METHODOLOGY
MSCI ESG RESEARCH LLC

May 2025

Country Scope 1 Emissions Implied Temperature Rise (ITR) Methodology

MSCI ESG Research LLC

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1 Objective

1.1 Overview

The Country Scope 1 Emissions Implied Temperature Rise (ITR) is a forward-looking metric that measures climate impact through the alignment of countries and portfolios of sovereign-issued assets to different levels of global temperature rise, including the Paris Agreement temperature goals.[1]

Limiting global warming to 1.5°C may help mitigate the catastrophic impact of climate change, particularly for small island states, which are most threatened by sea level rise.[2][3] According to the Intergovernmental Panel on Climate Change (IPCC), preventing this situation is conditioned on the world economy reaching net-zero emissions by the year 2050— hence the shorthand term "net-zero" to designate a 1.5°C-aligned transition alignment of the global economy.[4]

The Country Scope 1 Emissions ITR metric shows the temperature-alignment of a country based on its current Scope 1 greenhouse gases (GHG) emissions and projected future decarbonization trajectory.

The Country Scope 1 Emissions ITR methodology closely follows MSCI ESG Research's company ITR methodology.[5] The Country Scope 1 Emissions ITR model is informed by best-practice recommendations on measuring portfolio alignment set out by the Glasgow Financial Alliance for Net Zero (GFANZ).[6]

1.2 Interpretation

The key to understanding Country Scope 1 Emissions ITR is the concept of a **carbon budget** – the maximum amount of greenhouse gases that the world can emit to keep the global warming below 1.55°C by 2100 and, by extension, how much a country can release as its fair share in global decarbonization efforts. The ITR is an absolute measure that calculates the implied temperature rise by 2100 if the entire world economy had the same carbon budget overshoot or undershoot as a given country or a portfolio.

The Country Scope 1 Emissions ITR measures how well a country or a portfolio aligns with climate goals. It focuses on the alignment between country projected emissions and a science-based temperature

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[1] The Paris Agreement is an international treaty on climate change adopted by 196 Parties at the United Nations (UN) Climate Change Conference (COP21) in Paris, France. Its overarching goal is to keep global warming to well below 2°C, and aim for 1.5°C, compared to preindustrial levels.

[2] "Paris Agreement, Article 2", UNFCCC 2015.

[3] "Introducing 1.5: Politics first." Center for International Climate Research, November 11th, 2016.

[4] "Special Report: Global Warming of 1.5 ºC." IPPC, 2018.

[5] Refer to "Implied Temperature Rise Methodology", available on ESG Manager.

[6] "Measuring Portfolio Alignment." GFANZ, November 2022.

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scenario.[7] The methodology does not aim to reflect climate transition risk and so it does not factor in the costs associated with the transition to a low-carbon economy (e.g., changes in asset values; carbon pricing). The ITR methodology incorporates various science-based assumptions, including the Network for Greening the Financial System (NGFS)'s Net Zero scenario, the University of Graz's effort sharing budget approach[8] and Glasgow Financial Alliance for Net Zero (GFANZ)'s recommendations.

Throughout this document, the term **Scope 1 Emissions** means territorial/production emissions[9] excluding emissions from Land Use, Land-Use Change and Forestry (LULUCF). The methodology does not factor in Scope 1 Emissions associated with LULUCF, nor does it consider embodied or avoided emissions[10]. This is due to the current lack of underlying data, appropriate counterfactual scenarios and accounting standardization.

A glossary of technical terms used in this methodology document is included at the end of the document. MSCI ESG Research does not use artificial intelligence (AI) for data collection or in the production processes for the Country Scope 1 Emissions Implied Temperature Rise methodology.

1.3 Modelling steps

Exhibit 1 illustrates Country Scope 1 Emissions ITR's main modelling steps, which are explained in further detail below and in Appendix II.

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[7] For a detailed description of what our various climate metrics measure and their potential use cases, please refer to the paper "Understanding MSCI's Climate Metrics", which is available on MSCI.com: https://www.msci.com/www/research-report/understanding-msci-s-climate/03589573881

[8] K. Williges, L. H. Meyer, K. W. Steininger, G. Kirchengast, 2022, "Fairness critically conditions the carbon budget allocation across countries".

[9] "*Domestic GHG emissions from sources located within the country territory. This Scope 1 definition aligns with the definition of production emissions. Production emissions are emissions attributable to emissions produced domestically and include domestic consumption and exports. This definition follows the territorial emissions approach adopted by UNFCCC for annual national inventories and is typically referenced by sovereigns in their Nationally Determined Contributions (NDCs)*". Partnership for Carbon Accounting Financials (PCAF). 2022. The Global GHG Accounting and Reporting Standard Part A: Financed Emissions. Second Edition.

[10] "*Emission reductions that the financed project produces versus what would have been emitted in the absence of the project (the baseline emissions). In the context of the Financed Emissions Standard, avoided emissions are only from renewable power projects*". Partnership for Carbon Accounting Financials (PCAF). 2022. The Global GHG Accounting and Reporting Standard Part A: Financed Emissions. Second Edition.

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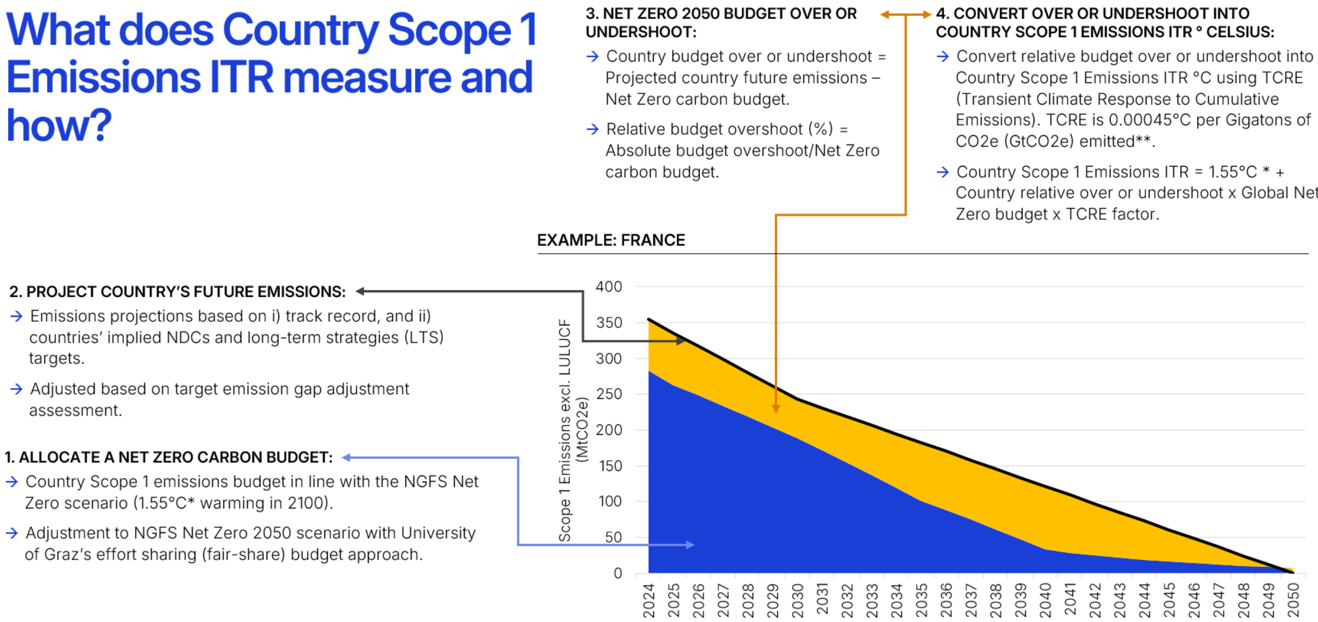
Exhibit 1: Key modelling steps of Country Scope 1 Emissions ITR



Source: MSCI ESG Research, 2025. Note: This is an illustrative example and the values displayed may not reflect the actual Country Scope 1 Emissions ITR of the depicted country. See Annex II and Glossary for further details.

**1.55°C is the baseline temperature of the REMIND Net Zero 2050 NGFS scenario. Any overshoots/undershoots of the benchmark are relative to this 1.55°C baseline.*

***IPCC AR6 Report (Summary for Policymakers): "Each 1000 GtCO2 of cumulative CO2 emissions is assessed to likely cause a 0.27°C to 0.63°C increase in global surface temperature with a best estimate of 0.45°C"*

1) **Allocate a Net Zero carbon budget**: We determine each country's 1.55°C-aligned carbon budget by combining two approaches: one from the NGFS REMIND-MAgPIE "Net Zero 2050" pathway and another from an emissions reduction effort-sharing (basic needs) perspective developed by academic researchers at the University of Graz which considers the development status and population of countries. This initial budget is rolled over annually– i.e., it is adjusted each year by subtracting the latest realized emissions (which spend the budget) at the country level.

2) **Project each country's emissions through 2050**: We derive a forward-looking emissions path considering: (a) the country's declared climate targets (e.g., nationally determined contributions (NDCs[11]); net-zero targets) and (b) an adjustment of projections based on the country's historical decarbonization trajectory.

3) **Quantify over-/undershoot**: We compare projected emissions with the allocated carbon budget to see if the country's cumulative emissions remain within or above that budget.

[11] NDCs embody efforts by each country to reduce national emissions and adapt to the impacts of climate change. See https://unfccc.int/process-and-meetings/the-paris-agreement/nationally-determined-contributions-ndcs

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4) **Convert over-/undershoot to a temperature**: The final step uses the transient climate response to cumulative emissions (TCRE) factor to convert any budget over or undershoot into degrees Celsius above the baseline of 1.55°C.

In summary, the Implied Temperature Rise of a country is calculated based on its projected Scope 1 emissions considering disclosed emissions reduction targets and the over- or undershoot in emissions relative to its carbon budget, taking into account the country's basic needs and stage of development and a global cost-effectiveness criterion.

Country Scope 1 ITR Bands

Country Scope 1 Emissions ITR outputs range between 1.3°C and 10°C. For ease of comparison, MSCI ESG Research uses ITR bands that assign clear alignment labels to temperature ranges, from "1.5°C Aligned" to "Strongly Misaligned."

Alignment is defined by the two temperatures set by the Paris Agreement climate goals: +1.5°C and +2°C global mean temperature increase compared with preindustrial levels.[12] Alignment corresponds to any ITR output at or below those thresholds, with separate ITR bands for ITR outputs at or below each threshold.

Misalignment is defined as any ITR output exceeding those thresholds, with ITR bands established relative to the Regionalized Model of Investments and Development (REMIND) NGFS "Current Policies" scenario, which yields a (rounded) 3.2°C temperature at the 2100 horizon.[13]

Exhibit 2 below sets out the Country Scope 1 Emissions ITR bands and corresponding ITR output ranges:

Exhibit 2: Overview of ITR Bands

1.5° C Aligned	Countries that are 1.5°C Aligned are aligned with the Paris Agreement's maximal objective of limiting the global mean temperature rise to 1.5°C compared with preindustrial levels. They either significantly contribute to mitigating catastrophic climate change, benefit from relatively large needs-based effort-sharing carbon budgets because they are in earlier stages of economic development, or both.
2° C Aligned	Countries that are 2°C Aligned meet the Paris Agreement's minimum objective of limiting the global mean temperature rise to 2°C compared with preindustrial levels. They support a low-carbon transition, benefit from relatively large needs-based effort-sharing carbon budgets because they are in earlier stages of economic development, or both.

[12] See Article 2 of the Paris Agreement.

[13] "NGFS Climate Scenarios Database: Technical Documentation V3.1." Intergovernmental Panel on Climate Change (IPPC), September 2022.

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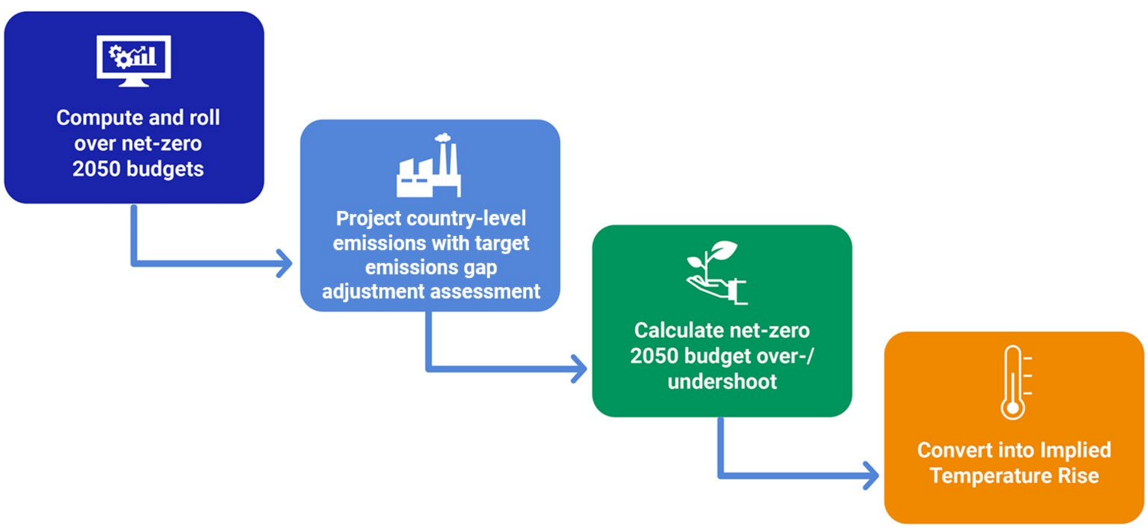
Misaligned	Countries that are Misaligned are not aligned with the Paris Agreement goals. Their pace of decarbonization is too slow to mitigate catastrophic climate change. Their implied temperature rise falls between 2°C and 3.2°C, even after any positive adjustments made to their carbon budgets if they are in earlier stages of economic development.
Strongly Misaligned	Countries that are Strongly Misaligned have an implied temperature rise that is greater than 3.2°C, which exceeds even the business-as-usual climate projection, even after any positive adjustments made to their carbon budgets if they are in earlier stages of economic development. Their contribution to catastrophic climate change is higher than that of most countries.

