set what they consider to be suitable thresholds** for their trigger metric, a breach of which triggers a rebaselining. **An alternative is to rebaseline each period** (e.g. each year or quarter), as required under Objective Tier 4, but this may place excessive burden on investors. For portfolios with infrequent trades and/or flows, this may also be unnecessary. Under each rebaselining action, adjustments to historic data made by issuers and data vendors should also be fed through.

Although not directly relevant for tracking the direction and magnitude of emissions against an Objective Tier, **investors and their clients may wish to understand how and why a portfolio's emissions pathway has changed over time**. Investors may work directly with data vendors to understand this and potentially draw on attribution analysis, discussed above.

**Increasingly, AI tools may be able to conduct this analysis**, alongside helping to track the evolution of trigger metrics, flag potential errors in underlying data, and investigate reasons for them.

### **Adjusting targeted emissions pathways**

**Investors monitoring their portfolio emissions may have emissions targets**. These targets may focus on absolute emissions or emissions intensity, and they may be fixed value or be a proportional reduction from a base year.<sup>6</sup> In their application, targets may also align with different Objective Tiers.

**Most targets are likely to be derived – directly or indirectly – from scenarios modelling economy-wide emissions reduction pathways** required to achieve an overarching emissions and/or temperature-related goal. **This means they focus on absolute emissions pathways**, which when used for setting emissions intensity targets, requires implicit or explicit assumptions about the future evolution of financial metrics.

**For investors aligning with Objective Tier 1**, and with an investment universe reflecting the wider economy, **portfolio emissions targets derived from economy-wide emissions pathways are suitable**. No target adjustments are required due to changing portfolio composition.

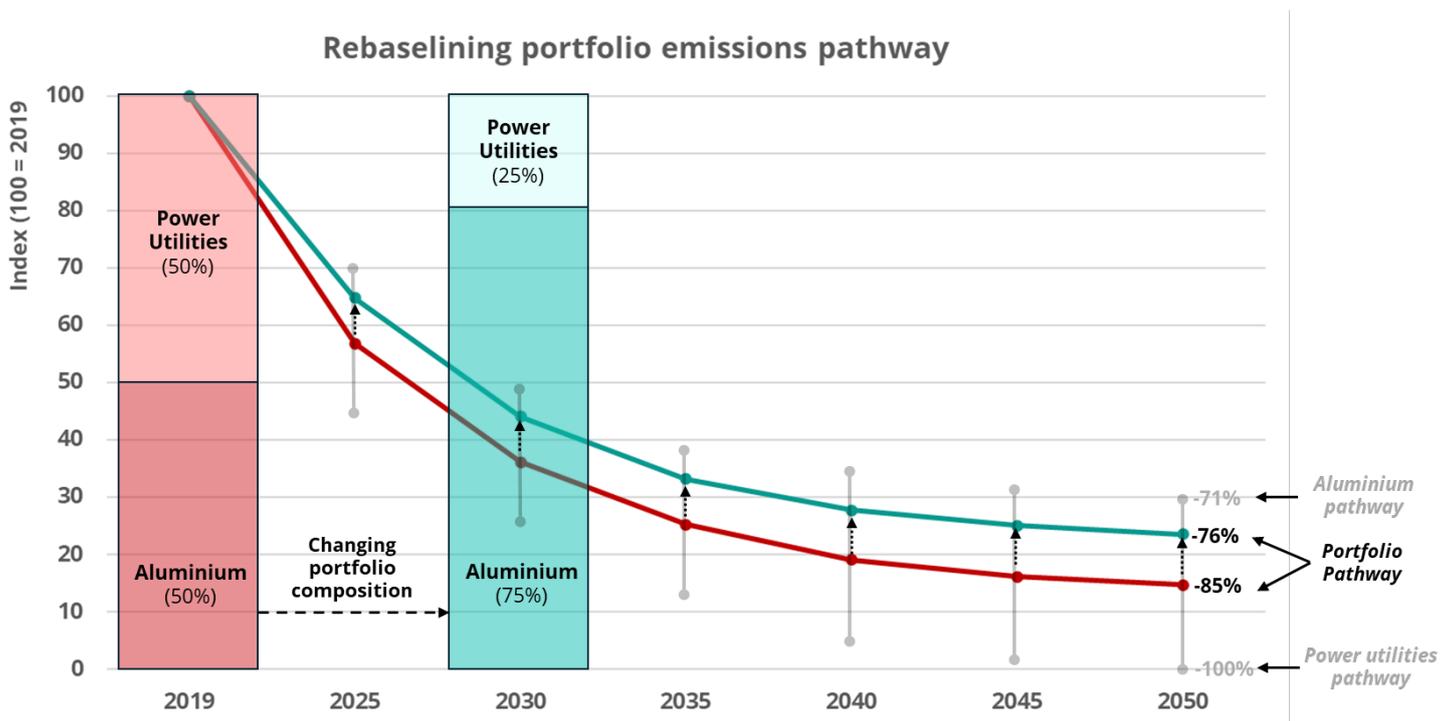
However, **for investors aligning with Objective Tier 2, emissions targets are best set as the weighted-average of sector-level pathways**, according to their sector-share profile (i.e. the number of shares owned from each sector, irrespective of their financial

