



ETHOS CLIMATE
TRANSITION RATINGS
METHODOLGY

The **Ethos Foundation** is composed of more than 240 tax-exempt Swiss pension funds and institutions. Founded in 1997, its aim is to promote socially responsible investment and to foster a stable and prosperous socio-economic environment.

Signatory of:



Ethos Services provides advisory services in the field of socially responsible investments. Ethos Services offers socially responsible investments funds, analyses of shareholders' general meetings with voting recommendations, a program of dialogue with companies as well as environmental, social and corporate governance ratings and analyses. Ethos Services is owned by the Ethos Foundation and several members of the Foundation.

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INTRODUCTION
AND GENERAL
PRINCIPLES

1. Introduction

Climate change is one of the greatest challenges facing humanity. The science is clear: to avoid global warming above 1.5°C by the end of the century, which would lead to catastrophic consequences, we must reduce CO₂e emissions. Both public and private sectors have a key role to play in financing a low-carbon economy.

Institutional investors are also expected to align their investments with such a low-carbon economy.

First, it is part of their stewardship duty to integrate material financial risk into their investment strategy. As such, climate change poses physical, transition, and legal risks that will impact the value of the companies in their portfolios.

Second, solutions exist to mitigate the effects of climate change and companies that propose such solutions or adapt quickly to new low-carbon technologies should be favoured by investors to ensure that financial flows are aligned with a 1.5°C pathway.

Third, as owners of listed companies, institutional investors can use their voting rights to ensure that investee companies allocate capital efficiently and in line with a low-carbon economy.

Fourth, investors are facing increasing regulatory and transparency requirements to demonstrate how they are addressing climate change and sustainability issues.

The Ethos Foundation was created by institutional investors with the sole purpose of ensuring that sustainability is reliably taken into account in their investment decisions. For several years now, Ethos has been measuring the CO₂e intensity of its investment funds and encouraging companies to disclose their emissions and set ambitious CO₂e reduction targets.

However, while the carbon intensity of investments and portfolios is an important indicator, Ethos believes that it is not sufficient to measure the environmental impact of companies and portfolios and how their CO₂e emissions will evolve in the future. This is why Ethos has invested considerable resources to develop this methodology, which allows it to assess the climate action of some 2'000 corporate companies worldwide. The assessment has two components to reflect the double materiality of companies' climate challenges. The first is the impact of the companies' activities on the climate by determining a temperature score, while the second aims to identify the risks that companies face in relation to climate change.

Although several similar methodologies already exist, Ethos decided to develop its own approach in particular to include a credibility factor in its assessment of companies' commitment to climate action. The resulting

temperature score gives a more accurate picture of the temperature rise our planet would face if all the companies were to act the same way as those analysed. This approach is therefore forward-looking whereas traditional measures of CO₂e emissions, such as the Weighted Average Carbon Intensity of a portfolio (WACI) are backward-looking.

Such a temperature score allows investors to better measure the impact of their engagement activities, for example.

Ethos also recognises the rapid evolution of climate science and technology. The methodology will therefore continuously evolve to take into account the latest scientific developments in the field of climate change.

Vincent Kaufmann

CEO

2. Background and foundations

PARIS AGREEMENT

The Paris Agreement entered into force in November 2016 and includes commitments from all countries to reduce their emissions and work together to adapt to the impacts of climate change.

Respecting the Paris Agreement means “avoiding the unmanageable”, by limiting global warming “to well below 2°C” and pursuing efforts “to limit the temperature increase to 1.5°C above pre-industrial levels”¹. The latter threshold is highlighted by climate scientists as the red line that should not be crossed to avoid risks of far more severe climate change impacts². To do this, a strong and rapid reduction in global greenhouse gas (GHG) emissions is needed, by massively decreasing in fossil fuel combustion³. Measuring how companies are progressing towards these objectives and how they are impacted by climate change is therefore key for institutional investors and ensure financial flow are aligned to a low carbon economy.

IMPLICATIONS OF RISING TEMPERATURES

The current level of knowledge attests that the increase in GHG emissions has an impact on the transgression of major planetary boundaries⁴ that jointly regulate the stability and resilience of our planet. Transgressing these boundaries increases the risk of generating abrupt and irreversible environmental changes on a large scale and compromises the living conditions of the human species. The acceleration of droughts and extreme weather events in early 21st century are examples of serious problems that could become even more common if temperature rise by 1.5°C. Global warming already affects marine and terrestrial ecosystems by decreasing suitable habitats space and irreversibly changing their

composition. Above a 2°C rise, the severity of habitat loss will strongly increase as the number of areas prone to fire will surge throughout Europe, threatening biodiversity and [carbon sinks](#).

In addition, the frequency and the intensity of extreme events such as hot temperatures or heavy precipitations over land are projected to increase greatly⁵. If proper action is not taken in time, numerous adaptation measures will no longer be effective or feasible, leading to unbearable consequences. To limit global warming to around 1.5°C, an immediate and radical reduction of emissions in all sectors is necessary and GHG emissions should be reduced to net zero by the early 2050s [1].

TEMPERATURE ALIGNMENT METHODOLOGIES

In this context, temperature alignment scores are becoming an important tool for investors, whether they are used for regulatory, wealth management and reporting purposes (to support the target-setting process) or for active ownership. However, there is currently no internationally recognised standard for measuring a company’s temperature alignment. Ethos’ research has shown that the results vary significantly according to the chosen data, methodology and hypotheses.

Several methodologies have attempted to provide temperature metrics and tools for portfolio alignment purposes. Technical guidance on emerging best practices has been developed by industry groups such as the Portfolio Alignment Team (PAT), which provides guidance on analysing and forecasting financial portfolio alignment with the objectives of the Paris Agreement. Future research priorities have also been defined by the

¹ United Nations, Paris Agreement (2015)

² United Nations Climate Change <https://unfccc.int/process-and-meetings/the-paris-agreement>

³ Intergovernmental Panel on Climate Change (Éd.). (2015). Climate change 2014 : Synthesis report. Geneva, Switzerland: Intergovernmental Panel on Climate Change.

⁴ Steffen, Will, et al. “Planetary boundaries: Guiding human development on a changing planet.” *science* 347.6223 (2015): 1259855, <https://www.science.org/doi/10.1126/science.1259855>

The nine Planetary Boundaries are: *Climate Change – Novel Entities – Stratospheric Ozone Depletion – Atmospheric Aerosol Loading – Ocean Acidification – Biogeochemical Flows – Freshwater Use – Land System Change – Biosphere Integrity* (six planetary boundaries already crossed in 2022 are indicated in italic).

⁵ IPCC AR6, WGII, [Summary for Policymakers](#), p18

PAT in areas where there is currently insufficient maturity to identify best practice.

Other methodologies provide strong foundations, set best practices, and provide different perspectives on key methodological aspects. The common ground lies in the scenarios used as benchmarks which usually follow the latest existing science and are taken from recognised sources (IPCC, IEA). However, the scope of a company's emissions that are included may vary: in some cases, emissions outside the company's direct control (scope 3 emissions) are included, while in other cases only scope 1 and 2 are taken into account.

A common shortcoming of most existing temperature methodologies is that they consider targets reported by companies without assessing the likelihood of these targets being met. As a result, these methodologies assume companies will achieve their climate targets. Ethos is critical of this hypothesis, especially when considering that the vast majority of companies fail to meet their targets. Such targets are often voluntary and there are few sanctions for companies that do not achieve their targets. Ethos therefore considers that this assumption may lead to overly optimistic results. It is therefore essential to assess the credibility of the companies' climate ambition. To address this gap, Ethos has developed its own credibility assessment. The Ethos climate credibility score makes it possible to estimate the proportion of the targets set by companies that can be credibly expected to be achieved.

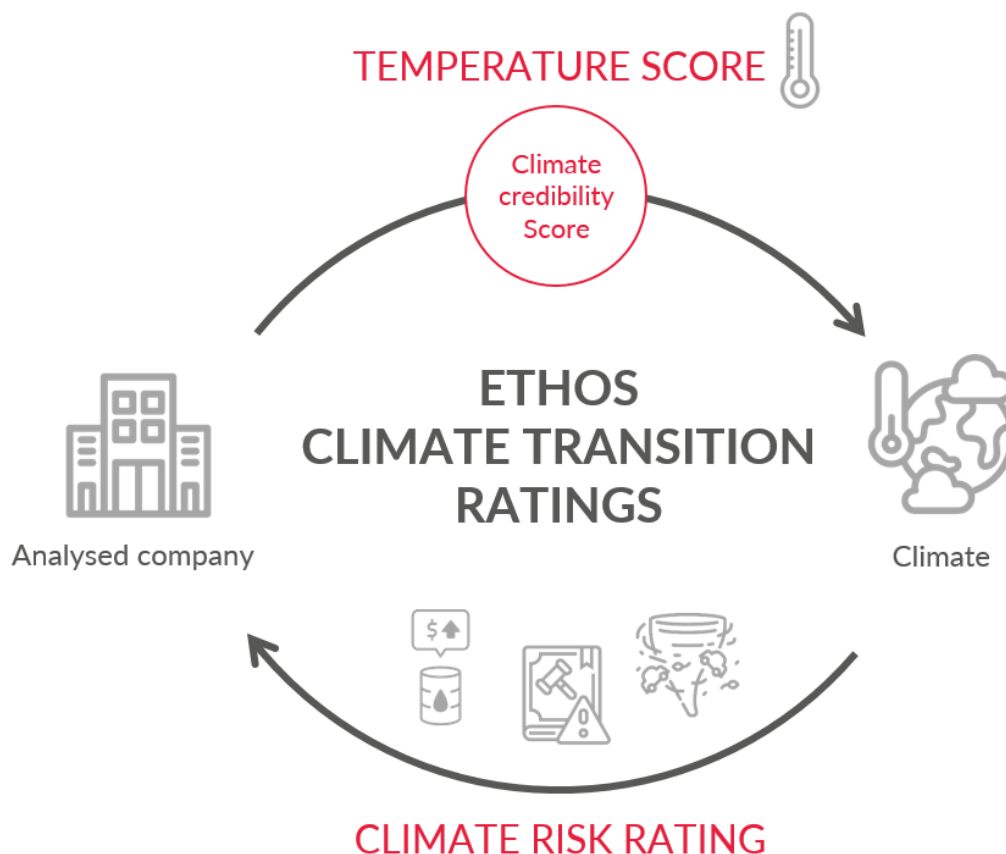
Setting ambitious net-zero targets without putting the necessary financial resources and efforts to meet those targets is not sufficient to demonstrate a credible path to lower emissions and a lower temperature score. Unlike most other methodologies, the Ethos Temperature Score will give a high temperature to a company that does not demonstrate a credible path to net zero, despite ambitious targets disclosed.