Source: MSCI ESG Research, NGFS (2022).

2 Country-level Scope 1 Emissions ITR

The Country Scope 1 Emissions ITR model is characterized by four main modelling steps, as illustrated in Exhibit 3, below. A comprehensive overview of the computation process of ITR is provided in Appendix II.

Exhibit 3: Block diagram representation of a country-level ITR model



Source: MSCI ESG Research

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2.1 Computing Net Zero 2050 budgets

There are many potential ways to estimate a country's remaining net zero 2050 emissions budget.[14] MSCI ESG Research combines two of these approaches in the Country Scope 1 Emissions ITR model:

- **Least-cost budget**: A model adopted by the Network for Greening the Financial System (NGFS), a global group of central bank supervisors. This approach considers shifts in climate policies, advances in clean-energy technologies, and changes in energy and economic systems to outline a potential pathway for achieving net-zero GHG by the year 2050.[15]
- **Effort-sharing budget**: A model developed by faculty at the University of Graz which aims to allocate emissions that remain for alignment with 1.5°C warming among countries based on their current and projected population and resource needs.[16]

These budgets are combined to calculate a blended budget intended to balance equity and efficiency in allocating emissions budgets to countries. Exhibit 4 below sets out how these budgets are combined to produce a final budget pathway for a given country:

Exhibit 4: Steps for determining the net zero 2050 budget pathway for countries

Steps		Description
1	Determine initial least-cost net zero 2050 carbon budget	Downscale the NGFS REMIND-MAgPIE Net Zero 2050 Integrated Assessment Model (IAM) scenario data from the regional level to the country level to establish a country-specific least-cost net zero budget.
2	Determine initial effort-sharing net zero 2050 carbon budget	Calculate a basic needs-based emissions allocation (%) at country-level and apply NGFS REMIND-MAgPIE Net Zero 2050 scenario's global budget to establish a country-specific effort-sharing net zero budget.

[14] In addition to the approaches to allocating carbon budgets cited here, see, for example, "Mitigation Pathways Compatible with Long-term Goals," IPCC Sixth Assessment Report, Mitigation of Climate Change, April 4, 2022. See also Niklas Höhne, Michel den Elzen and Donavan Escalate, "Regional GHG reduction targets based on effort sharing: a comparison of studies," Climate Policy 14 (2014):122-147.

[15] The NFGS budget, which supplies a reference for financial institutions, uses a so-called Integrated Assessment Model that considers such shifts with a focus on cost-effective mitigation. See, "Mitigation Pathways Compatible with Long-term Goals," IPCC Sixth Assessment Report, Mitigation of Climate Change," IPCC, April 4, 2022. See also, "NGFS Net Zero 2050 REMIND-MAgPIE scenario," Data & Resources, Scenarios Portal, Network for Greening the Financial System.

[16] What we refer to as the "effort-sharing budget" considers the sufficiency of the remaining budget for countries' anticipated developmental needs based on the U.N. Human Development Index (HDI), a composite index of life expectancy, education, and per capita income. See Keith Williges, Lukas Meyer, Karl Steininger and Gottfried Kirchengast, "Fairness critically conditions the carbon budget allocation across countries," Global Environmental Change 74 (May 2022), which includes discussion of effort-sharing approaches and their respective techniques for allocating emissions budgets.

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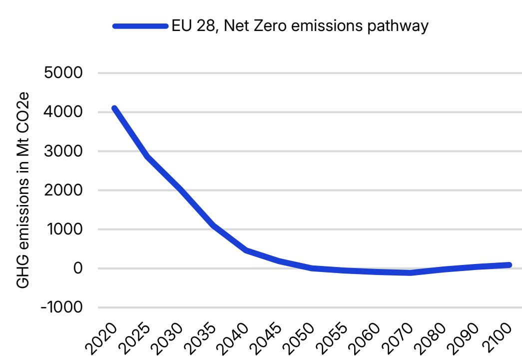
Steps		Description
3	Calculate the initial blended net zero 2050 carbon budget	Derive country-level initial blended net zero 2050 carbon budget as a simple average of (1) the least-cost net zero 2050 carbon budget and (2) the effort-sharing net zero 2050 carbon budget.
4	Budget rollover and deduction of realized emissions to compute final blended budget	Update the country-level blended net zero 2050 carbon budgets year by year, considering recent country emissions. Subtract latest realized emissions from the country's remaining blended net zero 2050 budget to calculate the final blended budget.

2.1.1 Least-cost Budget

MSCI ESG Research uses country and region decarbonization pathways from the REMIND-MAgPIE NGFS Net Zero 2050 scenario to calculate each country's least-cost budget. These pathways are defined and aligned with a 1.5°C temperature before converting them into absolute Scope 1 Emissions reduction requirements. Through this conversion, the approach preserves a direct link to the science-based concept of the carbon budget (i.e., the cumulative emissions until global net-zero that would result in 1.5°C of global warming, with a given probability).[17] It is assumed based on the NGFS Net Zero 2050 scenario that if all countries and regions followed the pathways, the world would be on a 1.5°C trajectory with a probability higher than 50% by 2050.[18]

Exhibit 5 below sets out the steps used to calculate the least-cost budget:

Exhibit 5: Steps for calculating the least-cost budget

Step	Description	Illustrative graphical representation
1	**Starting point: Regional pathways from REMIND-MAgPIE model** • Begin with the regional net zero pathways defined by the REMIND-MAgPIE model's Net Zero 2050 scenario by NGFS. • The pathways are modelled under a global cost-effectiveness criterion for 13 model regions, aiming to optimize	

[17] "Special Report: Global Warming of 1.5 ºC." IPPC, 2018.

[18] NGFS Scenarios Portal: https://www.ngfs.net/ngfs-scenarios-portal/explore/

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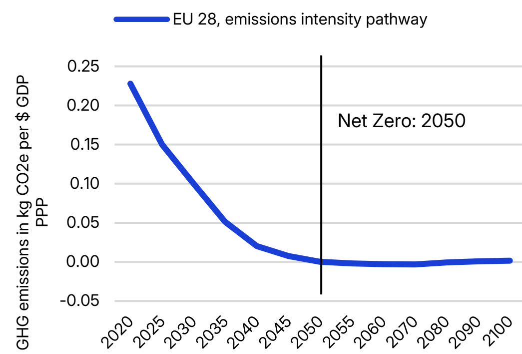
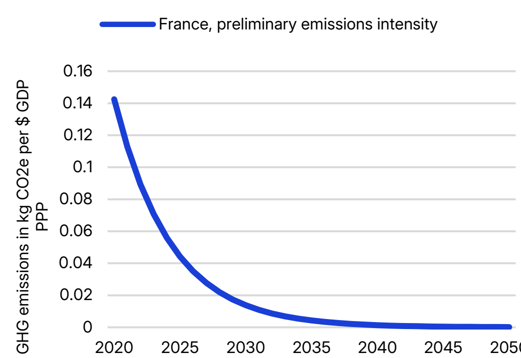
<table>
<tr><th>Step</th><th>Description</th><th>Illustrative graphical representation</th></tr>
<tr><td></td><td>the transition to net-zero while considering regional characteristics.
• The dataset used includes Scope 1 Emissions.</td><td>Source: Network of Central Banks and Supervisors for Greening the Financial System (NGFS). Illustrative graphical representation reflects an evaluation of the EU 28 region. The values displayed may not reflect the actual values for that country or region.</td></tr>
<tr><td>2</td><td>Convert regional emissions to regional intensity pathways
• Translate the absolute emissions regional pathways (E) to emissions intensity pathways (EI) by dividing emissions by the regional Gross Domestic Product (GDP) from the REMIND model.
$$EI = \frac{E}{GDP}$$
• This allows normalization of emissions relative to economic output, providing a carbon intensity metric at a regional level.</td><td>

Source: MSCI ESG Research, Network of Central Banks and Supervisors for Greening the Financial System (NGFS). Illustrative graphical representation reflects an evaluation of the EU 28 region. The values displayed may not reflect the actual values for that country or region.</td></tr>
<tr><td>3</td><td>Calculate country-level preliminary emissions intensity
• Calculate each country's emissions intensity pathway from 2020 by dividing its emissions by its GDP for that year.
• Determine the year when each region is expected to converge to net-zero emissions from the REMIND regional pathways.
• Connect the 2019 actual emission intensities to the net-zero convergence year intensities using a geometric growth rate. This growth rate is calculated with the formula:</td><td>

Source: MSCI Research, NGFS, United Nations Framework Convention on Climate Change (UNFCCC), Multi-Regional Input Output modelling (MRIO). Illustrative graphical representation reflects an evaluation of France, in the EU 28 region. The values displayed may not reflect the actual values for that country or region.</td></tr>
</table>

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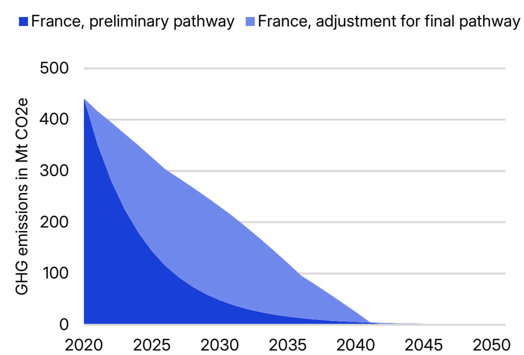
Step	Description	Illustrative graphical representation
	$$GF = \left(\frac{EI_{cy}}{EI_{by}}\right)^{\frac{1}{cy-by}}$$ where, GF = Growth factor EI = Emissions intensity cy = Convergence year by = Base year	
4	**Compute final country-level budget pathways ensuring all countries in region add up to regional pathway** • Calculate preliminary emissions by multiplying each country's preliminary emission intensity by its projected GDP from the REMIND model till 2050. • Sum the preliminary emissions of all countries in a region and compare this total to the REMIND regional emissions. • Distribute any differences among countries based on their share of regional emissions to ensure consistency with regional emissions. • Merge each country's historical emissions with the calculated future emissions to create a comprehensive emissions budget pathway.	*Source: MSCI Research, NGFS, UNFCCC, MRIO. Illustrative graphical representation reflects an evaluation of France, in the EU 28 region. The values displayed may not reflect the actual values for that country or region.*

Assumptions

- **Net-Zero convergence**: All countries in a modelled region are assumed to reach net-zero emissions simultaneously.
- **Emissions intensity convergence**: To be 1.5°C aligned, all countries within a region would need to converge to the same emissions intensity by the specific net-zero year for the region from the NGFS model.

Limitations

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- **Lag in model update**: There could be a lag between updates to the Net Zero 2050 scenario from REMIND-MAgPIE and MSCI updates. This may lead to discrepancies, as the Country Scope 1 Emissions ITR assessment updates aim to be aligned with the model version used for corporate and real estate ITR models (using NGFS Scenarios Phase 3).

2.1.2 Effort-sharing Budget

Countries with different development levels cannot realistically decarbonize at the same pace. Some countries may require more carbon budgets to reach a critical level of development. Others may have economies that are more reliant on fossil fuels and may face greater challenges to decarbonize at a faster rate.

MSCI ESG Research aims to address these differential equity-based needs by defining an effort-sharing Net Zero 2050 scenario pathway (the effort-sharing budget) aligned with a goal of limiting global temperature rise to 1.5°C by 2100.

Exhibit 6 below sets out the steps used to calculate the effort-sharing Budget:

Exhibit 6: Steps for calculating the effort-sharing budget for countries

Step	Description	Graphical representation and formulas
1	**Starting point: Equal per capita distribution of emissions till 2050** • We calculate the minimum emissions budget each country needs, based on an assumption of consistent 7% annual reduction rate in global emissions from 2020.[19] • This approach balances ambition with practicality, recognizing that exceeding this rate may impose undue burdens on certain countries.	$e^e = e^s * \left((1-\delta)^{(t^e - t^s)}\right)$ where, e^e = Emissions at end year (2050) e^s = Emissions at start year (2020) δ = Annual reduction rate of 7% t^e = End assessment year (2050) t^s = Start assessment year (2020)
2	**Set basic human developmental needs threshold for countries** • To consider equity in basic developmental needs, a minimum UN	HDI Threshold: 0.55 epc^{HDI} = Emissions per capita for basic needs 1.6 tCO_2

[19] UN Environment Programme – Emissions Gap Report 2019 states that achieving the 1.5°C target would require an annual emissions reduction of 7.6%, a figure that is commonly rounded down to 7% (https://wedocs.unep.org/bitstream/handle/20.500.11822/30797/EGR2019.pdf)

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Step	Description	Graphical representation and formulas
	Human Development Index (HDI) threshold is set at 0.55 (corresponding to the lower bound of the medium human development category in HDI).[20] • Countries with an HDI below 0.55 receive a baseline emissions per capita allowance (1.6 tCO_2 per capita/year) to address basic development needs.[21]	
3	**Assign initial emissions to low-HDI countries** • Countries with HDI below 0.55 are initially allocated emissions corresponding to the threshold. • Their emissions then decrease linearly from this starting point to the target per capita level by 2050, ensuring a gradual and fair transition.	Initial allocation: If HDI_i < 0.55, $$e_i^{start} = epc^{HDI} * p_i^{start}$$ where, e_i^{start} = Initial emissions for the country i epc^{HDI} = Emissions per capita for basic needs 1.6 tCO_2 p_i^{start}= Country i's population in 2020
4	**Calculate the global effort-sharing emissions budget** • The remaining global emissions budget for 2020–2050 is determined based on the total emissions reduction required. • This forms the basis for equitable emissions allocation across all countries.	$$B = \frac{(t^{end} - t^{start})(\sum e_i^{start} - \sum e_i^{end})}{2} + (t^{end} - t^{start}) * \sum e_i^{end}$$ where, B = Remaining global budget based on effort-sharing basis t^{end} = End assessment year (2050) t^{Start} = Start assessment year (2020) e^{end} = Emissions in the end assessment year

[20] Human Development Index: https://hdr.undp.org/data-center/human-development-index#/indicies/HDI

[21] K. Williges, L. Meyer, K. Steininger, G. Kirchengast "Fairness critically conditions the carbon budget allocation across countries", 2022.