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<sup>6</sup> They may also be set relative to the emissions profile of the portfolio's benchmark. Another approach is to set a cumulative carbon budget for a portfolio, meaning any under or overachievement of interim emissions targets increases or decreases the stringency of the required future trajectory. Functionally, this can only be used with absolute emissions targets.

value). Most scenario modelling exercises produce sector-level emissions pathways, based on their relative ability to contribute to the overarching scenario objective under assumed conditions (with caveats – see below). **This means a rebaselining of emissions under Objective Tier 2 would also trigger a rebaselining of target pathway.**

**Figure 9 illustrates how such a rebaselining might work**, using a simplified portfolio with two sectors – power utilities and aluminium. Global decarbonisation pathways for these sectors are taken from the OECM 1.5°C model (discussed below). It shows the weighted decarbonisation pathway to 2050 under a portfolio with a 50/50 sector-share weighting in the base year (2019), and the revised target pathway from a reweighting in 2030 to 75/25 toward the aluminium sector.



**Figure 9** – Rebaselining emissions targets with changing sector-share weighting. Data source: [UTS \(2022\)](#). Graphic created by Greenwheel. The information shown above is for illustrative purposes. Forecasts and estimates are based upon subjective assumptions about circumstances and events that may not yet have taken place and may never do so.

A weighted-average sector pathways approach to target *setting* may also be suitable for investors aligning with Objective Tier 1, but which face an investment universe with: (a) significantly different or more concentrated than the balance of emissions in the wider economy, and/or (b) significant representation from sectors not well captured in modelling exercises (e.g. agriculture). However, target *rebaselining* would remain unnecessary.

**For those with Objective Tier 3, either approach may be suitable.** For highly diversified portfolios or those reflective of the wider economy, maintaining economy-wide headline targets may be suitable. **For those more concentrated, a sector-weighted approach may be appropriate.**

**Emissions targets for Objective Tier 4 cannot easily be set following modelled pathways**, given progress is measured as rolling-average change in emissions. Additionally, in some cases investor engagement may initially focus on improving the emissions disclosure of some issuers, which may appear to *increase* their emissions.

**However, there remain several challenges to using scenario modelling exercises to set - and where appropriate, rebase - portfolio emissions targets** for investors under Objective Tiers 1-3. Key challenges are outlined below and **mostly derive from the fact that most integrated assessment models (IAMs) are not designed for investor use**, but instead for high-level guidance for policy makers.

**(1) Misaligned sector definitions.** Most models define sectors by key energy production and demand activities and vectors (e.g. electricity, road transport, residential buildings), rather than industrial classifications. This can make understanding the appropriate emissions pathway difficult for a specific GICS sector, for example. Additionally, some sectors are often poorly or even entirely unrepresented, such as agriculture.

**(2) Misaligned emissions scopes.** Most models examine only direct (scope 1) emissions to the sectors they model, with assignment of scope 2 emissions to individual sectors potentially complex.