3. Ethos' methodology

The Ethos climate transition ratings enable institutional investors to assess the extent to which a company contributes to and is affected by the climate crisis (dual materiality). Ethos assesses not only the credibility of the company's temperature alignment, but also the impacts of climate change on the company.

Considering the dual materiality faced by companies, The Ethos climate transition ratings therefore consist of two key components: the Temperature Score and the Climate Risk Rating.

The Temperature Score is a powerful indicator that links a company's climate ambition and performance to a tangible reality: the rise in the global temperature and risks associated with it. The Temperature Score answers the question: What would be the global temperature rise if all companies acted with the same level of climate ambition and performance as the analysed company? It evaluates how a company's activities and strategy are consistent with climate science. The Temperature Score can then be aggregated at the portfolio level to measure the portfolio's alignment with climate objectives.



In practice, the Temperature Score is constructed by comparing a company's [adjusted emissions](#) with the available [carbon budget](#) to limit global warming to 1.5°C over the 2010-2050 period. If the company's cumulative emissions during this period are below its allocated carbon budget, the temperature of the company will be lower than 1.5°C. If the cumulative adjusted emissions are above the allocated carbon budget, the temperature will be above 1.5°C. A company's adjusted emissions are estimated on the basis of historical data, disclosed targets and Ethos' climate credibility score on target achievement.

The climate risk rating assesses the extent to which a company is exposed to the negative consequences of climate change. It evaluates the company's exposure and sensitivity to the three most material types of risk: physical risks, carbon-related financial risk and climate liability risks.

The foundations of Ethos climate transition ratings are driven by the latest and most reliable scientific information available. By taking into account the recommendations of industry groups and constantly monitoring new developments in the field of climate-related metrics, Ethos ensures that its methodology is robust and science-based.

The methodology aims to use the most reliable data available, as close as possible to the company's actual [activities](#) and emissions. Therefore, company data may come from various sources such as disclosures by the companies themselves, external estimates by third-parties, or estimates by Ethos.

APPLICATIONS OF ETHOS "CLIMATE TRANSITION RATINGS"

Tailored to the needs of institutional investors and financial institutions, Ethos climate transition ratings can be used in the following applications:

- Financial institutions and asset holders such as pension funds can align their investment activities with global climate objectives;
- Institutional investors can evaluate companies' exposure to the consequences of climate change;
- Portfolio-level results can be used for reporting purposes (e.g., to complete the Swiss Climate Scores⁶ template) or to follow reporting guidelines (e.g., ASIP's recommendations⁷);
- Companies can be engaged on the basis of a robust and science-based analysis of their climate performance;
- Civil society actors can challenge companies' climate communications on the basis of factual elements;
- Ethos climate transition ratings also aim to help investors decide whether to support a climate transition report from companies that organise a "Say on Climate" vote at their annual general meeting.

EXTERNAL REVIEW OF THE METHODOLOGY

The entire methodology has been reviewed by an external committee composed of three academics from the University of Lausanne and the École Polytechnique Fédérale de Lausanne (EPFL). For Ethos, this review was a logical, and necessary step in the methodology development process to challenge, improve and add additional credibility to the initial proposal.

The three reviewers had access to the full methodology document about the Temperature Score and provided thorough feedback and suggestions for improvement that has been taken into account.

⁶ Swiss Climate Score, <https://www.sif.admin.ch/sif/en/home/swiss-climate-scores/brief-summary.html>

⁷ ASIP ESG Reporting 2022, Standard for Pensionfunds, <https://www.asip.ch/de/Newsroom/Medienecke/183-asip-esg-reprting-2002/>



TEMPERATURE
SCORE

4. Overview

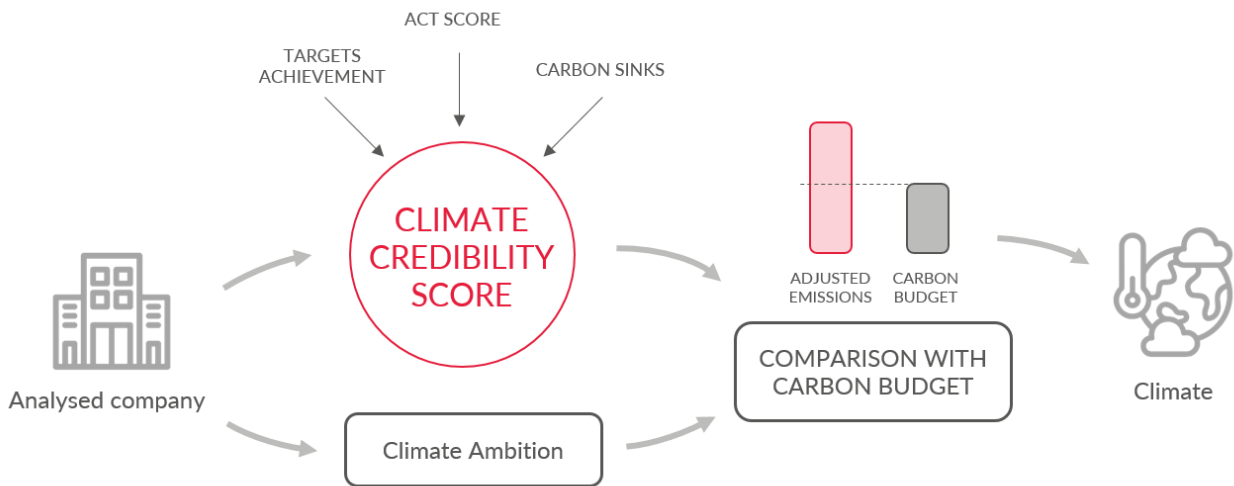
The Ethos Temperature Score is the indicator that links a company's performance to a tangible reality that reflects the rise in the global temperature.

The Temperature Score represents the global temperature rise in 2100 if the global economy has the same ambition and the same climate protection performance as the analysed company. Essentially, the company's adjusted emissions are compared with its carbon budget to give an indication of its contribution to global warming.

The data output for this score is a temperature in degrees. While this temperature is an indicator, it does

not represent actual projected warming. In fact, the sum of all companies' adjusted emissions will not result in real emissions. Real projected warming involves many more interdependent parameters that cannot be accounted for by economic activities alone.

To calculate the temperature score, Ethos has chosen the 1.5°C reference point. The reference point is the determinant factor of carbon budgets as it determines how much may still be emitted in order to limit global warming to this reference point.



TEMPERATURE SCORE

5. General principles

Building on existing best practices and recommendations, Ethos' methodology is based on a number of key principles, assumptions and parameters.