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Step	Description	Graphical representation and formulas
		e^{Start} = Emissions in the start assessment year
5	**Compute per capita emissions in 2050** • The per capita emissions level in 2050 is calculated by dividing the remaining global budget by the total global population. • This helps establish a fair baseline for emissions distribution.	$$epc^{end} = \frac{\left\{\frac{2B-\left(t^{end}-t^{start}\right)\sum e_i^{start}}{t^{end}-t^{start}}\right\}}{\sum p_i^{end}}$$ where, epc^{end} = Emissions per capita at the end assessment year (2050) B = Remaining global budget based on effort-sharing basis t^{end} = End assessment year (2050) t^{Start} = Start assessment year (2020) e_i^{start} = Initial emissions for the country i (2020) p_i^{end}= Country i's population in the end assessment year (2050)
6	**Calculate additional budget for Low-HDI Countries** • The eligibility for additional emissions allowances is considered for low-HDI countries. • This accounts for their population changes over time, ensuring reasonable resources for development.	$$b_i^{HDI} = \gamma_i^{HDI} * \left\{\frac{1}{2}\left(t^{end}-t^{start}\right)\left[\left(epc^{HDI} * p_i^{start}\right)-\left(epc^{end} * p_i^{end}\right)\right]+\left(t^{end}-t^{start}\right)*\left(epc^{end} * p_i^{end}\right)\right\}$$ where, b_i^{HDI} = Additional budget allocated to the country Υ_i^{HDI} = 1 for countries with HDI_i < 0.55, 0 for countries with HDI_i >= 0.55 epc^{HDI} = Emissions per capita for basic needs 1.6 tCO_2

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Step	Description	Graphical representation and formulas
		t^{end} = End assessment year (2050) t^{Start} = Start assessment year (2020) epc^{end} = Emissions per capita at the end assessment year (2050) p_i^{start} = Country i's population in the start assessment year (2020) p_i^{end} = Country i's projected population in the end assessment year (2050)
7	**Allocate remaining global budget** • After accounting for the basic needs budgets for low-HDI countries, the remaining global budget is distributed among all countries based on their populations, ensuring equitable per capita allocation. • By integrating population dynamics into the distribution process, this step is intended to support a more inclusive and fairer framework for global climate action while maintaining the overarching goal of staying within the global emissions limit.	$b_i^{EPC} = [B - \sum b_i^{HDI}] \frac{p_i^{start} + p_i^{end}}{\sum \mathrm{p_i^{start}} + \sum \mathrm{p_i^{end}}} + b_i^{HDI}$ where, b_i^{EPC} = Country budget under emissions per capita based on basic needs, effort-sharing approach B = Remaining global budget b_i^{HDI} = Additional budget allocated to the country p_i^{start} = Country i's population in the start assessment year (2020) p_i^{end} = Country i's population in the end assessment year (2050)
8	**Determine each country's percentage share in global emissions budget till 2050** • The percentage share of each country in the global emissions budget is calculated based on their calculated allocated emissions budgets (step 7) divided by total global budget. This	$cep_i = \frac{b_i^{EPC}}{\mathrm{GB}} * 100\%$ where, cep_i = Percentage share for country i based on effort-sharing budget (%)

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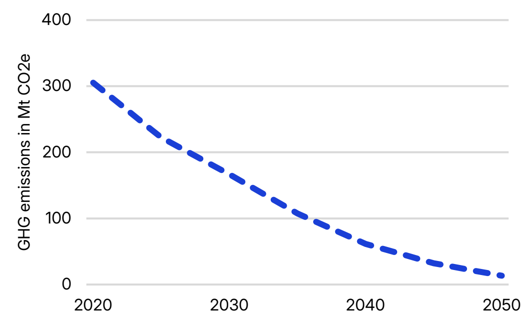
Step	Description	Graphical representation and formulas
	metric reflects each country's responsibility and contribution to the global target.	b_i^{EPC} = Country budget under emissions per capita based on basic needs, effort-sharing approach GB = Total global budget
9	**Calculating the effort-sharing emissions pathway (2020-2050)** • Calculate each country's annual emissions budget from the effort-sharing approach by multiplying its percentage share to the annual global emissions budget from the NGFS data derived from the REMIND-MAgPIE model for each year between 2020 and 2050. • This provides an annual emissions budget pathway for each country, aligning their pathways with both the NGFS Net Zero 2050 scenario and an effort-sharing approach.	*MSCI Research, NGFS, University of Graz. Illustrative graphical representation reflects an evaluation of France. The values displayed may not reflect the actual values for that country.*

Assumptions:

- **Constant effort-sharing factor**: The effort-sharing percentage share for countries is constant annually between 2020 and 2050, derived from the overall budget for that time frame.
- **Non-adjusted HDI levels**: HDI levels remain static through 2050, as the University of Graz study allocates emissions based on developmental needs up to 2050.
- **Redistribute negative emission budgets globally**: Allocate equally to all countries in case of any negative budgets resulting from the removal of LULUCF emissions in the NGFS data.

2.1.3 Blended budget

The blended net zero 2050 carbon budget (the blended budget) is the simple average of the least-cost (2.1.1) and effort-sharing budgets (2.1.2). The least-cost budget prioritizes economic efficiency and feasibility, while the effort-sharing budget emphasizes fairness and equity (e.g., per capita and basic needs development considerations). By combining them, the blended budget is intended to provide countries with allocations that are both equitable and practical. MSCI ESG Research believes this

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approach helps to align global climate goals with differentiated national capacities and circumstances, fostering broader acceptance and implementation of climate strategies.

We calculate the annual blended budget for each country using the formula:

$$Blended\ budget = \frac{Least\ cost\ budget + Effort\ sharing\ budget}{2}$$

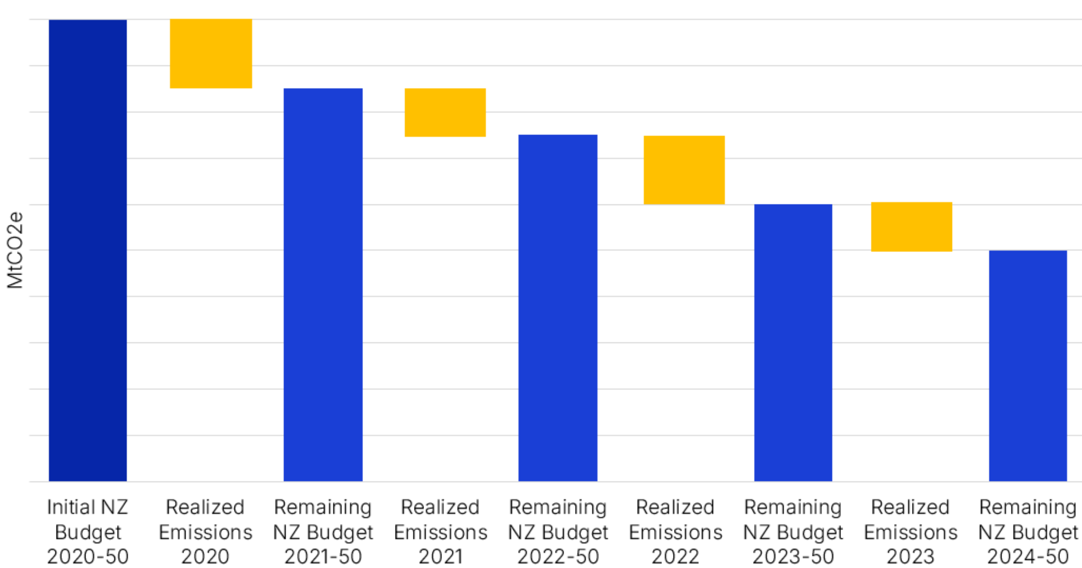
2.1.4 Blended budget rollover and realized emissions "costs"

The calculations above yield an initial blended budget covering the entire period 2020-2050, allocated for any country as of Jan. 1, 2020. To remain 1.5°C-aligned, the country's emissions must stay within what remains of that initial budget at any point in time.

Budget rollover defines what remains of the initial budget since the 2020 baseline year. Year after year, the blended budget is rolled over by subtracting realized emissions, as shown in Exhibit 7.

Put simply, a country's blended carbon budget is "spent" though realized emissions. Similarly, the global carbon budget is "spent" through the cumulative emissions of all countries.

Exhibit 7: Subtraction of realized emissions (illustrative example)



Source: MSCI ESG Research. Note: This is an illustrative example without reference to a specific country.

All historical emissions after 2020 are costed against a country's initial budget. This approach reflects the scientific fact that global warming is the result of cumulative emissions, including historical emissions.

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2.2 Projecting country emissions until 2050

Once a country-level blended budget is up to date (i.e., all realized emissions have been costed against the remaining budget), Scope 1 Emissions are projected to 2050. Each country's emissions projection considers country-level climate targets and adjusts the trajectory based on the country's record of reducing emissions since the Paris Agreement at the annual rate required to meet its emissions target. This is necessary to determine whether the country may overshoot or undershoot its remaining carbon budget.

The country emissions used in the ITR model are based on either reported or estimated data from the country emissions dataset under the MSCI ESG Research Total Portfolio Footprinting Methodology.[22] A country's future emissions are projected from the latest available country emissions data (e.g., 2021) until 2050 (the conclusion of the ITR time frame).[23] For instance, for a country whose latest available emissions data is for 2021, the first year of projected emissions will be in 2022.

After projecting the Scope 1 Emissions for a country through to 2050, the time series of these projections can be aggregated to calculate a country's cumulative projected carbon emissions value.

A country's Scope 1 Emissions projection is referred to as its **adjusted targets-at-face-value**. Adjusted targets-at-face-value is calculated by calibrating between two projected emissions using a target emissions gap adjustment factor approach:

- **Targets-at-face-value**: a country's announced climate targets-based projected emissions trajectory. This trajectory follows an emissions trajectory in line with the country's reported climate targets.
- **Track record**: a country's historical trends-based trajectory. This follows an emissions trajectory based on historical trends and the relationship between Scope 1 Emissions and GDP.

Exhibit 8 below provides an overview of how adjusted targets-at-face-value is calculated:

Exhibit 8: Steps for determining emissions trajectory for countries

Step		Description
1	Determine targets-at-face-value projected emissions	The cumulative projected Scope 1 Emissions from the reference year to 2050, with model assumptions that the country meets its reported climate targets.
2	Determine track record projected emissions	The cumulative projected Scope 1 Emissions from the reference year to 2050, with model assumptions that the country has no additional reported climate targets. This

[22] For more details on our emissions methodologies for countries, refer to the Total Portfolio Footprinting Methodology document

[23] This is referred to as Year reference of current ITR.

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		projection incorporates historical Scope 1 emissions data (reported or estimated) and assumes the country will follow an emissions trajectory similar to its historical trends and its relationship with GDP.
3	Calculate the target emissions gap adjustment factor weight	The target emissions gap adjustment factor weight (%) is calculated based on the country's progress towards its climate targets based on the annual emissions reduction rate needed to achieve its conditional and/or unconditional emissions target[24] and its recent emissions reduction performance since the Paris Agreement. This weight is applied to the cumulative projected carbon emissions decarbonization trajectory (i.e., it is applied against both the targets-at-face-value and track record values).
4	Calculate the adjusted targets-at-face-value projected emissions	The cumulative Scope 1 Emissions from the reference year to 2050, with model assumptions that the country meets a portion of its reported climate targets as defined by the target emissions gap adjustment factor weight. This projection takes the latest available Scope 1 Emissions data (reported or estimated) as baseline and projects future emissions considering country decarbonization targets. Projections are adjusted based on the potential gap between the decarbonization rate required to achieve the country's targets and the country's historical emissions reduction rate since the Paris Agreement (i.e., based on the targets emissions gap adjustment factor above).

Each of these steps are discussed in greater detail below.

2.2.1 Targets-at-face-value projected emissions

The targets-at-face-value projected emissions reflect a country's cumulative projected Scope 1 Emissions from the reference year to 2050 based on:

- The country's projected emissions based on nationally determined contribution (NDC) targets through 2030; and
- The country's projected emissions based on long-term strategies (LTS) targets through 2050.

[24] "When targets are dependent on external financial support, these are marked as "conditional" targets. The targets a country can achieve without external financial support are referred to as "unconditional". UNDP 2023 "What are NDCs and how do they drive climate action?"

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Each of these inputs are discussed in greater detail below.