**(3) Geographic differences.** Models often only disaggregate individual large economies, grouping the remainder into regions. These economies and regions may produce different pathways for different sectors. For portfolios with issuers that operate multi-nationally, determining their appropriate emissions pathway may be complex.

**(4) Scenario assumptions vs outturns.** ‘Normative’ scenarios that work backward from a pre-defined end point (e.g. Net Zero) may include assumptions about technology, policy and preferences that may not materialise. This may place key decarbonisation options out of reach for individual issuers within a given period, particularly if key factors are outside their influence or ‘zone of discretion’.<sup>vii</sup>

**Challenge (4) is inherent to normative scenarios, and (3) is difficult to solve. However, (1) and (2) can be addressed with appropriate model structuring.** For example, the One Earth Climate Model (OECM), developed by the University of Technology Sydney (UTS) in collaboration with the UN Net Zero Asset Owner Alliance (NZAOA) structures sectors by GICS and emissions by Scopes. The explicit objective behind the model’s development was to be decision useful for the financial sector.<sup>viii</sup>

Other organisations, such as the SBTi and Transition Pathways Initiative (TPI) attempt to address challenges (1) and (2) through mapping activities, which require additional assumptions. While this can help investors and issuers with usability, the original challenge remains, and users remain dependent on mapping assumptions that may not be internally consistent, or which they may not agree with or have capacity to judge.

## Annex I - example rebaselining under Objective Tier 2

This simplified, illustrative example assumes £1 million is allocated across two sectors (energy and financials) in the FTSE All-Share, in a 2022 base year. It uses a two percentage point change in intra-sector holdings as the significance threshold, which is reached in a single step in 2026. The example is based on actual but incomplete data and is illustrative only. Graphics created by Greenwheel.

### 1 Calculate average sector-share emissions (tCO<sub>2</sub>/share)

	2022	2023	2024	2025
Energy	3.84	3.55	3.17	3.17
Financials	0.01	0.009	0.008	0.007

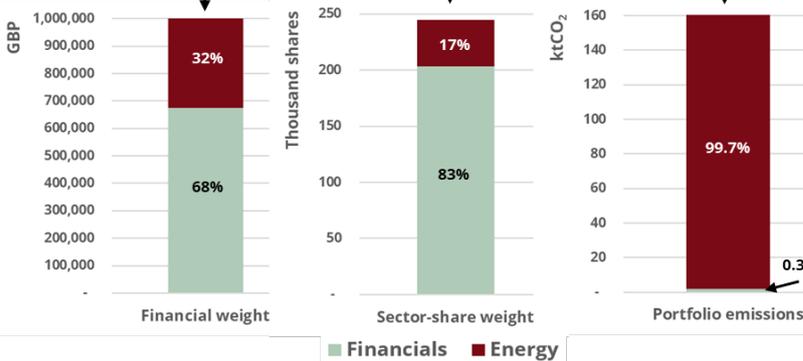
For **setting and adjusting base year** emissions      For **adjusting interim year** emissions

### 2 Calculate base year sector-share weight and emissions

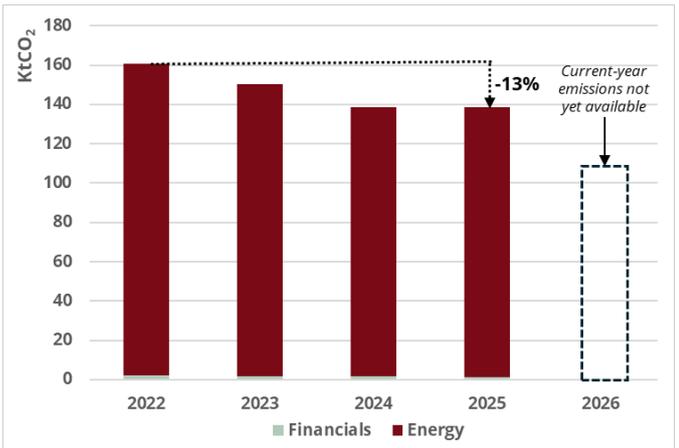
£1 million allocated to two sectors only, with **financial weight** set by relative sector market cap