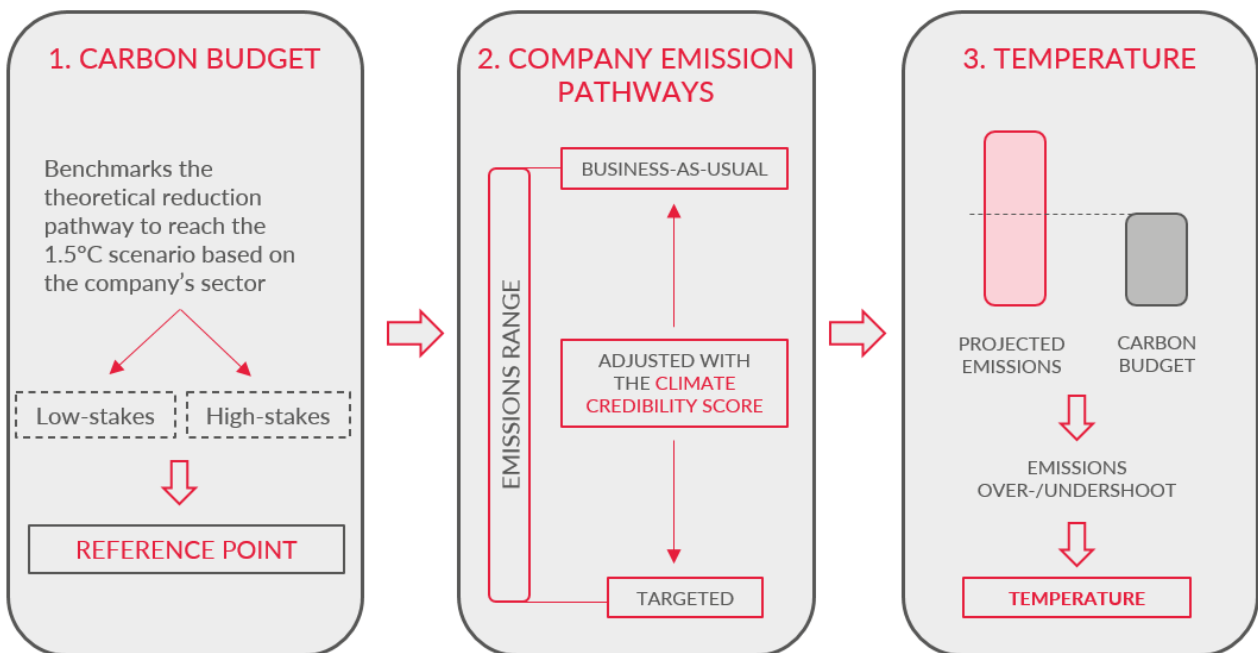
PRINCIPLE	EXPLANATION
GLOBAL WARMING SCENARIO CHOSEN	The 1.5°C scenario has been retained as the benchmark against which a company's performance is compared. This scenario was chosen because it is one of the most commonly cited climate thresholds and reflects the objective of the Paris Agreement to limit global warming to 1.5°C above pre-industrial levels. The associated scenarios used throughout the methodology, including to construct carbon budgets, are based on scientific research by the IPCC and IEA.
TEMPORALITY	The 2010-2050 period is considered to compare the company's cumulative emissions with the company's budgeted emissions. The base year chosen for this methodology is 2010, which is the reference year used by the IEA in most 1.5°C scenarios.
SECTORAL APPROACH	A sectoral approach is used for the decarbonisation pathways. The sectoral decarbonisation pathway differentiates high-emitting sectors (referred to as high-stakes) from low-emitting sectors (low-stakes) and treats them differently in the analysis (refer to section 7.1 for further details).
EMISSIONS INTENSITIES	This methodology uses emission intensities ⁸ rather than absolute emissions. Emission intensities are obtained by dividing the company's absolute emissions by its activity: $Intensity = \frac{Emissions}{Activity}$
EMISSIONS COVERED	All relevant scopes of CO ₂ e emissions are taken into account based on sector classification. For high-stakes companies, only material, sector-specific scopes are considered. For low-stake companies, all scopes (1, 2 and 3) of emissions are taken into consideration, and the carbon budget is determined by Ethos.
CLIMATE CREDIBILITY SCORE	Ethos distinguishes between a company's targeted emissions and its adjusted emissions. Targeted emissions represent the company's future emissions if it fully achieves its declared climate targets. Adjusted emissions include the climate credibility score made by Ethos, which adjusts the targeted emissions and gives the future credible emissions pathway.

⁸ Ethos is aware of the limitations of using intensities instead of absolute emissions from a climate protection perspective. In particular, a reduction in intensities does not necessarily correspond to a reduction in absolute emissions. While a reduction in absolute emissions remains at the heart of limiting global warming, emission intensities have been chosen as a benchmark as they allow comparisons to be made between companies of different sizes and activities.

6. Main methodological steps

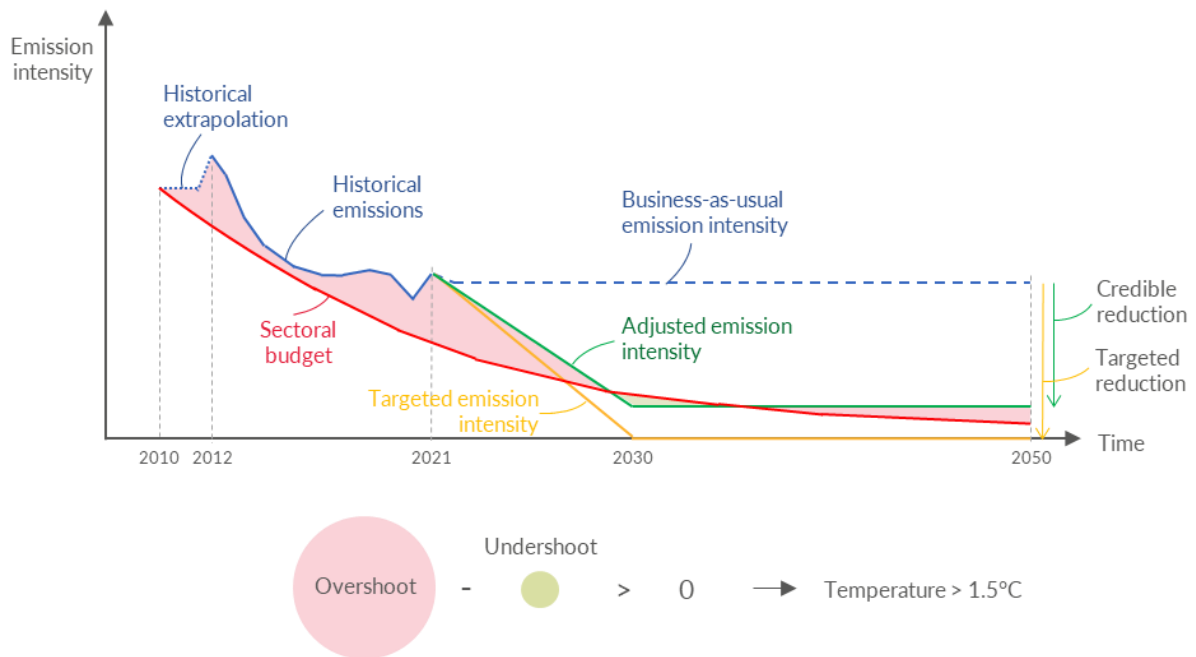
Based on these general principles, the following main steps allow the temperature score to be calculated for each company covered in Ethos' research universe :

1. Setting the carbon budget: This step sets the benchmark for the company's theoretical reduction pathway, in order to be aligned with a 1.5°C scenario. This pathway is determined by the following elements:
 - a) Sectoral classification of the company: A sectoral decarbonisation pathway is chosen so that companies are categorised by sector, differentiating between sectors with high decarbonisation challenges and having an impact on the emissions of companies in other sectors.
 - b) Determination of the carbon budget for companies operating in sectors without a decarbonisation approach: a hypothetical emissions reduction trajectory is determined for sectors without a specific decarbonisation budget
 - c) Determination of the carbon budget for companies operating in sectors for which decarbonisation pathways exist (high carbon intensity sectors): a specific hypothetical emissions reduction pathway is determined for each sector facing major climate challenges;
 - d) Company budget intensities: The sectoral carbon budget is translated into a hypothetical emissions pathway that the company should theoretically follow between 2010 and 2050 to be aligned with a 1.5°C scenario.



2. Estimating the company's emission pathways: Emission pathways need to be estimated according to different scenarios that reflect the company's possible level of climate action. The following steps are crucial:
 - a) Historical data collection and estimation corresponds to the collection of emission intensities from 2010 to the cut-off year which is the latest year of available company data.
 - b) The forecast of the company's activity corresponds to the company's activity level from the cut-off year to 2050.
 - c) Business-as-Usual intensities represent the future emissions pathway if the company maintains its current emission intensity.
 - d) Targeted intensities represent the emissions pathway if the company fully implements its declared targets.
 - e) Company climate credibility score and adjusted intensity represent the adjusted targeted emissions pathway taking into account the company's credibility and ability to meet its targets.
 3. Estimation of the company's temperature: the company's temperature score is obtained by comparing the company's adjusted emissions with the company's carbon budget.
- Each of these main steps is explained in the following sections.

TEMPERATURE SCORE GRAPHICAL REPRESENTATION



Graphical representation of historical (blue line), historical extrapolation (blue dotted line), business-as-usual (blue dashed line), targeted (yellow line), adjusted (green line) and budgeted emissions (red line) pathways in a case where the credibility is high. Detailed information on data collection and estimation is provided in section 8.

7. Setting the carbon budget

The carbon budget is the benchmark that allows an emissions pathway to be translated into a temperature score. It sets the amount of CO₂-equivalent (CO₂e) still to be emitted at the global level in the period 2010-2050 and provides a reference point against which a company's emissions are compared to obtain a temperature score.

Carbon budgets used by Ethos as part of this methodology are initially constructed from recognised sources, such as IPCC and the IEA. Their research estimates the total amount of CO₂ left to be released to limit global warming to a certain limit over a predefined time-period. The predefined limit represents a warming scenario, such as the 1.5°C scenario or the 2°C scenario. The scenario chosen here is 1.5°C (with a 67% probability) and the time period is set to 2010-2050, with a corresponding carbon budget of 748.33 gigatonnes of CO₂ (see section 9.1).

From this global amount of CO₂, there are several options for creating decarbonisation pathways across the economy. This methodology adopts a sectoral approach to decarbonisation: high-stakes sectors are treated differently from other sectors. High-stakes sectors have a dedicated sectoral budget that takes into consideration their specific decarbonisation potential. On the other hand, other sectors are expected to follow the global decarbonisation pathway, as explained in section 7.2.

Decarbonising sectors with high climate impacts is essential because it enables the decarbonisation of other sectors that depend on them. For example, if the energy sector is decarbonised, the indirect emissions of all other sectors of the economy can benefit from this decarbonisation. This is why these sectors are considered to have a high climate impact.

The company's carbon budget represents the theoretical reduction that a company should hypothetically achieve to be aligned with a 1.5°C scenario, given its sector. It takes the form of emission data points over the period 2010 until 2050, i.e. budgeted intensities.