Nationally determined contributions targets

NDC targets are evaluated based on:

- The latest available NDC quantification data from the International Monetary Fund (IMF). [25]
- The latest available Scope 1 Emissions data from the MSCI ESG Research Total Portfolio Footprinting Methodology.
- The end year for NDC targets from the Climate Watch NDC dataset[26].

The IMF dataset indicates a country's projected emissions based on the implied average of the country's conditional and unconditional targets. Due to methodological differences between this dataset and the MSCI ESG Research Total Portfolio Footprinting Methodology dataset, a conversion factor is applied to the IMF data. For example, if the latest emissions data for 2023 for a country is 120 $MtCO_2e$ according to the MSCI ESG Research dataset and 100 $MtCO_2e$ according to the IMF dataset, conversion factor of 1.2 (120 / 100) is applied to scale IMF figures accordingly. This results in a normalized Scope 1 Emissions dataset through to 2030.

This projection is combined with the NDC target year data from Climate Watch NDCs data to compute a projected Scope 1 Emissions through to 2030, subject to the following assumptions:

- If a country has multiple NDC targets, the first NDC target year is used as the target year for emissions reduction estimation.
- For countries with no NDC targets, the calculation defaults to 2030 values from the IMF's National Greenhouse Gas Emissions NDC quantifications data.
- The conversion factor from IMF emissions data to MSCI emissions data is kept constant.

Long-term strategies targets

LTS targets and commitments are evaluated based on the Climate Watch LTS dataset, which includes targets and commitments related to net-zero, climate neutrality and carbon neutrality goals, and percentage-based emissions reduction goals relative to a specific base year. Each of these are treated differently:

- **Net-zero and climate neutrality commitments**: The projection assumes that the country will reach net zero emissions for all GHG gases by the committed year.

[25] IMF: National Greenhouse Gas Emissions Inventories and Implied National Mitigation (Nationally Determined Contributions) Targets.

[26] Climate Watch Data Explorer.

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- **Carbon neutrality commitments**: The projection assumes that the country will reach net zero emissions for carbon dioxide (CO_2) by the committed year, estimating the country's carbon emissions share as a percentage of total global GHG emissions based on historical data.
- **Percentage reduction targets**: The projection assumes that the country will reach its percentage-based emissions reduction target in the committed year relative to the base year.

This results in a projected Scope 1 Emissions trajectory through to 2050, subject to the following assumptions:

- If a country commits to a percentage reduction range, the average of that range is used (e.g. if a country has committed to reducing emissions by between 30% and 40%, a goal of 35% will be assumed).
- For countries without an LTS target but with an NDC target, the NDC target trajectory is extended with the same growth rate from the NDC target year through to 2050.

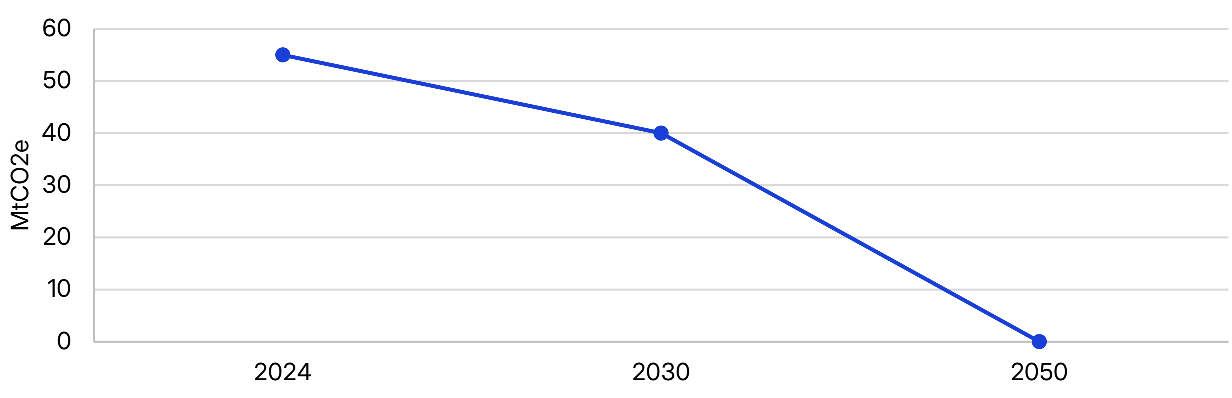
Combined targets

The NDC- and LTS-based emissions calculated above are combined with the country's most recent Scope 1 Emissions data to establish the country's emissions trajectory when its targets and commitments are taken at face value. This is merged with historical emissions data to create a continuous emissions trajectory.

For countries that lack both NDC and LTS targets, the IMF NDC quantification data[27] will be used to assume an NDC target year of 2030. The assumed NDC target will use the same growth rate from the current reference year through to 2030 to extrapolate the LTS emissions until 2050.

Exhibit 9 below shows an example trajectory based on combined targets.

Exhibit 9: Combining NDC and LTS Targets (illustrative example)



[27] IMF: National Greenhouse Gas Emissions Inventories and Implied National Mitigation (Nationally Determined Contributions) Targets.

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Source: MSCI ESG Research. Note: This is an illustrative example without reference to a specific country.

2.2.2 Track record projected emissions

Track record projected emissions are calculated based on:

- Historic (from 1990) and projected (through to 2029 or the latest available year) country-level Gross Domestic Product (GDP)-Purchasing Power Parity (PPP) data from the IMF.
- Historic Scope 1 Emissions from the MSCI ESG Research Total Portfolio Footprinting Methodology.

A linear regression is applied to the IMF GDP data to extend projections through to 2050. A linear correlation is then calculated between historic emissions and GDP that assigns higher weight to recent years to reflect evolving trends. Future emissions are projected through to 2050 based on this correlation.

This component of the methodology is subject to the following assumptions:

- A simple linear relationship is assumed between historical growth trends and future GDP estimations. This means that the model may not capture all shifts in global economic dynamics.
- Emissions and GDP are assumed to maintain a linear relationship over time. Significant shifts in energy mix or policies could alter this relationship in future.
- 2020 emissions are assumed to be an average of 2019 and 2021 to provide a stable baseline and smooth out the fluctuations caused by an outlier event (i.e., the COVD-19 pandemic).

2.2.3 Target emissions gap adjustment factor weight

The final two steps consist of calculating and adjusting the targets-at-face-value projected emissions based on a target emissions gap adjustment factor weight for those countries that have disclosed climate targets. This assessment is meant to adjust stated decarbonization trajectories that lack follow-through based on historical reductions (e.g., a country setting a distant net-zero target in 2050 with no interim targets in place).

Using the target emissions gap adjustment factor weight, targets-at-face-value projected emissions are weighted against the track record trajectory. In the example shown in Exhibit 11 below, the target weight of the Targets-at-Face-Value projected emissions trajectory is presented for two scenarios based on how close the country is to achieving its stated target.

A target emissions gap adjustment factor weight of 100% is equivalent to taking country’s climate targets at face value. This means the country was assessed as likely to meet its stated targets. Conversely, a weight of 0% is equivalent to the track record emissions trajectory, that is, assuming the country has no targets in place.

The process to calculate the target emissions gap adjustment factor weight is described in further detail below.

<u>Step 1: Classify NDC targets and create time series</u>

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Each NDC target is classified as either conditional or unconditional.[28] Conditional and unconditional targets are evaluated separately in this step and all other steps until step 4 below.

A time series of emissions data is calculated for each NDC target using the MSCI ESG Research Total Portfolio Footprinting Methodology dataset and the IMF NDC quantification dataset. Missing years are added through linear interpolation.

The time series provides a value for each year between 2021 and the NDC target's end year. The baseline year of 2021 is used to provide a common conversion year for resolving differences between the IMF and MSCI ESG Research Emissions data.

Step 2: Calculate target emissions gap value

The target emissions gap value is calculated as the difference of two average annual growth rates (AAGRs) below:

- The required emissions reduction AAGR necessary to meet NDC targets from the Paris Agreement year of 2015.
- The country's actual emissions reduction AAGR – i.e., the rate at which a country has reduced or increased its emissions – between 2015 and the current assessment year.

A positive target emissions gap value means that the country is closer to (or exceeding) its required emissions reduction AAGR. A negative gap indicates that the country is at risk of missing its NDC targets.

This approach assumes a linear trajectory for calculating AAGRs that simplifies the complex dynamics of emissions over time.

Step 3: Calculate target emissions gap adjustment factor weight

The target emissions gap adjustment factor weight is a percentage from 0% to 100% indicating the degree to which a country's track record projected emissions are used instead of its targets-at-face-value projected emissions.

As set out in Exhibit 10 below, a country's target emissions gap adjustment factor weight is based on its target emissions gap. A gap below a threshold set out in the left column results in the weight set out in the right column. Weights are assigned in fixed 10% bands (i.e., a gap value of -1.5% corresponds to a 90% weight).

Exhibit 10: Converting target emissions gap to target emissions gap adjustment factor weight

Target emissions gap of less than...	Corresponds to a weight of...

[28] "When targets are dependent on external financial support, these are marked as "conditional" targets. The targets a country can achieve without external financial support are referred to as "unconditional". UNDP 2023 "What are NDCs and how do they drive climate action?"

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0%	100%
-1%	90%
...	...
- 9%	10%
-10%	0%

Source: MSCI ESG Research

Step 4: Combine the conditional and unconditional targets weight

As noted above, conditional and unconditional NCD targets are evaluated separately, with each type receiving its own target emissions gap adjustment factor weight. The final target emissions gap adjustment factor weight is calculated as:

$$Weight_{Final} = \frac{Weight_{Unconditional} + (Weight_{Conditional} * 0.5)}{2}$$

The 50% adjustment applied to the conditional weight reflects that a country might only achieve its conditional goal if it receives external support or meets additional conditions, making the target achievement less certain.

2.2.4 Adjusted targets-at-face-value projected emissions

The final adjusted targets-at-face-value projected emissions ($Targets_{Adjusted}$) is calculated using:

- Targets-at-face-value projected emissions ($Targets_{Face\ value}$) (see section 2.2.1)
- Track record projected emissions ($Targets_{Track\ record}$) (see section 2.2.2)
- The target emissions gap adjustment factor weight (w) (see section 2.2.3)

It is calculated as:

$$Targets_{Adjusted} = w * Targets_{Face\ value} + (1 - w) * Targets_{Track\ record}$$

This approach is applied to the time series Scope 1 Emissions data to build an emissions trajectory from the latest country emissions data's year until 2050. An illustrative example is set out in Exhibit 11 below.

Note that both the targets-at-face-value and track record the projected country emissions and time series are available from MSCI ESG Research.

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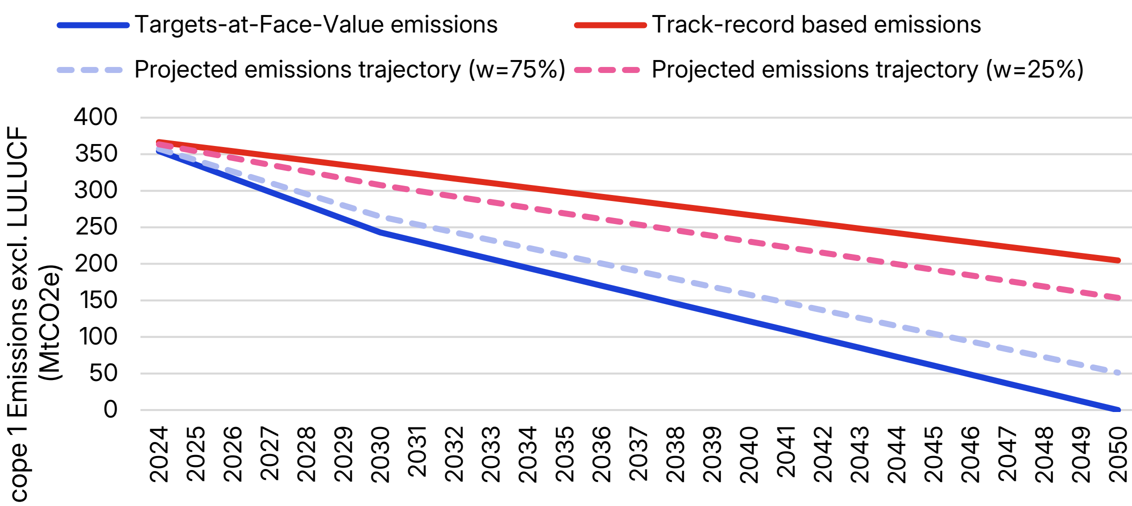
Exhibit 11: Target Emissions Gap Adjustment Factor Weight applied to a country's projected emissions



Source: MSCI ESG Research. Note: This is an illustrative example without reference to a specific country.

2.3 Calculating net zero 2050 budget over- or undershoot

Sections 2.1 and 2.2 describe the methodology used to calculate a country's remaining carbon budget and projected emissions, respectively. These values are used to calculate the extent to which a country's emissions are projected to overshoot or undershoot its cumulative net zero 2050 budget.

An overshoot indicates that a country's total projected emissions exceed its budget, while an undershoot means that emissions remain within budget (i.e., that the country's emissions are 1.5°C aligned). Over-/undershoot is measured cumulatively over the entire 2020-2050 period. Exhibit 12 below sets out an illustrative example of how over-/undershoot is calculated.