**Sector-share weight** calculated by number of shares bought in each sector, regardless of price.

**Absolute portfolio emissions** calculated by multiplying number of shares in each sector by average sector-share emissions (Step 1)



### 3 Aggregate portfolio emissions from holdings



Sector-share weighting

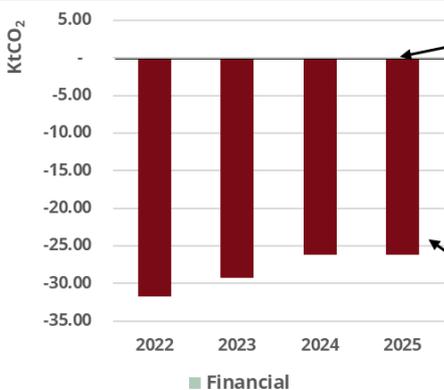
	2022	2023	2024	2025	2026
Energy	17%	17%	17%	17%	15%
Financials	83%	83%	83%	83%	85%

**Base year emissions** calculated as per step 2

**Sector-share weight remains stable**, so portfolio emissions are the aggregate of actual holdings, including intra-sector weight change. **Financial weights may change without consequence.**

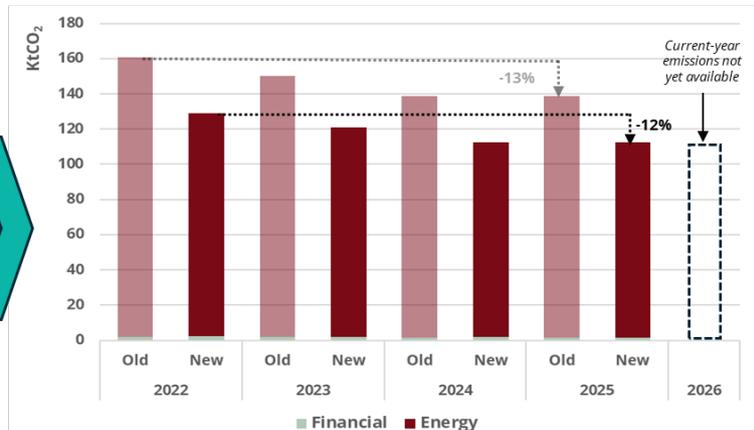
**Sector-share weight changes above significance threshold (2pp) in current year, triggering rebaselining** of emissions in previous years

### 4 Rebaseline base and interim year emissions



**Emissions added to the baseline** for the up-weighted sector reflect ownership share of actual emissions for stocks bought for each previous year (not visible here due to difference in magnitude with emissions removed)

**Emissions removed from the baseline** for the de-weighted sector reflect the number of shares sold multiplied by average sector share emissions in each year (calculated in Step 1)



## Endnotes

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<sup>i</sup> [Greenwheel \(2026\)](#)

<sup>ii</sup> [TCFD \(2017\)](#)

<sup>iii</sup> [Minrova Research Center \(2025\)](#)

<sup>iv</sup> [Greenhouse Gas Protocol \(2025\)](#)

<sup>v</sup> [SBTi \(2025\)](#)

<sup>vi</sup> [UNEPFI \(2023\)](#)

<sup>vii</sup> [Gosling \(2025\)](#)

<sup>viii</sup> [UTS \(2022\)](#)

*We thank Professor Tom Gosling of the London School of Economics for his feedback during the drafting of this paper, but we stress that the contents are entirely the author's own.*

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## Key Information

No investment strategy or risk management technique can guarantee returns or eliminate risks in any market environment. Past performance is not a guide to future results. The prices of investments and income from them may fall as well as rise and an investor's investment is subject to potential loss, in whole or in part. Forecasts and estimates are based upon subjective assumptions about circumstances and events that may not yet have taken place and may never do so. The statements and opinions expressed in this article are those of the author as of the date of publication, and do not necessarily represent the view of Redwheel. This article does not constitute investment advice and the information shown is for illustrative purposes only. Whilst updated figures are not available for all sources, we have performed further analysis and believe that this data has not significantly changed and is reflective for 2026.

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Please contact us if you have any questions or would like to discuss any of our strategies.

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