CO₂ AND CO₂-EQUIVALENT BUDGET

The carbon budget must be disclosed in CO₂-equivalents and not only in CO₂. The IPCC mentions that non-CO₂ greenhouse gases can account for an uncertainty in the range of more or less 220 gigatonnes of CO₂. As there is no clear methodological reason to add or subtract this amount from the carbon budget, Ethos has chosen in this methodology not to add or subtract any budget related to non-CO₂ GHG emissions. Therefore, we assume that the budget in CO₂ is equal to the budget in CO₂e.

7.1 COMPANY SECTORAL CLASSIFICATION

The company's carbon budget is based on the classification of a company as high or low-stake sectors:

Low-stakes sectors refer to economic sectors where companies tend to have low emission intensities, meaning that they emit low amounts of GHG emissions per revenue they generate. The sectoral classification used is the one is the Global Industry Classification Standard (GICS) industry level. This includes sectors such as banking, telecommunications and media. In low-stakes sectors, the company's consolidated revenues are used as a measure of the [company's activity](#).

High-stakes sectors refer to economic sectors that tend to have high emission intensities, meaning that they emit large amounts of GHG emissions per activity generated and/or are linked to issues where the stakes for decarbonisation are high. These sectors are sometimes referred to as Sectoral Decarbonisation Approach (SDA) sectors, which is a methodology for generating carbon budgets for high-stakes sectors. The definition of high-stakes sectors is based on the work of the [Transition Pathway Initiative](#) (TPI). In high-stakes sectors, the company's physical units, i.e. tangible outputs, are used as the measure of the company's activity (see table 2).

TABLE 2 : LIST OF THE HIGH-STAKES SECTORS USED AND THEIR PHYSICAL UNITS.

SECTOR	PHYSICAL UNIT
Electric Utilities	MWh of electricity produced
Oil & Gas	primary energy supply in MJ
Steel	tonne of steel produced
Cement	tonne of cementitious product produced
Aluminium	tonne of primary and secondary aluminium produced
Automobile Manufacturers	expected lifetime kilometers driven by newly registered passenger cars
Airlines	revenue tonne kilometer (RTK) ⁹
Shipping	tonne-kilometer
Pulp and Paper	tonne of pulp, paper and paperboard produced
Diversified Mining	tonne of Copper Equivalent (tCuEq) produced

The sector in which a company operates and generates most of its revenue determines its carbon budget and influences the data points and units required to calculate the company's temperature. From a methodological perspective, the main differences between the two types of sectors are:

- The company's activity is expressed in revenue for low-stakes and in physical units for high-stakes sectors.
- Carbon budget benchmarks are constructed by Ethos based on the work done by the United Nations and the IPCC for low-stakes sectors while third-party data is used for high-stakes.

⁹ 'Revenue tonne kilometres' (or RTKs), is the total number of revenue-generating tonnes of both passengers and freight multiplied by the distance flown. This is different from revenue passenger kilometres' (or RPKs), which is the total number of paying passengers multiplied by the

SECTOR	COMPANY ACTIVITY	CO2E BUDGET
Low-Stakes	Revenue	Constructed by Ethos
High-Stakes	Physical Unit	Constructed by third parties

7.2 LOW-STAKES COMPANY BUDGET

Ethos constructs the carbon budget for low-stake companies based on two different time periods: from 2010 to 2019 and from 2020 to 2050. This construction is necessary as there is no global reduction pathway for the entire 2010-2050 period. The required emissions reduction path for each period is based on recognised sources:

- For the period 2010 to 2019, the [UN Emissions Gap Report](#) estimates that the absolute emission reduction factor that was needed in 2010 to limit global warming to 1.5°C was 3.3% per year [2].
- From 2020 to 2050, the [IPCC AR6 WG3 Table SPM.2 report](#) presents the global emission reduction pathways corresponding to different scenarios [1]. The scenario chosen in this methodology is the one that limits warming to 1.5°C with a 50% probability, with action starting in 2020. This scenario was then adjusted to a >67% probability based on data from the [IPCC AR6 WGI Table SPM.2](#) [3], which estimates the remaining carbon budget to be 400 gigatonnes of CO₂ from 2020 to 2050. A linear interpolation is made between each of the IPCC reduction thresholds (2030, 2040 and 2050) to obtain an annual reduction path.

The reduction rate given by the UN Emissions Gap report and the IPCC report is for absolute emissions. As this methodology uses emission intensities, the absolute reduction rate is adjusted using the two following parameters:

- The expected compound average annual real growth rate of the economy [4]: This allows the expected real GDP growth of the global economy to be taken into account when constructing an intensity reduction path for the economy as a whole. The expected annual real GDP growth rates given by the International Energy Agency are 2.6% between 2010 and 2020, 3.6% between 2020 and 2030, and 2.7% between 2030 and 2050. When taking GDP growth into account, the more the economy grows, the more

distance flown. TPI uses RTKs, otherwise the Carbon Performance of individual airlines with freight businesses that are significantly larger or smaller than average can be distorted.

the emissions intensity needs to decrease to stay on a fixed absolute emissions reduction path.

- The decarbonisation rate of the economy [2]: The historical decarbonisation of the economy is used as a baseline from which further decarbonisation is required to achieve absolute emission reductions. The annual decarbonisation rate used is 0.3%, as reported by the IPCC for the 2010-2019 period. It is assumed by Ethos to remain stable for the 2020-2050 period as there is no evidence of a different decarbonisation rate in the future.

This absolute emissions reduction path is then converted into an intensity reduction path using the observed global decarbonisation rate [2] and the global compound average growth rate [4]:

$$\begin{aligned}
 & \text{Intensity reduction path} = \\
 & \frac{\text{Absolute reduction path}}{\text{Decarbonation rate} \times \text{World average growth rate}}
 \end{aligned}$$

7.3 HIGH-STAKES COMPANY BUDGET

For high-stakes sectors, this methodology uses the work of the Transition Pathway Initiative (TPI) to obtain derive sectoral carbon budgets. The budgets are based on the Sectoral Decarbonisation Approach (SDA) and can be found on the [TPI website](#). The work of the TPI translates GHG emissions targets made at the international level into appropriate sectoral benchmarks against which individual company performance can be compared [5].

7.4 COMPANY BUDGETED INTENSITIES

The sectoral carbon budgets constructed in sections 7.2 and 7.3 provide budgeted intensities from 2010 to 2050. These intensities represent the hypothetical reduction path that a company should follow to be aligned with the 1.5°C scenario, given its sector.

Budgeted intensities are annual data points that represent a theoretical reduction pathway. However, it is the cumulative emissions over the period 2010 to 2050 that are essential for the temperature score. As there are multiple reduction pathways to achieve the allocated budget, a temporary overshoot may be offset by an undershoot of similar magnitude over the period.

8. Estimating the company's future emissions pathways

The budgeted intensities explained in the previous section need to be compared with the company's potential emissions pathways.

Several scenarios, reflecting different levels of climate action are considered to estimate the company's future emissions from the cut-off year to 2050:

- **Business-as-usual emissions intensities:** if the company maintains its current performance in terms of emission intensity (no targets, no reduction in emission intensity)
- **Targeted emissions intensities:** if the company meets its targets entirely.
- **Adjusted emissions intensities based on Ethos' climate credibility score:** only if the credible share of the reduction is taken into account in the targeted intensities.

These scenarios represent different projections of emissions intensities. They are based on historical data and forecasts of the company's activity. These two processes are explained in sections 8.2 and 8.3. Sections 8.4 to 8.5 describe each of the possible emission scenarios and their derived intensities in detail.

8.1 HISTORICAL DATA COLLECTION AND ESTIMATION

As the company's emissions pathways are constructed until 2050 based on historical data and are expressed in intensities, it is necessary to collect and estimate the company's emissions and activity from 2010 to the cut-off year.

The data is mainly obtained from the companies or from third-party providers. Ethos' analysts carry out additional research to verify the data and make appropriate changes to retain the most relevant data, while keeping track of and justifying the modified data. To deal with missing data points in historical data, Ethos uses various imputation methods such as linear interpolation, neighbourhood averaging, and mean/median replacement. Forward-looking estimates are based on a set of internally consistent assumptions about future socio-economic conditions and related mitigation measures. They are quantitative projections and are neither predictions nor exact forecasts.

The emissions data collection process is generally the same for all the sectors. The relevant scopes for the high-stakes sector will differ, as will the activity unit (physical or revenue) used to derive emissions intensities. Companies in high-stake sectors will have intensities expressed in tCO₂e/physical units, while companies in other sectors will have intensities expressed in tCO₂e/million of revenues USD.

Historical emissions intensities, from 2010 to the cut-off year, are derived using known absolute emissions and activity disclosed by the company and/or from third-party data providers. Emissions may be reported in relative terms (i.e. in intensities, but not necessarily the same intensity unit as the one used in this methodology), or in absolute terms.

Ethos' methodology does not take into account avoided emissions (i.e. emissions savings that occur outside a company's value chain) as there is currently no accepted calculation method.

8.1.1 MISSING DATA POINTS

If the company never published any data and no historical intensities are available from external sources, the following hypothesis is used to estimate the company intensities by scope at the cut-off year:

$$\text{Past intensity of the company} = \text{Sectoral 3rd quartile} + (1.5 * \text{interquartile range})$$

The use of this specific statistical threshold based on the company's sector means that the company's intensity is considered to be equal to the worst intensities of its sector, excluding outliers. Ethos has chosen this method in order to disfavour companies that do not report on climate change. It is also based on the assumption that companies with poor reporting are more likely to have a high intensity compared to other companies in their sector as they have no known strategies or measures in place. For all other previous years, intensities are assumed to remain constant at the intensity of the cut-off year's¹⁰.