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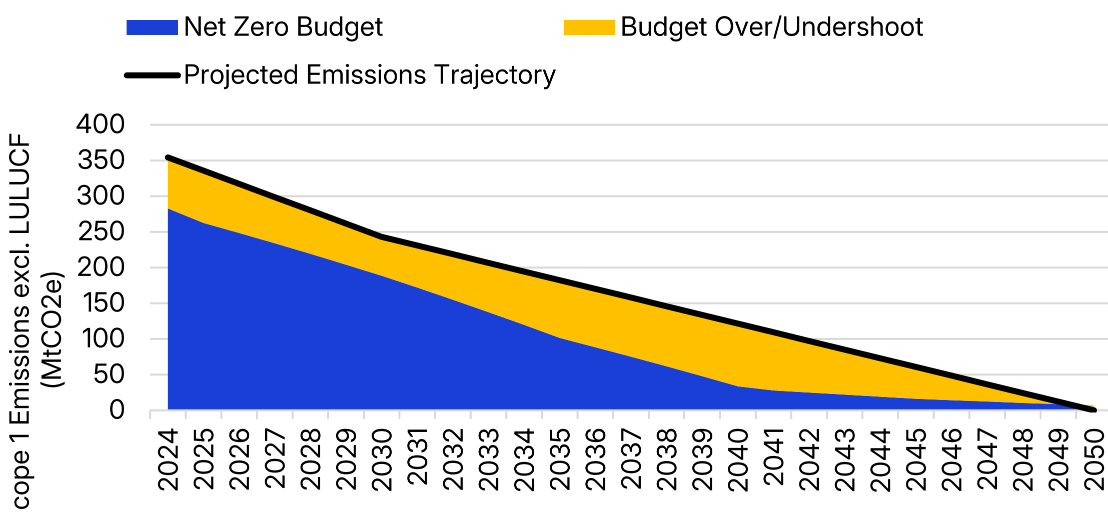
Exhibit 12: Cumulative assessment of over- or undershoot (illustrative example)



Source: MSCI ESG Research. Note: This is an illustrative example without reference to a specific country.

A country's carbon budget over- or undershoot (the area in yellow) is simply the country's cumulative projected carbon emissions (the area under the black line) subtracted from the country's cumulative Net Zero 2050 carbon budget (the area in blue).

An absolute carbon budget overshoot can also be derived as:

$$Overshoot = Cumulative\ Emissions\ -\ Cumulative\ budget$$

where $Cumulative\ Emissions$ corresponds to the country's cumulative adjusted targets-at-face-value projected emissions (2.2.4) and $Cumulative\ budget$ refers to the country's cumulative blended budget (2.1.3).

Exhibit 13 provides an illustrative example of a country overshooting its budget using MSCI ESG Research datapoint factor names.

Exhibit 13: Compute the absolute carbon budget over- or undershoot (illustrative example)

Factor	Value
Cumulative Projected Carbon Emissions [Scope 1] - Adjusted Targets-at-Face-Value	4,399.4 MtCO2e
Cumulative Net Zero 2050 Carbon Budget [Scope 1] - Blended budget	2,554.9 MtCO2e

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Factor	Value
Absolute Carbon Budget [Scope 1] Overshoot [Blended budget, Adjusted Targets-at-Face-Value trajectory]	1,844.4 MtCO2e

Source: MSCI ESG Research. Note: This is an illustrative example.

Moving towards the ultimate ITR question — what if the world exceeded its budget by an equivalent amount as this country? — requires converting the absolute carbon budget overshoot to a relative overshoot per country expressed as a percentage of the country's cumulative budget.

Relative overshoot is calculated as:

$$Relative\ overshoot\ = \frac{Absolute\ overshoot}{Cumulative\ budget}$$

Exhibit 14 provides an illustrative example of a relative overshoot calculation for a hypothetical country using MSCI ESG Research datapoint factor names.

Exhibit 14: Compute the absolute carbon budget over- or undershoot (illustrative example)

Factor	Value
Absolute Carbon Budget [Scope 1] Overshoot [Blended budget, Adjusted Targets-at-Face-Value trajectory]	1,844.4 MtCO2e
Cumulative Net Zero 2050 Carbon Budget [Scope 1] - Blended budget	2,554.9 MtCO2e
Relative Carbon Budget [Scope 1] Overshoot [Blended budget, Adjusted Targets-at-Face-Value trajectory] [%]	72%

Source: MSCI ESG Research. Note: This is an illustrative example.

2.4 Converting over-/undershoot into Country Scope 1 Emissions ITR

Converting a country's over- or undershoot to an implied temperature rise answers the question: "If the world economy were to operate like this country, what would be the projected rise in global temperature?"

Two main steps are involved in this extrapolation:

- Extrapolating the country-relative overshoot from the relevant remaining global carbon budget; and
- Expressing the global budget overshoot as an implied temperature rise.

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2.4.1 Extrapolating country over- / undershoot to the relevant remaining global carbon budget

A country's ITR is always tied to a reference year (e.g., 2023) as the year of assessment. To yield a temperature rise, the country's over- or undershoot in 2023 is extrapolated to a remaining global budget as of 2023. For instance, a country with a reference year of 2023 will get an ITR based on the remaining global budget as of Jan. 1, 2023 (1,004.1 $GtCO_2e$).

Under the REMIND NGFS Net Zero 2050 model, the sum of absolute emissions in $GtCO_2e$ to keep global warming to 1.5°C as of Jan. 1, 2020, was 1,171.6 $GtCO_2e$. The CO_2e unit means that the global budget estimate covers all greenhouse gases, consistent with the ITR model's assessment of the full range of GHG emissions at country level. This carbon budget is much higher than the CO_2-only carbon budget.

To derive what remains of this carbon budget in 2021, 2022, 2023 and 2024 global CO_2e emissions were deducted. This was done by deducting the annual global emissions estimates published in the UN Environment Programme's Emissions Gap (UN GAP) reports. UN GAP emissions estimates are annual science-based assessments consistent with the IPCC's findings.[29]

Exhibit 15: Remaining global 1.55°C carbon budgets

Year	Remaining global budget ($GtCO_2e$)	Previous year emissions ($GtCO_2e$)
2020	1,171.6	–
2021	1,117.6	54
2022	1,061.5	56.1
2023	1,004.1	57.4
2024	947	57.1

Source: NGFS (2022), UN GAP Reports (2022, 2023, 2024), MSCI ESG Research. Initial 2020 budget reflects estimated global CO_2e budget as of Jan. 1, 2020, based on REMIND NGFS. Previous year emissions values reported in or derived from UN GAP reports.

Using the remaining global carbon budget, a country's relative over- or undershoot is expressed in terms of a global temperature rise. To calculate this, a transient climate response to cumulative emissions (TCRE) factor is used. It is referred to by the IPCC and provides a near-linear relationship that links each additional unit of emissions produced beyond the available remaining 1.5°C carbon budget to degrees of additional global warming, specifically, 0.00045°C warming per $GtCO_2$.[30]

In other words, for each Gt of CO_2 emissions exceeding the global Net Zero 2050 carbon budget, an additional ~0.00045°C of warming is expected over the scenario baseline of 1.55°C.

[29] UN GAP report 2022.

[30] "Climate Change 2021: The Physical Science Basis", IPCC, 9 August 2021; A GtCO2 is equal to one billion metric tons of CO2.

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This relationship is used in the ITR methodology to convert a country or portfolio's allocated carbon budget over- or undershoot into a value in degrees Celsius of additional warming.[31]

$$Additional\ warming = Relative\ overshoot * Remaining\ global\ 1.55°C\ budget * TCRE\ factor$$

To then calculate the Implied Temperature Rise, additional warming is added to the base temperature of 1.55°C of the REMIND NGFS Net Zero 2050 scenario (i.e., the base temperature that defined the decarbonization pathway used in this methodology).

$$Country\ Scope\ 1\ Emissions\ ITR = 1.55°C + Additional\ warming$$

To illustrate, Exhibit 16 outlines a hypothetical country that overshoots its allocated carbon budget as of 2024 by 72% and calculates a global implied temperature rise assuming that the whole economy overshoots at the same rate.

Exhibit 16: ITR conversion calculation (illustrative example)

Factor	Value
Relative carbon budget overshoot (country-level)	72%
Remaining Global Net Zero 2050 carbon budget	947 $GtCO_2e$
TCRE factor	0.00045°C/$GtCO_2e$
Implied Temperature Rise	1.9°C (1.55°C + 947 x 0.72 x 0.00045)

Source: MSCI ESG Research. Note: This is an illustrative example.

[31] Based on the relationship presented in "Measuring Portfolio Alignment," Appendix O. GFANZ, November 2022.

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3 Portfolio-level Country Scope 1 Emissions ITR for sovereign portfolios

The Country Scope 1 Emissions ITR model facilitates portfolio-level ITR for sovereign-issued assets based on the "aggregated budget approach" recommended by GFANZ.[32] This approach aggregates the country-level carbon budgets financed by a portfolio to derive a portfolio-level Net Zero 2050 budget. An Implied Temperature Rise can then be computed by summing the over- or undershoots of countries in the portfolio using a TCRE factor. This provides an aggregation approach consistent with country-level ITR assessments.

Similar to country-level ITR, the question asked by portfolio-level ITR is: what would be the estimated global warming if the global carbon budget was over- or undershot to the same extent as this portfolio?

Portfolio-level ITR is intended to help investors assess a portfolio's contribution to global warming. For instance, some investors may want to know the cumulative impact of their financing across countries at a certain economic classification level (e.g. emerging market portfolios).

The remainder of this section describes portfolio-level Country Scope 1 Emissions ITR in greater detail.

3.1 Defining portfolio ownership

This approach aggregates all countries' projected emissions and carbon budgets using an attribution factor based on the Partnership for Carbon Accounting Financials (PCAF) framework. According to the framework, if a portfolio finances 5% of a country's PPP-adjusted GDP value, it "owns" (i.e., finances) 5% of this country's projected emissions and 5% of this country's carbon budget — and therefore, 5% of this country's over- or undershoot.[33]

A portfolio's ownership of emissions and carbon budget of each constituent is calculated as:

$$Ownership_{Country} = \frac{Outstanding\ Amount_{security}}{PPP\ adjusted\ GDP_{country}}$$

3.2 Calculating Financed Budget and Over or Undershoot

Once a portfolio's ownership values have been computed, the net zero 2050 budgets and budget overshoots financed by the portfolio are quantified. An example is set out below in Exhibit 17.1.

[32] "For benchmark divergence and ITR metrics, practitioners should use an aggregated budget approach in order to maximize the scientific robustness of their disclosures" ("Measuring Portfolio Alignment." GFANZ, November 2022).

[33] Since an absolute over- or undershoot is equal to: country projected emissions – country carbon budget.

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Exhibit 17.1: Determine portfolio ownership factors (illustrative example)

Portfolio breakdown	Ownership *Outstanding bond amount (USD mn) / PPP GDP (USD mn)*	Country Cumulative Budget	Country Budget Overshoot	Financed Budget	Financed Budget Overshoot
Sovereign A	0.05	50 GtCO2e	20 GtCO2e	2.5 GtCO2e (0.05 × 50 GtCO2e)	1 GtCO2e (0.05 × 20 GtCO2e)
Sovereign B	0.04	15 GtCO2e	5 GtCO2e	0.6 GtCO2e (0.04 × 15 GtCO2e)	0.2 GtCO2e (0.04 × 5 GtCO2e)

Source: MSCI ESG Research. Note: This is an illustrative example for the 2024 ITR reference year.

3.3 Calculating portfolio-level budget, overshoot and ITR

Exhibit 17.2: Determine portfolio budget, overshoot and ITR (illustrative example)

Portfolio (aggregated)	Portfolio Financed Budget *∑Financed Budgets_Country_i*	Portfolio Financed Budget Overshoot *∑Financed Budget Overshoots_Country_i*	Portfolio Relative Overshoot	Remaining Global Budget as of 2024	TCRE factor	Portfolio ITR *1.55°C + portfolio relative over/undershoot × Global Net Zero Budget × TCRE*
Portfolio (Sovereign A + Sovereign B)	3.1 GtCO2e	1.2 GtCO2e	39%	947 GtCO2e	0.00045°C per GtCO2e	1.7 °C

Source: MSCI ESG Research. Note: This is an illustrative example for the 2024 ITR reference year.

Using the financed budgets and financed overshoots, the portfolio budget and overshoot are calculated as:

$$Portfolio\ Financed\ Overshoot = \sum Financed\ Overshoot_i$$

$$Portfolio\ Financed\ Budget = \sum Financed\ Budget_i$$

An example is set out in Exhibit 17.2. In the portfolio aggregation formula, the contribution of each portfolio constituent *i* is calculated based on the reference year of the constituent's budget. The portfolio ITR is calculated with this formula:

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$$Portfolio\ ITR = Base\ Temperature + \frac{\sum\left(TCRE * Global\ Budget_{year,i} * Financed\ Overshoot_i\right)_i}{\sum Financed\ Budgets_i}$$

4 Assumptions and limitations

4.1 Use of REMIND NGFS Net Zero 2050 scenario

Climate scenarios are predicated on certain assumptions and probabilities, and so is the Country ITR model.

Country ITR model relies on the REMIND-Model of Agricultural Production and its Impact on the Environment (MAgPIE) NGFS Net Zero 2050 scenario, which projects a temperature rise at the 2100 horizon of 1.55°C.