If emissions data points are missing in the period from 2010 to the cut-off year and at least one year with known intensities could be derived for another year, two cases arise:

- a) If the company already existed, i.e. an activity data point is available, but emissions data are missing for all scopes (1, 2 and 3): historical intensities are estimated based on the average of the last three known intensities.
- b) If no activity data point is available: historical intensities are not estimated as the company may not have existed. As a result, the company's temperature score will be calculated using data from the first available year of activity after 2010.

¹⁰ It should be noted that 2020 was a particular year in terms of emissions because of the COVID-19 pandemic, which may impact the companies' intensities. While both emissions and activity may have seen a decrease during the COVID-19 pandemic, one could think that the intensity would remain at similar levels. However, the data suggests otherwise: the activity may have decreased more than the emissions, given that some of the companies have incompressible emissions. The

8.2 FORECASTING THE ACTIVITY OF THE COMPANY

As the company's emissions pathways are forward-looking and expressed in intensities, it is necessary to forecast the company's activity from the cut-off year until 2050.

In this methodology the future company revenues are estimated using the following method and parameters, similarly for all sectors:

The statistical Exponential Damped Trend Method (EDTM) is used. This method looks at past trends in company's revenue to extrapolate projected future revenue. It uses a damping parameter that limits a company's growth or degrowth to reasonable levels (i.e. avoids exponential growth/degrowth). It is estimated using the least squares method, and lower and upper bounds are based on existing literature¹¹ and empirical results.

A maximum degrowth parameter limits the degrowth of companies to a 50% reduction in activity. This parameter is necessary because empirical results show that activity forecasts reach zero or negative activity levels, given the historical activity of the company. It is assumed that companies will not reduce their activity by more than 50% compared to the last known activity value. The 50% threshold is based on Ethos' assessment of the most likely threshold at which companies usually delist, merge or file for bankruptcy. In addition, the definition of a maximum degrowth parameter avoids disproportionately favouring companies with a significant decline in activity in recent years, which has sometimes occurred due to the COVID-19 pandemic or other punctual external factors.

The EDTM method was chosen because it corresponds to the expected evolution of company activity, as it is based on past trends:

- If the company's activity has been decreasing in recent years, it is expected to continue to decrease, but not to zero or negative levels of activity, unless the company has a structural issue.
- If a company's activity has been increasing in recent years, it is expected to continue to grow, but not at the same rate. It is expected to have a decreasing growth rate for economic and physical reasons.

The results obtained are not intended to predict the future activity of a company, but rather the likely evolution of its activity given its self-declaration and past activities.

opposite may also be true if the share of incompressible emissions is relatively small for a given company. As a result, the intensities are impacted and this should be kept in mind when interpreting the results.

¹¹ "Forecasting: Principles and Practice"; Rob J Hyndman and George Athanasopoulos; Monash University, Australia

8.3 BUSINESS-AS-USUAL-INTENSITIES

The business-as-usual (BaU) scenario is one in which no emissions reduction target is included, i.e. the company maintains its current climate performance in terms of emission intensity.

BaU intensities are based on historical data that are projected into the future, starting from the cut-off year until 2050. To determine the future business-as-usual emission intensities, the first step is to obtain the historical emissions, activity and intensity data (prior to the cut-off year) as explained in section 8.1. Then, based on the historical data, the methodology defines that:

Future business as usual intensities
= Average of the 3 most recent known intensities

Future intensities are estimated using the average of the 3 most recent historical intensities, provided there is at least one known data. This estimation assumes that, in a business-as-usual scenario, companies' emissions change at the same rate as their economic activity, as both measures are coupled. As a result, the intensity will remain constant in the future. A three-year average is used to limit volatility due to punctual events such as a pandemic.

8.4 TARGETED INTENSITIES

The targeted emissions pathway represents the company's emissions from 2010 to 2050 if the company achieves 100% of its GHG emissions reduction targets. Targeted intensities take into account the targets set by the company and assume that these targets are fully met. To construct targeted emissions intensities, the company's targets are required and should be transformed into a standardised format.

8.4.1 TARGETS CONSIDERED

Companies are very heterogeneous in the way they report their GHG emissions reduction targets. It is necessary for this methodology to have a single format for targets: the reduction in the company total emissions intensity (all scopes) compared to a baseline year.

Targets are derived primarily from self-declared targets reported by companies in the CDP questionnaire and completed where necessary with the company's reporting. For each of the company's targets, the following elements are collected and may need to be translated into a standardised format:

- Timeline: baseline year and the target year
- Coverage: percentage and scopes covered

› Emissions that are not in the scope of the target are said to be uncovered. These uncovered emissions are not affected by a company's target.

- Absolute or intensity: the target is translated into absolute terms if given in intensities, using the activity as defined in section 7.1

8.4.2 TARGETED INTENSITIES CALCULATION

Once targets are expressed in a similar format, the targeted emissions pathway for the company is constructed. Companies often set several targets, which sometimes overlap. In order to determine the company's targeted emissions pathway, the targets need to be combined, taking into account the target coverage and different time periods (2030, 2050, etc.). The following hypotheses are made:

1. The GHG emissions reduction path for a target between a baseline year and a target year is linear.
 - a) Ethos assumes that the company will make the same GHG emissions reduction effort each year, unless stated otherwise by the company.
2. For overlapping targets (in scope and time-period), the target set at the most recent date is used, and the other is discarded.
3. To aggregate targeted emissions when the company sets overlapping targets, several cases exist:
 - a) If the targets overlap in scope, have the same base year and target set date, but differ in the target year, the target with the lowest target year is used until its target year. After the target year of this first target, a linear interpolation is made between the first target emissions and the second target emissions. This case is very common and happens when companies set a 2030 target for their scope 1 and 2 as well as a 2050 target for their scope 1, 2 and 3 for instance.
 - b) If the targets cover the same time-period, have the same target set date and the scopes covered overlap, then the average between the linear interpolations of the two targeted pathways is considered over the time period. This case is not common but may happen when companies set an intensity and an absolute target at the same time, for the same scope with the same target year.
4. If the company does not have a target after a specific year within the 2010-2050 timeframe, it is assumed that the targeted emission intensity remains constant after the last known target year. In fact, if the company does not set a target, it is assumed that it will not achieve any additional intensity reduction.

Based on these hypotheses, targeted intensities are calculated and take the form of data points for each year from the cut-off year to 2050.

THE CLIMATE AMBITION SCORE

The climate ambition score measures whether the targets set by the company are ambitious enough in terms of climate protection to be aligned with the 1.5°C scenario. It is obtained by computing the average ratio of the targeted intensities to the company's budget each year from the cut-off year to 2050.

If the targeted intensities are equal to the company's budget over the period, it indicates that the targets set are ambitious enough for a 1.5°C scenario and the ambition score is equal to 1 (100% ambitious).

Conversely, if the targeted intensities are higher than the company's budget over the period, the targets are not considered ambitious enough to reach the 1.5°C scenario. For example, an ambition score of 50% means that the company plans to reduce on average only half of what is required to be aligned with a 1.5°C scenario.

company's overshoot or undershoot of its allocated carbon budget.

The climate credibility score is necessary because a significant number of companies have set ambitious sustainability targets in the past without reaching them, as Ethos' empirical data has shown. A study¹² has also shown that European companies that have published climate targets are not very effective at explaining how they intend to achieve their targets (specific actions, costs of actions, expected emission reductions for each action, cost per unit of GHG emissions abated), which creates a risk that the targets will only be partially achieved. A survey has shown that only 11% of the surveyed companies had reduced their emissions in line with their ambitions over the five years prior to the survey¹³.

Ethos' climate credibility score is based on three components:

1. The achievement of the company's past and ongoing targets, referred to as the target achievement credibility assessment,
2. The company's **ACT** rating (Assessing low-Carbon Transition), if available,
3. The use (actual or planned) of carbon sinks.