REMIND-MAgPIE is an integrated assessment model (IAM) that produces scenario outputs based on certain policy and socioeconomic pathways, summarized in Exhibit 18. To do so, it simulates interactions between a range of variables including energy production, the global economy, and greenhouse gases. One key advantage of IAMs is to provide a holistic view of the complex reality affecting climate change, accounting for interdependencies and feedback loops between different physical and socioeconomic variables. Emissions computed in the REMIND-MAgPIE model are passed to the Model for the Assessment of Greenhouse Gas Induced Climate Change (MAGICC) model for calculation of global mean temperature change, which is then downscaled to regional temperature.[34]

Resulting scenarios are designed to ensure comparability of climate estimates with those of the IPCC, through the same probabilistic setup as the one used by the IPCC's "Special Report: Global Warming of 1.5°C."[35]

Notes on scenario selection

The NGFS scenario is used because it is produced with high-quality IAMs. They are open-source which adds transparency and sophistication to the ITR model. Decarbonization pathways are differentiated by sector and region supporting nuanced ITR benchmarking in line with GFANZ recommendations. Lastly, they cover all greenhouse gases. The REMIND scenarios are regarded as science-based transition scenarios. The Net Zero 2050 version is used in the ITR model to align with GFANZ recommendations to select a 1.5°C– aligned, low- or no-overshoot scenario.

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[34] Meinshausen, M., Raper, S. C. B., & Wigley, T. M. L.. 2011. "Emulating coupled atmosphere-ocean and carbon cycle models with a simpler model, MAGICC6 – Part 1: Model description and calibration." *Atmospheric Chemistry and Physics*, 11(4), 1417–1456.

[35] "Special Report: Global Warming of 1.5 ºC." IPPC, 2018.

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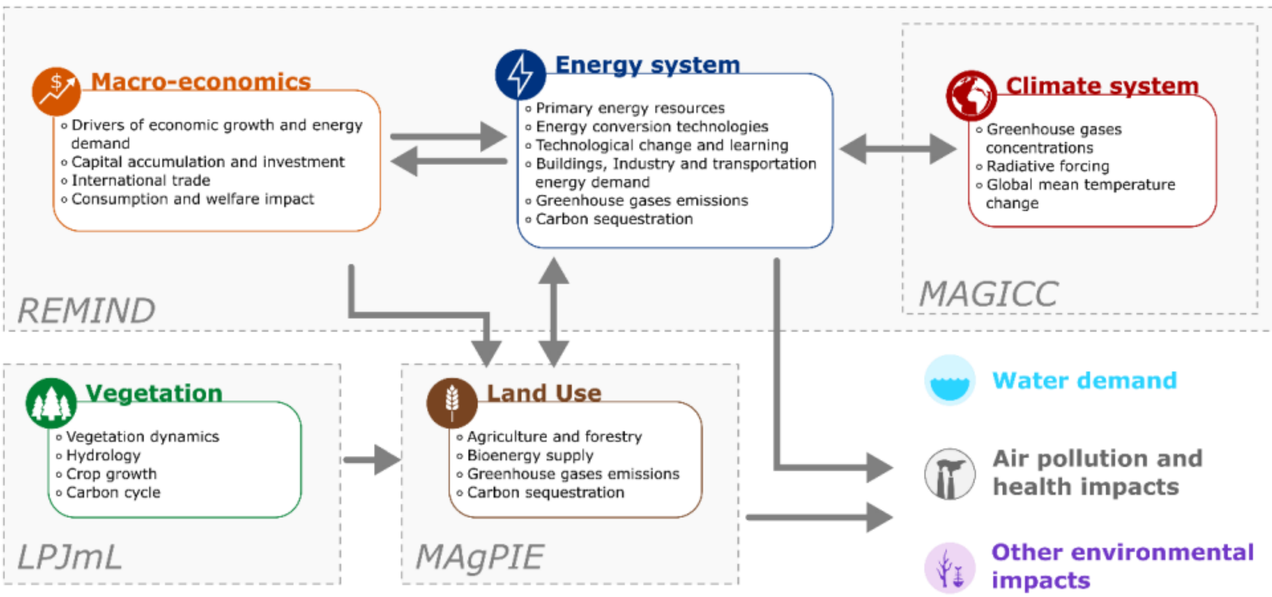
Exhibit 18: Overview of the REMIND-MAgPIE framework



Source: NGFS (2022).

The REMIND NGFS Net Zero 2050 scenario includes the following key assumptions:

- The scenario results in a 1.55°C global mean surface warming at the 2100 horizon compared to preindustrial times. It is composed of decarbonization pathways differentiated by sectors and regions. The scenario also includes differentiated GDP projections until 2100 — these estimates are obviously subject to a high level of uncertainty.
- The scenario foresees global CO_2 emissions to be at or close to net-zero in 2050, with global emissions falling by around 45% between 2020 and 2030, in line with the IPCC's findings.[36] Countries with a clear commitment to a specific net-zero policy target defined before the end of 2021 are assumed to meet this target. Given that not all net-zero targets are for 2050, various regions have positive emissions in 2050. Some sectors have negative emissions at this horizon (e.g., oil and gas), compensating for other sectors that have positive emissions (e.g., transportation).
- This is a "low overshoot" 1.5°C scenario, that is, median temperature increase compared to preindustrial levels is required to return to below 1.5°C in 2100, after a limited temporary overshoot. It is designed to be compatible with the 6th Assessment Report of the IPCC (AR6) scenario category C1, which "limit[s] warming to 1.5°C (>50%)[37] with no or limited overshoot".[38] These characteristics are

[36] "The evidence is clear: the time for action is now. We can halve emissions by 2030." IPPC, April 4, 2022.

[37] This designates a probability higher than 50%.

[38] "NGFS Climate Scenarios Database: Technical Documentation V3.1." NGFS, September 2022.

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in line with the GFANZ recommendation on scenario selection for designing portfolio alignment metrics.[39]

- This is an "orderly" scenario, that is, it assumes immediate and smooth policy reaction, as well as rapid technology change. That makes it different from the REMIND NGFS Divergent Net Zero scenario, where the transition does not happen smoothly across sectors.
- Carbon dioxide removal (CDR) measures have a significant, profound impact on mitigation trajectories. The assumption here is that higher CDR availability enables a more gradual phase-out of the use of fossil fuel across various sectors and end-uses.
- As noted by the NGFS, climate scenarios are neither predictions nor forecasts. They help to gauge various impacts associated with a certain course of action, for example, "If these decarbonization pathways were followed, what would be the likely global temperature rise?" For instance, assume that the entire steel sector follows the REMIND NGFS Net Zero 2050 pathway, while other sectors overshoot theirs; the global warming would then likely be higher than the 1.55°C end temperature of the scenario.

4.2 Flooring and capping

The Country Scope 1 Emissions ITR outputs are floored at 1.3°C and capped at 10°C for both countries and portfolios at the final step when we calculate temperature rise combining the remaining global net zero 2050 carbon budget, relative carbon budget overshoot with the TCRE factor.

- **The minimum ITR is set at 1.3°C**. This represents a reasonable estimate of the additional warming that is already locked in due to past emissions. The current warming caused by human activities was estimated to be near 1.2°C in 2023 and is further increasing 0.2°C per decade due to past and current emissions.[40] It was considered plausible to set the lower boundary at 1.3°C in the absence of robust, globally scalable carbon-removal technologies.
- **The maximum ITR is set for a country at 10°C**. This corresponds to an alarming consumption of one's fair share of the global carbon budget. The highest temperature cited by the IPCC and other leading climate scientists in a worst-case climate scenario range between 5°C and 6°C. This 6°C temperature represents the average global warming of the planet if no efforts are made to curb global emissions.[41] However, it is conceivable that a single country's own contribution to global warming is aligned to a scenario of higher than 6°C. While the real world is made up of diverse countries with low and high carbon contributions, it is not likely to face a mean temperature rise of 6°C. But if the world economy behaved like a single strongly misaligned country, the estimated global warming would be much higher.

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[39] See Key Judgement 2 in "Measuring Portfolio Alignment." GFANZ, November 2022.

[40] "Climate change widespread, rapid, and intensifying.", IPCC, 9 August 2021.

[41] "Climate Change 2014 Synthesis Report Summary for Policymakers." IPPC, 2014.

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4.3 Uncertainties around ITR modelling

Like any forward-looking model, ITR is a simplified representation of a future that remains radically uncertain. It is underpinned by a set of assumptions, some of which are derived from the REMIND NGFS Net Zero 2050, as mentioned in section 6.1.

Normative vs predictive

The temperature expression of ITR does not equate to a forecast of future global warming. It is a translation of alignment with pathways that are normative, not predictive by design. ITR provides an intuitive sense of the degree of alignment or misalignment with a given NGFS forward- looking 1.5°C-aligned pathway, which may not be followed in the real world, but which is consistent with a scenario where global warming is limited to 1.5°C.

Given that, the 1.55°C end-temperature increase benchmark from the NGFS scenario might give an impression of false precision, the 1.55°C benchmark should be treated as a helpful 1.5°C rough estimate to assess countries' alignment within a regional composition. Similarly, the ITR computation through a TCRE factor is not as sophisticated as a fully-fledged climate model that would include a range of non-linearities (e.g., feedback loops past a certain degree of warming). The essential use case of ITR is to measure the relative alignment of countries intuitively and transparently vis-à-vis a certain pathway, and not to aim for the most comprehensive temperature modelling, which is subject to high levels of uncertainty.

The target emissions gap adjustment factor assessment is a normative feature too. It can increase projected emissions for countries that are farther from their targets using a weighting based on certain indicators that are defined according to our judgement (e.g., track record in achieving past targets). These indicators and weighting are not precisely predictive. As the economy is transitioning for the first time to net-zero, it is extremely challenging to build a model using accurate predictors for a country's complete low carbon transition: there are no sufficient historical data.

Time horizon conclusion

The forward-looking ITR assessment starts in 2020 and concludes in 2050. It is benchmarked against a 1.55°C long-term temperature increases at the 2100 horizon, which is a common scientific horizon point for estimating global warming (e.g., in IPCC reports). So, there is a discrepancy between the time horizon conclusion for ITR assessment and that of global warming estimation.

This approach is warranted. Due to geophysical processes, there is a time lag between CO_2 emissions, CO_2 concentrations in the atmosphere, and the resulting global-mean temperature. Temperature is stabilized decades after decarbonization action, as some of the climate feedback processes slowly unfold (e.g., melting of ice sheets, ocean heat uptake). Since the NGFS Net Zero 2050 assumes that the world reaches net-zero in 2050, estimating the resulting (stabilized) global warming at the 2100 horizon is a warranted approach. Besides, lengthening the ITR time frame to a time horizon conclusion beyond 2050 only reinforces uncertainties about the long-term future and weakens the time reference for climate action.

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No time horizon conclusion is ideal. It is plausible, under certain assumptions, to model a scenario in which the world remains carbon positive in future years (e.g., 2090). This would in turn postpone the magnitude and time reference of the stabilized global warming temperature.

This ITR methodology is a way of assessing country alignment performance through cumulative emissions computation over a defined period (2020-2050), not as a scientific tool for predicting global warming.

5 Coverage and data updates

MSCI ESG Research uses the IMF World Economic Outlook (WEO) as a starting point to determine the coverage universe for Country Scope 1 Emissions ITR.[42] A country is eligible for inclusion in the coverage universe if it meets all the following data requirements:

1. Carbon budget data under both, least-cost (NGFS Net Zero 2050 scenario) and effort-sharing (UN Human Development Index) approaches
2. National Greenhouse Gas Emissions Inventories and Implied National Mitigation (Nationally Determined Contributions) Targets in IMF Climate Change Dashboard and emissions reduction targets data in Climate Watch data
3. Historical Scope 1 excluding LULUCF emissions data at country-level

The list of countries in scope and the underlying minimum data availability criteria are reviewed every three years.

5.1 Data sources and treatment of absence of data

MSCI ESG Research collects and standardizes a wide range of publicly available data from inter-governmental databases and other third-party sources for each component of the methodology. Other third-party data includes data sourced from government databases, data vendors and non-governmental organizations (NGOs).

MSCI ESG Research relies only on reputable public sources to assess countries and calculate Country Scope 1 ITR. The list of data sources used in the model is available in Appendix III.

Where necessary, estimates are made throughout the methodology. The methods of estimation are outlined in the relevant methodology steps above. Where data is not available from our data sources or cannot be estimated for a given country, the indicator is excluded from the calculations of scores for that entity. The associated calculation is adjusted among the remaining available information.

[42] MSCI ESG Research follows the IMF WEO use of the term “country”. The term does not in all cases refer to a territorial entity that is a state as may be understood by international law and practice. For further information, refer to IMF country information > IMF Country Information. Last accessed May 2025.

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5.2 Data updates and quality assurance

The Country Scope 1 ITR data are typically updated by MSCI ESG Research on an annual basis. Data quality assurance processes are conducted on all data prior to publication to address accuracy, completeness and validity of data. Automated and manual data quality checks are conducted and data that is flagged through these checks is subject to further review, making the ITR update last up to 30 days.

5.3 Methodology update processes

The ESG Methodology Committee ("EMC") presides over the development, review and approval of all MSCI ESG Research methodologies. Methodology update proposals are subject to market consultation prior to approval for implementation by the EMC.

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Appendix I – Historic Country Scope 1 Emissions ITR

Any country-level ITR is as of a specific year. When a country's cumulative net-zero budget is rolled over, that country's ITR moves to the next reference year, with an updated net zero 2050 budget.

To calculate the Country Scope 1 Emissions ITRs for years prior to the current ITR reference year, the following building blocks are required:

- Carbon budget as of a specific reference year.
- Projected emissions with target gap adjustment factor, track record emissions, projected emissions with targets-at-face-value as of a specific model year.
- Global net zero 2050 budget as of a specific model year.

The allocated carbon budget as of a specific model year is available from 2020 onwards as part of the budget rollover feature (please see section 2.1 for more details).