8.5 COMPANY CLIMATE CREDIBILITY SCORE AND ADJUSTED INTENSITY

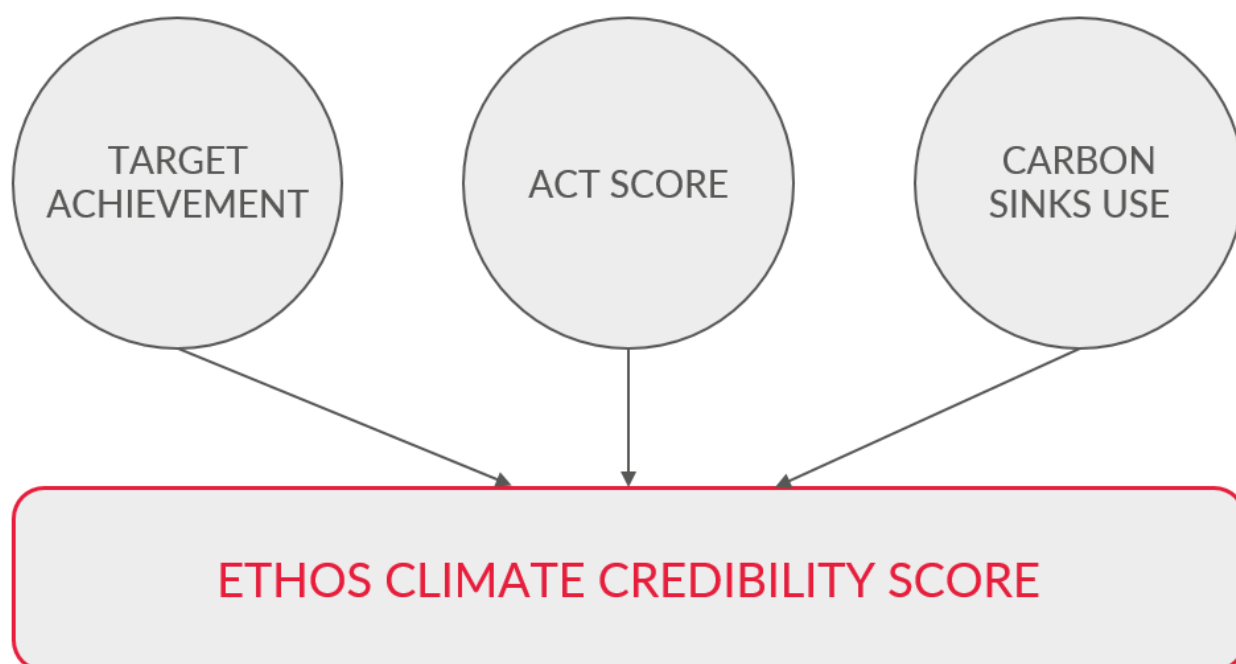
The key factor to the Ethos temperature score is the assessment of the company's credibility. In the previous sections, we explained how to get emissions intensities in two different scenarios: if the company continues as it did in the past (business-as-usual intensities) and if the company fully achieves its targets (targeted intensities). This is where other existing methodologies on transition assessments usually stop, whereas Ethos goes further.

The climate credibility score makes it possible to estimate the proportion of the targets set by the company that can be credibly expected to be achieved. This is expressed as a percentage of the targets set. When applied to emissions intensities, the credibility score gives the adjusted intensities.

The credibility of the company's reduction targets is a crucial part of the temperature score construction. The adjusted emissions are central to the calculation of the

¹² Sullivan, R. (2010). An assessment of the climate change policies and performance of large European companies. *Climate Policy*, 10(1), 38-50. <https://doi.org/10.3763/cpol.2008.0591>

¹³ BCG (2021), Use AI to Measure Emissions—Exhaustively, Accurately, and Frequently, <https://www.bcg.com/publications/2021/measuring-emissions-accurately>



8.5.1 COMPANY TARGET ACHIEVEMENT CREDIBILITY FACTOR

The starting point for the climate credibility score is the company's achievement of its past and current targets.

A company's ability to achieve its voluntary targets can be assessed in part by analysing its performance in achieving past targets and its current achievement of its ongoing targets. The weighted average target achievement is the parameter that will influence the credibility score of the company. The weighting of each individual target is determined based on the current share of emissions covered by the targets compared to the total emissions covered by targets.

The same targets considered to calculate the targeted intensities are used to calculate the target achievement credibility factor. Targets that a company chooses to remove (i.e. removed targets) are also included in this factor. These removed targets add information to the credibility calculation, as the company may choose to remove a target it has difficulties to achieve.

For each of the company's target, three different cases are possible:

- The target is in the past (i.e. target year is before the cut-off year): the final achievement rate of the target gives the specific target achievement and credibility.
- The target is ongoing for 3 years or more: the current adjusted achievement rate of the target gives the target credibility. The adjustment is explained in the following subsection.
- The target is ongoing for less than 3 years: the global average achievement rate of all companies in Ethos'

universe past and ongoing targets (for 3 years of more) is assigned to the target. This is because the target is considered too recent to contain sufficient target-specific information.

For all targets, targeted emissions are estimated based on the percentage of emissions covered by the target, similar to the estimation of future targeted intensities. The uncovered emissions are estimated to be the same percentage of emission in the target year and follow the reported/estimated emissions.

If the target is given as an intensity, it is converted into absolute terms by multiplying the intensity by the activity of the company.

CALCULATION OF THE ONGOING TARGET CREDIBILITY

For all ongoing targets, i.e. those with a target year later than the cut-off year, the credibility is calculated based on the achieved target progress (how much the company has managed to reduce its emissions at the cut-off year) and the target timeframe (the percentage of time that has elapsed at the cut-off year compared to the time between the cut-off year and the target year).

AGGREGATION TO OBTAIN THE COMPANY'S TARGET ACHIEVEMENT CREDIBILITY FACTOR

Once all company's individual target achievements have been calculated, the aggregation at the company level depends on the current share of emissions covered by each target compared to the total emissions covered by all company's targets.

8.5.2 ACT ASSESSMENT

The second credibility component is the ACT (Assessing Low-Carbon Transition) Assessment. ACT is an initiative launched by the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC) to encourage companies to place themselves on a trajectory compatible with global warming of less than 2°C. To achieve this objective, two of its founding members, the Agence de l'Environnement et de la Maîtrise de l'Énergie (ADEME) and the Carbon Disclosure Project (CDP), have jointly developed a methodology that allows a sectoral assessment of companies' transition plans.

The ACT score is a number on a scale ranging from 0 to 20 that reflects the degree of alignment of the company's strategy with sectoral decarbonisation trajectories.

In this methodology, the ACT score is used as an indicator of the credibility of a company's ability to achieve its climate targets. The rationale for using the ACT assessment, is that the elements assessed by this methodology are those that are likely to influence a company's ability to reach its targets. ACT evaluates among other things the objectives and priorities, the activities and decision-making processes, the value chain, the roles, responsibilities and remuneration, the skills and the culture of a company¹⁴. The ACT methodology is also recognised by the Glasgow Finance Alliance for Net zero (GFANZ) as a tool for assessing the credibility of transition plans and for investors to engage with companies¹⁵.

Once the company has been assessed using the ACT methodology, the current target credibility factor is set according to the following equation:

$$\text{Company ACT credibility factor} = \frac{\text{ACT score}}{20}$$

For example, if a company scores 16 out of 20 points on the ACT evaluation, it is assumed that the company will be able to reduce its emissions by 80% between the adjusted emissions and the climate target, and the ACT credibility factor is set at 0.8.

8.5.3 CARBON SINKS

The third component of the climate credibility score is the use (actual and planned) of carbon sinks. Carbon sinks are considered in Ethos' credibility score as a low-credibility solution that companies can use due to the numerous limitations of carbon sinks.

There are currently two issues regarding how carbon sinks are taken into account in a company's net climate impact:

1. Carbon sinks have limitations that make it incorrect to interpret that effectively reducing a certain amount of emissions is equivalent to financing the same amount of CO₂e absorption in carbon sinks.
2. Data on carbon sinks is still scarce and therefore a method needs to be developed to estimate how much a company relies on carbon sinks in its climate strategy. The issue arises from the observation that companies often report implicitly (or do not report) their intended use of carbon sinks.

Ethos' methodology therefore proposes solutions to these issues by:

1. Defining how to translate a company's reduction of **net emissions** achieved through carbon sinks into a reduction that considers the limitations of carbon sinks. This is done using a carbon sink equivalence factor (see below);
2. Determining the extent to which a company intends to use carbon sinks in its climate strategy if not reported directly by the company, by
 - a) Estimating a company's use of carbon sinks;
 - b) Calculating a company's fair share of carbon sink;
3. Constructing the carbon sinks credibility factor.

CARBON SINKS EQUIVALENCE FACTOR

The carbon sink equivalence factor aims to bridge the gap between the company's emissions and the company's contribution to carbon sinks in the context of the company's climate protection target. Carbon sinks have multiple limits, which imply that reducing one tonne of CO₂e cannot be equivalent to financing one tonne of CO₂e of carbon sinks. Ethos constructs this factor to consider carbon sinks in the company's climate target with as much climate science rigour as possible. Ethos believes that it is essential for companies to implement measures to effectively reduce their emissions. Financing

¹⁵ GFANZ (2022), Expectations for Real-economy Transition Plans <https://assets.bbhub.io/company/sites/63/2022/09/Expectations-for-Real-economy-Transition-Plans-September-2022.pdf>

carbon sinks should be seen as a complementary measure to the required absolute emission reductions.

Only natural carbon sinks are included in this methodology, as artificial carbon sinks are currently not available to companies on a significant scale. The current state of the market for carbon sink projects is that the majority of projects are forest management activities in developing countries¹⁶.

The major limitations of carbon sinks are additionality, fragility, permanence, time-lag, estimation uncertainties and limited global carbon sink capacity. An equivalence factor is estimated for each of these limits. For example, regarding the fragility of carbon sinks, most natural carbon sinks may have issues capturing carbon in the long term and these issues will be exacerbated by climate change [1]. Carbon sinks are particularly vulnerable to forest fires. Assuming an annual probability of forest burning of 0.12% over 100 years, the equivalence factor is estimated to $(1 - 0.0012)^{100} = 88.7\%$.

Such an estimate is made for each limitation and aggregated by multiplication to obtain the global carbon sink equivalence factor. This factor is estimated to be 13.3%. This means that for every tonne of carbon that the company calculates to have been absorbed in carbon sinks, 0.133 tonnes of the company's emissions can theoretically be removed from its climate target carbon emissions budget.

ESTIMATION OF A COMPANY'S USE OF CARBON SINKS

As data on carbon sinks is still decentralised and difficult to access, Ethos follows the steps below when limited data on the company's use of carbon sinks is available:

1. If the company plans to use carbon sinks and communicates how much, then the amount is converted, if necessary, into the number of sinks planned to be used in 2050;
2. If the company plans to use carbon sinks but does not communicate how much, then the company is assumed to offset its credibility adjusted "fair share" with carbon sinks. Similarly, if the company does not indicate whether it plans to use them, it is assumed that the company will use them for its "incompressible" emissions and will therefore develop its "fair share" of sinks.

The company's "fair share" of carbon sinks represents the quantity of carbon sinks that the company should finance or develop in its value chain in order for the global economy to limit climate change to a 1.5°C warming. Calculating a company's "fair share" contribution to carbon sinks not only help to overcome the lack of data

availability, but also allows to translate what it should mean for a company to set a net-zero target.

The "fair share" of carbon sinks that a company should develop is based on the idea that at any given time, the company's sinks/emissions ratio should be equal to the sinks/emissions ratio in the 1.5°C scenario for the area it operates in¹⁷. This means that for all companies, the amount of sinks financed or developed in 2050 should be equal to the company's carbon budget in 2050¹⁸.

This information leads to three ways of calculating a company's carbon sinks in this methodology:

1. The company reports its estimated carbon sinks in 2050;
2. The company reports its current use of carbon sinks. In this case, the estimated carbon sinks in 2050 are assumed to be at least equal to the current carbon sinks. This assumes that the company will not contribute less to carbon sinks than its current contribution;
3. The company's target in 2050 is less than its 2050 carbon budget, so the difference between its budget and the 2050 target is assumed to be met through carbon sinks. If a company's targeted net emissions are equal or above its carbon budget, it is assumed the company's reported targets is its target for its **gross emissions** (unless specified otherwise), and that no carbon sinks are planned to be used.

The minimum of the three calculations is taken as the final carbon sinks estimate in 2050 as it is necessary to ensure that the estimate is correct even if the company's reporting is unrealistic or contains errors.

For example, if a company reports that it will use carbon sinks equivalent to -30'000 tCO₂e in 2050, and the estimate of the company's carbon sinks in 2050 with its target compared to its budget is -500'000 tCO₂e, then this methodology assumes that the company has underestimated its carbon sinks use in 2050.

CARBON SINKS CREDIBILITY FACTOR

The carbon sinks credibility factor is calculated based on the carbon sinks equivalence factor and the company's estimated use of carbon sinks. This factor determines the share of carbon sinks that can be credibly achieved in 2050 compared to the targeted use of carbon sinks.

The carbon sink credibility factor aims to show the extent to which the company relies on carbon sinks to achieve the reductions set out in its climate objectives.

Thus, the more a company relies on carbon sinks to reduce its emissions, the lower its carbon sinks credibility

¹⁶ Forest Trends' Ecosystem Marketplace, Voluntary Carbon and the Post-Pandemic Recovery. State of Voluntary Carbon Markets Report, Special Climate Week NYC 2020 Installment. Washington DC: Forest Trends Association, 21 September 2020

¹⁷ Bettin, R., & Dugast, C. (2020). A framework for collective carbon neutrality : Executive summary. Carbone 4.

¹⁸ Carrillo Pineda, A., Chang, A., & Faria, P. (2020). Disclosure insight action foundations for science-based net-zero target setting in the corporate sector. SBTi.

factor will be, and the less credible its emission reduction targets will be.

8.5.4 COMPANY CLIMATE CREDIBILITY SCORE

The overall climate credibility score is the sum of all the above-mentioned factors that apply to a company:

$$\begin{aligned}
 & \textit{Overall credibility} \\
 & = [(0.15 \times \textit{Target Achievement credibility}) \\
 & \quad + (0.85 \times \textit{ACT credibility})] \\
 & \quad \times \textit{Carbon Sinks credibility}
 \end{aligned}$$

(or the company does not have any target), and the adjusted emissions are equal to the business-as-usual emissions. Therefore, the closer a company's credibility score is to 0, the less likely it is to meet its climate targets. This means that the company's temperature will be higher.

Where each factor has a value between 0 and 1.

The weights between the target achievement credibility and ACT credibility are based on the ACT methodology. The weight assigned to the target module in the ACT assessment is 85%, which was derived from a public consultation over the ACT methodology, involving relevant stakeholders. If the company does not have an available ACT assessment, the ACT credibility is not included in the calculation and the target achievement credibility factor weight is 1.

The carbon sinks credibility is then multiplied by the result of the Target Achievement and ACT credibility factors as it is considered to be an independent credibility factor.

8.5.5 ADJUSTED INTENSITIES

Once the climate credibility score has been calculated, a company's adjusted intensities can be constructed, which correspond to Ethos' estimation of the company's future emissions when taking into account the credibility score. The adjusted intensities will be between the business-as-usual intensities (section 8.3) and the targeted intensities (section 8.4).

The company's adjusted emissions can be interpreted as the difference between business-as-usual emissions minus the credible share of the targeted reduction.

By definition, the climate credibility score is between 0 and 1.

If the company's credibility is scored as 1, this means that the company's future targets are assessed to be fully (100%) credible, and that the adjusted emissions are equal to the targeted emissions. Therefore, the closer a company's credibility score is to 1 the, the higher the probability calculated by Ethos that the company will achieve its climate targets. This means that the company's temperature will be lower.

Conversely, if the company credibility is equal to 0, the company's targets are considered to be implausible (0%)

9. Estimating the company's temperature

To obtain the temperature score, the company's adjusted emissions (section 8.5.5) must be compared to its carbon budget (section 7.4) for each year of the 2010-2050 period. When this annual comparison is complete, we obtain a total **carbon budget over/undershoot** for the company. This over- or undershoot is then converted into a temperature score using a warming function based on the global carbon budget.

9.1 GLOBAL CARBON BUDGET

To calculate a temperature for a company, the carbon overshoot/undershoot must be compared to the global carbon budget for limiting global warming to 1.5°C. The planetary carbon budget remaining in early 2019 to have a 67% chance of limiting warming to 1.5°C is 400 gigatonnes of CO₂ [3]. The budget to be used in the methodology is the budget remaining at the beginning of 2010 (baseline year chosen by Ethos). To do this, the emissions between 2010 and 2019 must be added to the remaining budget in 2019. These emissions amount to 348.33 gigatonnes of CO₂.

Consequently, the remaining carbon budget in 2010 to limit warming to 1.5°C (>67%) is: 400+348.33 = 748.33 gigatonnes of CO₂ which we convert in 748,33 gigatonnes CO_{2e} as explained in section 7.

9.2 OVERSHOOT/UNDERSHOOT IN A TEMPERATURE SCORE

The methodology then looks at the emission trajectory required to stay within this 1.5°C carbon budget. This is then compared to a theoretical global emissions trajectory that would result if all companies had the same level of performance of climate protection as the company being assessed. The comparison results in a global carbon overshoot /undershoot which is calculated as follows:

$$\begin{aligned} & 1.5^\circ\text{C World emission over/undershoot ratio} \\ &= \frac{1.5^\circ\text{C World emission over/undershoot}}{\text{Remaining } 1.5^\circ\text{C budget}} \end{aligned}$$

By definition of the temperature score, we have:

$$\begin{aligned} & 1.5^\circ\text{C world emission over/undershoot ratio} = \\ & 1.5^\circ\text{C company emission over/undershoot ratio} \end{aligned}$$

The ratio of company emission overshoot/undershoot is then given by:

$$\begin{aligned} & 1.5^\circ\text{C company emission over/undershoot ratio} \\ &= \frac{\text{Company cummulative emissions} - \text{Carbon budget}}{\text{Carbon budget}} \\ &= \frac{\text{Emission over/undershoot}}{\text{Carbon budget}} \end{aligned}$$

9.3 TEMPERATURE SCORE

For its emissions-to-temperature factor, Ethos uses the Transient Climate Response to Cumulative Emissions (TCRE) factor, which is subtracted based on data from the IPCC AR6 WGI Table SPM.2, which provides the remaining planetary carbon budget of 400 gigatonnes of CO₂ and the corresponding additional global warming up to a temperature limit of 0.43°C [3]. This gives a TCRE factor of 0.001075 °C warming/GtCO₂¹⁹. This value is an approximation for a 67% probability of limiting global warming to 1.5°C²⁰, which is within the likely range formulated in IPCC AR6 WGI chapter 5 of 1.0°C–2.3°C per 1000 PgC [3].²¹

Given the TCRE definition and the “1.5°C global emission overshoot/undershoot ratio” equation, the temperature score formula used for each company is as follows:

$$\begin{aligned}
 \text{Temperature score} = & \\
 & 1.5^{\circ}\text{C} \\
 & + (\text{Remaning planetary } 1.5^{\circ}\text{C Budget} \\
 & \times \text{Company emission } 1.5^{\circ}\text{C over/undershoot ratio} \\
 & \times \text{TCRE})
 \end{aligned}$$

If the company emits more than its budget (overshoot), the ratio will be positive and greater than 0, raising the temperature score above 1.5°C. If the company emits less than its budget (undershoot), the ratio will be less than 0, maintaining the temperature score below 1.5°C. Finally, if the company emits exactly the amount of its budget, the ratio will be equal to 0 and the temperature score will be equal to 1.5°C.

EXAMPLE

If a company has a 1.5°C carbon budget of 1'000'000 tCO₂e over the 2010-2050 period and its total adjusted carbon emissions over the same period are 3'000'000 tCO₂e, then its emissions overshoot ratio is 2. Using the temperature score formula, we obtain:

$$\begin{aligned}
 & \text{Temperature score} \\
 & = 1,5 + (0,001075 \times 748,33 \times 2) = 3,11 \text{ }^{\circ}\text{C}
 \end{aligned}$$

9.4 PORTFOLIO TEMPERATURE AGGREGATION

The temperature score as obtained in the previous section is company specific. When considering a portfolio, the temperature scores of all relevant companies need to be aggregated into a portfolio temperature score.