Projecting emissions as of a specific year requires a clear definition of which information can be considered. For example, to project emissions as of 2021 (i.e., January 1, 2021), the ITR model uses emissions data up to 2020 (December 31, 2020). On the target side, all targets are included in the emissions projection. Exhibit 19 below outlines the data used to create a modelled history:

Exhibit 19: Data used to create back-stated projected emissions

Year reference of implied temperature rise	Scope 1 emissions data	Target data
2020	2019	All targets available up to today
2021	2019-2020	All targets available up to today
…	2019-…	All targets available up to today

Source: MSCI ESG Research.

The aim of the ITR model is to perform a forward-looking assessment including all country targets to assess the alignment with the 1.5°C scenario. Therefore, excluding the most recent country targets from past country ITRs would not align with the overall aim of the ITR metric. So, any ITR output in the ITR modelled history will integrate the latest country targets, even when the target announcement date (e.g., 2024) has occurred after the reference year in the modelled history (e.g., 2020).

Finally, the global budget that is required to translate the country-level carbon budget overshoot into a degree of warming is available from 2020 onwards. Please see Section 2.4 for more details.

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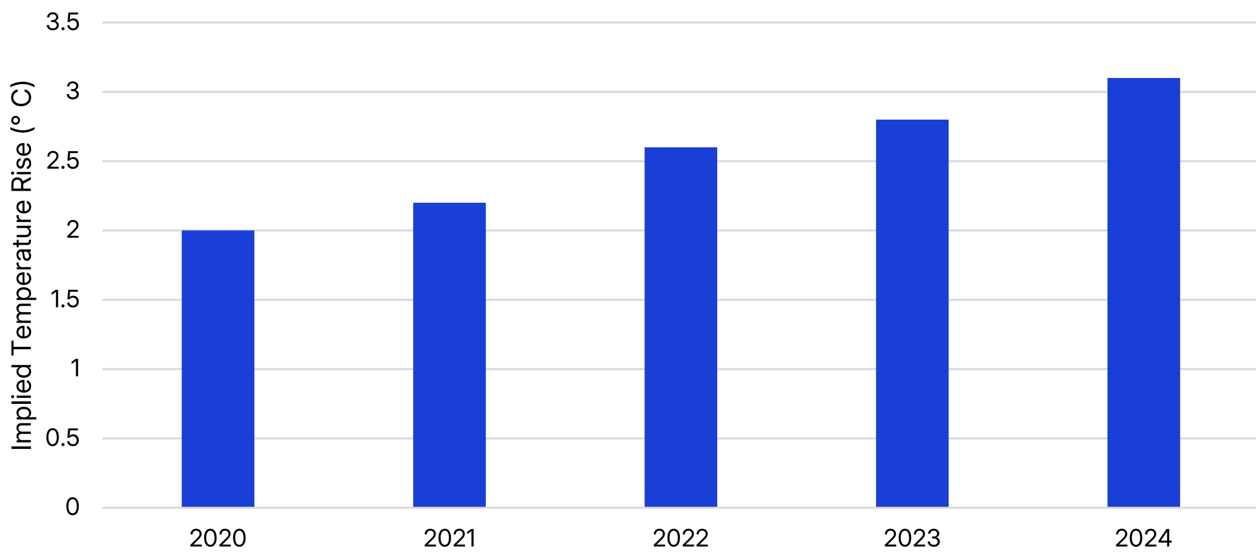
With these building blocks, a country-level ITR can be back dated for a specific year (year x):

$$ITR_{year\ x} = 1.55°C + \frac{Absolute\ Carbon\ Budget\ Overshoot_{year\ x}}{Carbon\ Budget_{year\ x}} * Global\ 1.55°C\ Budget_{year\ x} * TCRE\ factor$$

Using this formula, a hypothetical country's historic Country Scope 1 Emissions ITR could be calculated as set out below in Exhibit 20:

Exhibit 20: Modelled history for a country or a portfolio (illustrative example)



Source: MSCI ESG Research. Note: This is an illustrative example.

To calculate a back dated portfolio-level ITR, the modelled history computes the core components of constituents' ITR as of the selected reference year (year x). These include country carbon budget data, absolute country over- or undershoot, and reference global budget. The portfolio aggregation formula for year x is calculated as:

$$Portfolio\ ITR_{year\ x} = Base\ Temperature + \frac{\sum(TCRE * Global\ Budget_{year\ x,\ i} * Financed\ Overshoot_{year\ x,\ i})_i}{\sum Financed\ Budget_{most\ recent,\ i}}$$

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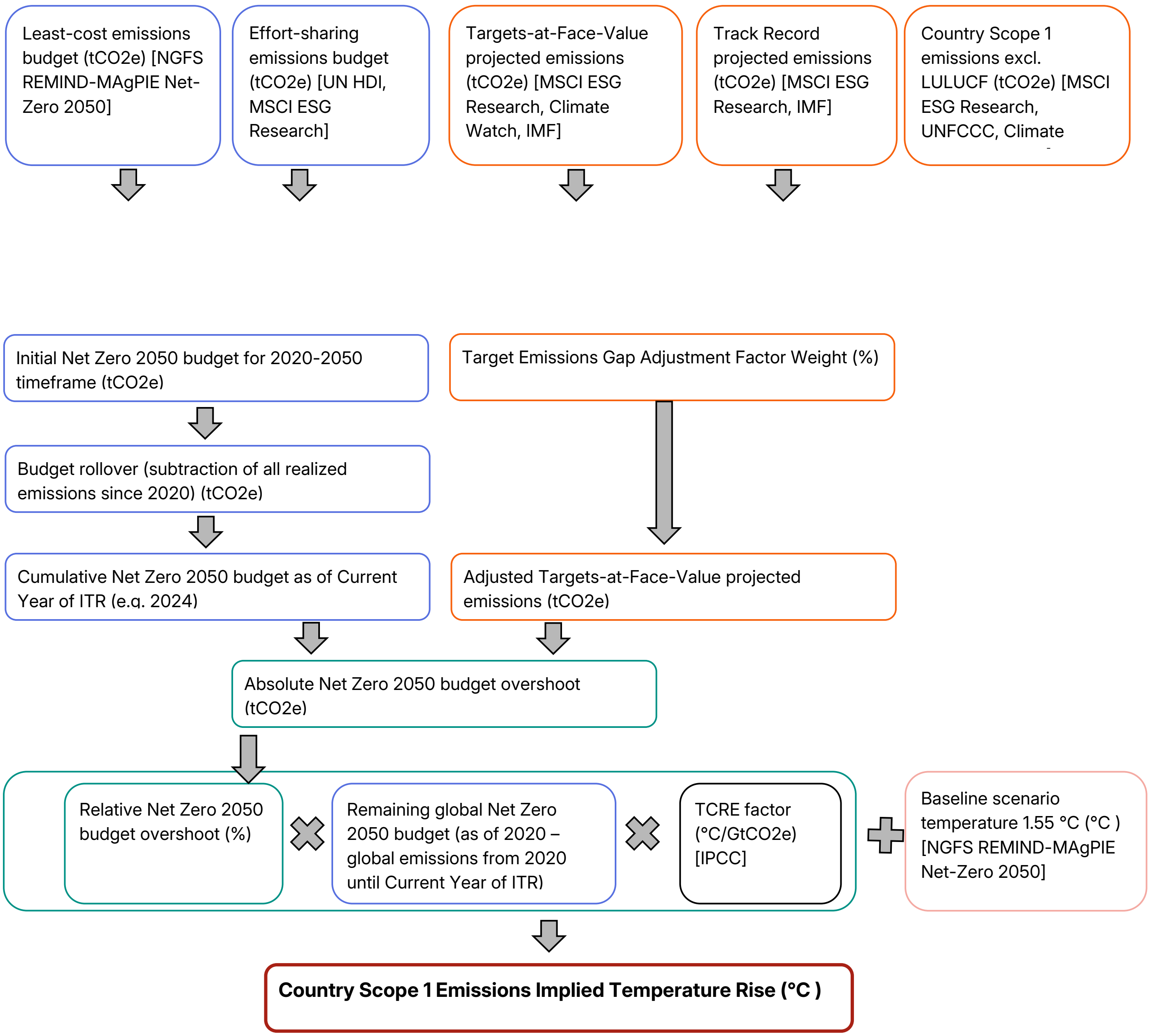
Appendix II – Overview of country-level Implied Temperature Rise computation



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Appendix III – List of sources

Data	Source
Government Carbon Emissions - Scope 1 excl. LULUCF	MSCI ESG Research, UNFCCC, Climate Watch, MRIO-PRIMAP Refer to "Total Portfolio Footprinting Methodology" for more details on country-level Scope 1 excluding LULUCF emissions
Net Zero 2050 Carbon Budget	NGFS REMIND-MAgPIE 3.0-4.4 (Net Zero 2050 scenario) Link: https://data.ece.iiasa.ac.at/ngfs-phase-3/#/downloads
NDC quantification data	IMF's National Greenhouse Gas Emissions Inventories and Implied National Mitigation (Nationally Determined Contributions) Targets Link: https://climatedata.imf.org/datasets/72e94bc71f4441d29710a9bea4d35f1d_0/
Country's human development level	UN Human Development Index (HDI) Link: Human Development Index | Human Development Reports
Country NDC and LTS targets data	Climate Watch. 2024. Washington, DC: World Resources Institute Link: https://www.climatewatchdata.org. NDCs: UNFCCC. 2024. NDC Registry. Link: https://unfccc.int/NDCREG.
Global emissions used for budget rollovers	UN Environment Programme Emissions Gap Reports Link: https://www.unep.org/resources/emissions-gap-report
GDP and population data	NGFS, World Bank, IMF population datasets

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Appendix IV – MSCI Country Scope 1 Emissions Implied Temperature Coverage

MSCI Country Scope 1 Emissions Implied Temperature Rise assessment is available for 170 countries (Exhibit 21) under its coverage. These lists may change over time.

Exhibit 21: MSCI Country Scope 1 Emissions Implied Temperature – Countries coverage

Afghanistan	Georgia	Oman
Albania	Germany	Pakistan
Algeria	Ghana	Panama
Angola	Greece	Papua New Guinea
Argentina	Guatemala	Paraguay
Armenia	Guinea	Peru
Australia	Guinea-Bissau	Philippines
Austria	Guyana	Poland
Azerbaijan	Haiti	Portugal
Bahamas	Honduras	Qatar
Bahrain	Hong Kong	Romania
Bangladesh	Hungary	Russia
Barbados	Iceland	Rwanda
Belarus	India	Saint Lucia
Belgium	Indonesia	Saint Vincent and the Grenadines
Belize	Iran	Samoa
Benin	Iraq	Sao Tome and Principe
Bhutan	Ireland	Saudi Arabia
Bolivia	Israel	Senegal
Bosnia and Herzegovina	Italy	Sierra Leone
Botswana	Jamaica	Singapore
Brazil	Japan	Slovakia
Brunei	Jordan	Slovenia
Bulgaria	Kazakhstan	Solomon Islands
Burkina Faso	Kenya	South Africa
Burundi	Kuwait	South Korea
Cambodia	Kyrgyzstan	Spain

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Cameroon	Laos	Sri Lanka
Canada	Latvia	Sudan
Cape Verde	Lebanon	Suriname
Central African Republic	Lesotho	Swaziland
Chad	Liberia	Sweden
Chile	Libya	Switzerland
China	Lithuania	Syria
Colombia	Luxembourg	Tajikistan
Comoros	Macedonia	Tanzania
Congo DR	Madagascar	Thailand
Congo Republic	Malawi	Togo
Costa Rica	Malaysia	Tonga
Croatia	Maldives	Trinidad and Tobago
Cyprus	Mali	Tunisia
Czech Republic	Malta	Turkey
Denmark	Mauritania	Turkmenistan
Djibouti	Mexico	Uganda
Dominican Republic	Moldova	Ukraine
Ecuador	Mongolia	United Arab Emirates
Egypt	Morocco	United Kingdom
El Salvador	Mozambique	United States
Equatorial Guinea	Myanmar	Uruguay
Eritrea	Namibia	Uzbekistan
Estonia	Nepal	Vanuatu
Ethiopia	Netherlands	Venezuela
Fiji	New Zealand	Vietnam
Finland	Nicaragua	Yemen
France	Niger	Zambia
Gabon	Nigeria	Zimbabwe
Gambia	Norway	

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Glossary

Name	Definition
Government Carbon Emissions - Scope 1 excl. LULUCF (tCO2e/yr)	The reported or estimated Scope 1 greenhouse gas emissions for the country territory (if available), in tons of CO2 equivalent per year (tCO2e/yr). Scope 1 emissions are domestic GHG emissions from sources located within the country territory. Values exclude land use, land-use change and forestry (LULUCF).
Government Carbon Emissions - Scope 1 excl. LULUCF Intensity (tCO2e/ USD million GDP-PPP)	The reported or estimated Scope 1 emissions intensity of greenhouse gases excluding land use, land-use change and forestry (LULUCF) for the country territory in tons of CO2 equivalent per year per PPP-adjusted GDP (tCO2e/ USD million GDP-PPP).
Intergovernmental Panel on Climate Change	Created in 1988, the Intergovernmental Panel on Climate Change (IPCC) is the United Nations body for assessing the science related to climate change. It determines the state of knowledge on climate change, identifying where there is agreement in the scientific community, and where further research is needed. The IPCC does not conduct its own research. IPCC reports are neutral, policy-relevant but not policy-prescriptive.
Glasgow Financial Alliance for Net Zero (GFANZ)	The Glasgow Financial Alliance for Net Zero (GFANZ) is a global coalition of more than 550 financial institutions committed to accelerating the decarbonization of the economy. Members commit to align their lending and investing with 1.5°C from preindustrial levels. The GFANZ workstream on portfolio alignment published, in November 2022, a landmark report on portfolio alignment measurement best practice, which the ITR model strives to align with.
Greenhouse Gas Protocol (GHGP)	The Greenhouse Gas Protocol (GHGP) is an accounting body setting carbon accounting frameworks to measure and manage greenhouse gas emissions from private- and public-sector operations, value chains and mitigation actions.

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Name	Definition
Network for Greening the Financial System (NGFS)	The Central Banks and Supervisors Network for Greening the Financial System (NGFS) is a group of central banks and supervisors willing, on a voluntary basis, to exchange experiences, share best practices, contribute to the development of environment and climate-risk management in the financial sector, and to mobilize mainstream finance to support the transition toward a sustainable economy. It commissions work on climate finance, including open-source climate scenarios. The ITR model uses the REMIND-MAgPIE Net Zero 2050 scenario to benchmark countries and portfolios.
Partnership for Carbon Accounting Financials (PCAF)	The Partnership for Carbon Accounting Financials (PCAF) is a global partnership led by the financial industry to enable financial institutions to develop and implement a harmonized approach to assess and disclose GHG emissions associated with their loans and investments.
Country Scope 1 Emissions Implied Temperature Rise - Start Year Model Horizon	The first modelling year for the Country Scope 1 Emissions Implied Temperature Rise model's time frame (2020-2050). The initial country carbon budget allocation is based on this year.
Reference Year of Current Country Scope 1 Emissions Implied Temperature Rise	The year corresponding to the current assessment of Country Scope 1 Emissions Implied Temperature Rise (ITR) metric, i.e., the year after which the emissions budget rollover has been implemented (deduction of realized emissions) and from which country projected emissions and the remaining budget are computed (e.g., the Country Scope 1 Emissions ITR of a country as of Jan 1st, 2021). See Country Scope 1 Emissions ITR methodology document for more information and context about these modelling steps.

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Name	Definition
Country Scope 1 Emissions Implied Temperature Rise Band Category [Blended budget, Adjusted Targets-at-Face-Value trajectory]	The classification of a country territory's Country Scope 1 Emissions Implied Temperature Rise outputs into four temperature alignment categories [1.5°C Aligned, 2°C Aligned, Misaligned, Strongly Misaligned]. The modeling assumptions include a Blended budget approach (an average of the least-cost and needs-based effort-sharing methods) and an Adjusted Targets-at-Face-Value projected emissions trajectory (projected emissions, in line with a country's climate targets, are adjusted based on the country's emissions reduction performance since the Paris Agreement and the annual rate needed to achieve its emissions target). See relevant section in Country Scope 1 Emissions ITR methodology document for further details.
Country Scope 1 Emissions Implied Temperature Rise [Blended budget, Adjusted Targets-at-Face-Value trajectory] [°C]	The degree Celsius Country Scope 1 Emissions Implied Temperature Rise (ITR) (by the year 2100), if the whole economy had the same over-/undershoot level of greenhouse gas emissions to the country analyzed, based on its most recent projected Scope 1 emissions. The modelling assumptions include a Blended budget approach (an average of the least-cost and needs-based effort-sharing methods) and a projected Adjusted Targets-at-Face-Value emissions trajectory (projected emissions, in line with a country's climate targets, are adjusted based on the country's emissions reduction performance since the Paris Agreement and the annual rate needed to achieve its emissions target). See relevant section in Country Scope 1 Emissions ITR methodology document for further details.
Cumulative Net Zero 2050 Carbon Budget [Scope 1] - Blended budget [tCO2e]	The cumulative direct greenhouse gas emissions (Scope 1) that remain available for the country to limit global warming to 1.55°C. The model assumptions incorporate the Blended budget (average of the least-cost and needs-based effort sharing methods). This metric is calculated as of the Year Reference of Current Country Scope 1 Emissions Implied Temperature Rise, using the initial budget allocated in the Start Model Year Horizon and adjusted by subsequent budget rollovers.

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Name	Definition
Cumulative Net Zero 2050 Carbon Budget [Scope 1] - Least-cost budget [tCO2e]	The cumulative direct greenhouse gas emissions (Scope 1) that remain available for the country to limit global warming to 1.55°C. The model assumptions incorporate the Least-cost budget (Network for Greening the Financial System (NGFS) Regional Model of Investments and Development-Model of Agricultural Production and its Impact on the Environment (REMIND-MAgPIE) Net Zero 2050 scenario). This metric is calculated as of the Year Reference of Current Country Scope 1 Emissions Implied Temperature Rise, using the initial budget allocated in the Start Model Year Horizon and adjusted by subsequent budget rollovers.
Cumulative Net Zero 2050 Carbon Budget [Scope 1] - Effort-sharing budget [tCO2e]	The cumulative direct greenhouse gas emissions (Scope 1) that remain available for the country to limit global warming to 1.55°C. The model assumptions incorporate an Effort-sharing budget approach (the basic needs qualification method by the University of Graz). This metric is calculated as of the Year Reference of Current Country Scope 1 Emissions Implied Temperature Rise, using the initial budget allocated in the Start Model Year Horizon and adjusted by subsequent budget rollovers.
Cumulative Net Zero 2050 Carbon Budget [Scope 1] - Blended budget in the first modeling year of ITR [tCO2e]	The initial cumulative net zero 2050 carbon budget (Scope 1) allocated to the country to limit global warming to 1.55°C in the Start Model Year Horizon of the Country Scope 1 Emissions Implied Temperature Rise. The model assumptions incorporate the Blended budget (average of the least-cost and needs-based effort sharing methods).
Cumulative Projected Carbon Emissions [Scope 1] - Adjusted Targets-at-Face-Value [tCO2e]	The cumulative projected greenhouse gas emissions (Scope 1) from the Reference Year of Current Country Scope 1 Emissions Implied Temperature Rise to the year 2050, with model assumptions that the country meets a portion of its reported climate targets as defined by the Target Emissions Gap Adjustment Factor Weight. This projection incorporates the latest available Scope 1 emissions data (reported or estimated), and the country's projected emissions, in line with a country's climate targets, are adjusted based on the country's emissions reduction performance since the Paris Agreement and the annual rate needed to achieve its emissions target.

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Name	Definition
Cumulative Projected Carbon Emissions [Scope 1] - Targets-at-Face-Value [tCO2e]	The cumulative projected greenhouse gas emissions (Scope 1) from the Reference Year of Current Country Scope 1 Emissions Implied Temperature Rise to the year 2050, with model assumptions that the country meets its reported climate targets. This projection incorporates the latest available Scope 1 emissions data (reported or estimated) and assumes the country will follow an emissions trajectory in line with its reported climate targets.
Cumulative Projected Carbon Emissions [Scope 1] - Track Record [tCO2e]	The cumulative projected greenhouse gas emissions (Scope 1) from the Reference Year of Current Country Scope 1 Emissions Implied Temperature Rise to the year 2050, with model assumptions that the country has no additional reported climate targets. This projection incorporates the latest available Scope 1 emissions data (reported or estimated) and assumes the country will follow an emissions trajectory similar to its historical trends and its relationship with GDP.
Cumulative Projected Carbon Emissions [Scope 1] - Adjusted Targets-at-Face-Value in first modeling year of ITR [tCO2e]	The initial projected cumulative direct greenhouse gas emissions (Scope 1) that were used to calculate the Country Scope 1 Emissions Implied Temperature Rise in the Start Model Year Horizon. The model assumptions incorporate the Adjusted Targets-at-Face-Value projected emissions trajectory (projected emissions, in line with a country's climate targets, are adjusted based on the country's emissions reduction performance since the Paris Agreement and the annual rate needed to achieve its emissions target).
Absolute Carbon Budget [Scope 1] Overshoot [Blended budget, Adjusted Targets-at-Face-Value trajectory] [tCO2e]	The projected absolute greenhouse gas emission over/undershoot (Scope 1) when comparing a country's projected emissions to its remaining emission budget available to limit global warming to 1.55°C. This is the difference in tCO2e between the Cumulative Projected Carbon Emissions (Adjusted Targets-at-Face-Value) and the Cumulative Net Zero 2050 Carbon Budget (Blended budget). A negative number corresponds to a budget undershoot and a positive number to a budget overshoot. The overshoot is capped at 10°C.

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Name	Definition
Relative Carbon Budget [Scope 1] Overshoot [Blended budget, Adjusted Targets-at-Face-Value trajectory] [%]	The projected relative carbon budget over/undershoot emissions (Scope 1) when comparing a country's projected emissions to its remaining emission budget available to limit global warming to 1.55°C. This is the relative difference between the Cumulative Projected Carbon Emissions (Adjusted Targets-at-Face-Value) and the Cumulative Net Zero 2050 Carbon Budget (Blended budget). A negative number corresponds to a budget undershoot and a positive number to a budget overshoot. The relative overshoot is capped at 10°C.
Target Emissions Gap Adjustment Factor Weight - Unconditional and conditional targets [%]	The weight (%) applied to the cumulative projected carbon emissions decarbonization trajectories (considers both, targets-at-face-value and track record) adjusts for a country's progress towards its climate targets based on the annual emissions reduction rate needed to achieve its conditional and/or unconditional emissions target and its recent emissions reduction performance since the Paris Agreement (target emissions gap value (%)). It is calculated by taking an average of Target Emissions Gap Adjustment Factor Weight - Unconditional targets (%) and half of the Target Emissions Gap Adjustment Factor Weight - Conditional targets (%).
Target Emissions Gap Adjustment Factor Weight - Unconditional targets [%]	The weight (%) allocated to the target emissions gap value (annual emissions reduction rate needed to achieve its unconditional emissions target and its recent emissions reduction performance since the Paris Agreement) for the unconditional target portion of the country's targets, if available. To calculate this, we compare the target emissions gap value - unconditional target (%) with a predefined table. If there is no target emissions gap, we assign 100% weight. For each 1% increase in the target emissions gap value (%), the weight decreases by 10%.

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Name	Definition
Target Emissions Gap Adjustment Factor Weight - Conditional targets [%]	The weight (%) allocated to the target emissions gap value (annual emissions reduction rate needed to achieve its conditional emissions target and its recent emissions reduction performance since the Paris Agreement) for the conditional target portion of the country's targets, if available. To calculate this, we compare the target emissions gap value - conditional target (%) with a predefined table. If there is no target emissions gap, we assign 100% weight. For each 1% increase in the target emissions gap value (%), the weight decreases by 10%.
Target Emissions Gap Value - Unconditional targets [%]	The estimated percentage difference in a country's emissions reduction performance since the Paris Agreement (2015) compared to the annual reduction rate required to meet its unconditional Nationally determined contributions (NDCs) target. This difference is measured between two rates: (a) the country's estimated average annual emissions growth rate (whether positive or negative) from the Paris Agreement to the NDCs target year, and (b) the average annual emissions growth rate from the Paris Agreement to the Reference Year for the Current Country Scope 1 Emissions Implied Temperature Rise metric.
Target Emissions Gap Value - Conditional targets [%]	The estimated percentage difference in a country's emissions reduction performance since the Paris Agreement (2015) compared to the annual reduction rate required to meet its conditional Nationally Determined Contributions (NDCs) target. This difference is measured between two rates: (a) the country's estimated average annual emissions growth rate (whether positive or negative) from the Paris Agreement to the NDCs target year, and (b) the average annual emissions growth rate from the Paris Agreement to the Reference Year for the Current Country Scope 1 Emissions Implied Temperature Rise metric.
Average Annual Rate of Emissions Reduction Required from 2015 to NDC Target Year - Unconditional targets [%]	The estimated average annual growth rate (positive or negative) of a country's emission from Paris Agreement (2015) to the Nationally determined contributions (NDCs) target year, considering the unconditional targets set in NDCs.

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Name	Definition
Average Annual Rate of Emissions Reduction Required from 2015 to NDC Target Year - Conditional targets [%]	The estimated average annual growth rate (positive or negative) of a country's emission from Paris Agreement (2015) to the Nationally determined contributions (NDCs) target year, considering the conditional targets set in NDCs.
Average Annual Rate of Emissions Reduced/ Increased from 2015 to Reference Year of Current Assessment [%]	The estimated average annual growth rate (positive or negative) of a country's emission from Paris Agreement (2015) from Paris Agreement (2015) to the Reference Year of Current Country Scope 1 Emissions Implied Temperature Rise metric.
Remaining Global Net Zero 2050 Carbon Budget [GtCO2e]	The remaining greenhouse gases emissions (Scope 1) available globally to limit global warming to 1.55°C, as of the Year Reference of Current Country Scope 1 Emissions Implied Temperature Rise.
Base Temperature of the Reference Scenario [°C]	The degrees Celsius global mean average surface warming (by the year 2100) according to the Network for Greening the Financial System (NGFS) reference scenario used in the Country Scope 1 Emissions Implied Temperature Rise model.
Transient Response to Cumulative CO2 Emissions (TCRE) Factor [°C/GtCO2e]	The Transient Response to Cumulative Emissions (TCRE) Factor defines the relationship between the absolute additional emissions and temperature increase over time. This factor is used to calculate the country and portfolio level temperature increase based on the country's or portfolio's emission budget overshoot.
Initial Net Zero 2050 Carbon Budget [Scope 1] [tCO2e/yr]	The Initial Net Zero 2050 Carbon Budget per Year in tCO2e (Scope 1) is the initial sum of greenhouse gas emissions (Scope 1) available for the country to emit to keep global warming to 1.55°C for the specific year. This is based on an initial budget allocation for the period 2020-2050, derived from model assumptions that incorporates the Blended budget (average of the least-cost and needs-based effort sharing methods).

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