This methodology uses the carbon budget approach, as recommended in the PAT report, which states that it is one of the most scientifically robust method [7], as it “based on the same physical science principles than the climate system” but it is highly dependent on data availability and quality. This approach assigns greater weight to high emitting companies with high sectoral reduction objectives.

The portfolio temperature is calculated as follows:

$$1.5^{\circ} + \left\{ 748.33 \times \frac{\sum_{i=1}^N \text{owned cumulative emissions}_i}{\sum_{i=1}^N \text{owned cumulative budget}_i} \times 0.001075 \right\}$$

¹⁹ GtCO₂: gigatonnes of CO₂

²⁰ IPCC WGI, AR6 Technical summary, Chap. TS.3.2, p. 94.

²¹ PgC: petagrams of carbon (1 PgC = 1 GtC)



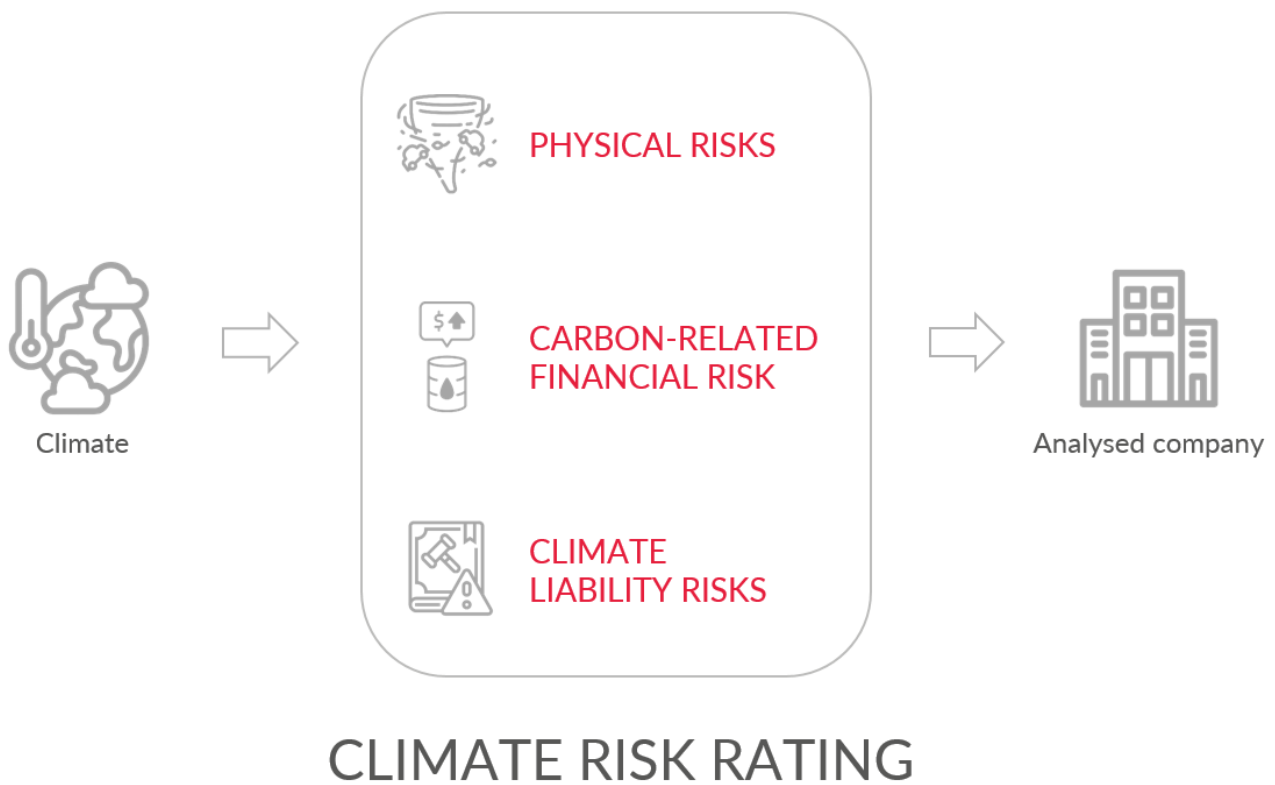
CLIMATE RISK RATING

10. Climate Risk Rating

The second aspect of Ethos' climate transition ratings is the Climate Risk Rating, which evaluates the impact of climate change on a company. This is done by assessing and rating a company's exposure against a set of material climate-related risks.

The Climate Risk Rating considers three risks that are considered as the most material:

- Physical risks, which assess the exposure to the consequences of climate change, including more frequent and severe natural hazards;
- Carbon-related financial risk, which considers the impact of rising carbon prices on corporate earnings;
- Climate liability risks, which evaluate the risks of a company facing climate-related litigation due to unsustainable practices.



10.1 PHYSICAL RISKS

The physical risk level represents the extent to which a company is exposed to physical risks associated with climate change. For example, it evaluates whether the company has assets in an area that could be inundated by rising sea levels or that could be subject to more frequent and severe natural hazards.

The exposure to physical risks is estimated using externally sourced indicators that include the company's sensitivity score and physical risk score for water stress, wildfires, heat- and cold-waves, floods and hurricanes. Physical risk exposures are additive between indicators and company-level sensitivity to each indicator is considered as a risk multiplier. The final score is calculated using a logarithmic curve designed to highlight companies with high-risk exposure and sensitivity to one or more indicators.

The result is a score ranging from 1-100 that represents the physical risk to a company in 2050 from to climate change under a moderate GHG emissions reduction scenario. A moderate climate change scenario, which is more likely than not to result in warming in excess of 2°C by 2100, is chosen as the aim is to evaluate the risks associated with the consequences of climate change.

10.2 CARBON-RELATED FINANCIAL RISK

The carbon-related financial risk reflects regulatory transition by evaluating the impact of rising carbon prices on company earnings. It looks at the financial risk a company faces if it has to pay its climate bill. The higher the carbon price, the greater the impact on a company's earnings and the higher the carbon-related financial risk becomes. Carbon prices are applied to companies' scope 1, 2 and 3 emissions to address the full spectrum of carbon-related financial risk.

The methodology uses research and data from third-party data providers, based on the OECD and IEA research, exploring different carbon prices scenarios (low, medium or high). Each different carbon price represents different ambitions for the implementation of the Paris Agreement. The high carbon price represents the implementation of policies that are considered sufficient to reduce greenhouse gas emissions in line with the goal of limiting climate change to 2°C by 2100 (the Paris Agreement).

As the objective of the carbon-related financial risk assessment is to evaluate the exposure of companies in the context of a transition with the aim to limit global warming to 1.5°C, the high carbon price level is chosen for this methodology with a time horizon of 2050.

The corresponding data point used is the unpriced carbon cost, i.e. the difference between what a company pays for carbon today and what it might pay in the future, as a percentage of the company's EBIT with a high carbon

price in 2050, capped at 100%. Analysed companies are then ranked based on their exposure to transition risks and the carbon-related financial risk rating is constructed in relative terms.

10.3 CLIMATE LIABILITY RISKS

The climate liability risk level aims to address the risk of litigation arising from a company's unsustainable practices, with a focus on the company's negative impact on climate change. As such, the frequency and likelihood of success of the potential lawsuits are assessed to derive the litigation risk exposure.

An empirical approach is used to assess the litigation risks associated with climate change. The approach looks at the current and past climate litigations against companies around the world. Three main explanatory factors are chosen to derive the exposure risk factors:

- **Jurisdiction:** the location of a company's headquarters changes the legal context in which the company operates;
- **Sectors of activity:** the company's sector of activity provides information on the company's role in climate change from the point of view of the public and the authorities;
- **Size of the company** (determined by the total revenues in exposed sectors): the larger the company, the more it is exposed to public and government scrutiny and the greater its absolute impact on climate change.

For the jurisdiction risk factor, the analysis is based on the Climate Laws Database [8] and the Global Trends in Climate Change Litigation (1986-2022) [9]. Based on the number of cases identified, a proportional risk factor is assigned to each jurisdiction. For the jurisdiction where no cases have been recorded, the jurisdiction risk factor is set to 0.

For the sectoral risk factor, the evaluation is based on data from the Grantham Research Institute on Climate Change and the Environment [8]. Focusing on lawsuits against corporations, the sector of energy was identified as the most exposed considering the high number of cases [10]. A proportional risk factor was applied to other sectors based on their number of cases. If a sector does not have any cases, the coefficient is set to 0 and the sector is not taken into account.

Within the sectoral identification, the size of the company, proxied by its share of revenues, is used to further differentiate companies within sectors and eliminate those whose business models (and revenue) expose them less to litigations than sectoral peers. To do so, Trucost green activity list is used and the share of green revenue is removed from the total revenue.

The size risk factor allows to differentiate larger companies, using a threshold based on the absolute aggregated revenue in brown sectors. The threshold is set at USD 2 billion of revenue from identified activities. If a company's absolute aggregated brown revenue is above 2 billion, the size factor is set to 1, and 0 otherwise. This threshold is based on the empirical analysis of current and past climate litigations and companies involved.

To obtain the aggregated Climate liability Risk Adjusted Share (CLRAS), the three factors are combined by multiplication. In the case of a risk factor is 0, the CLRAS is also 0. In this case, it is assumed that the climate liability risk is not relevant for this company.

10.4 CLIMATE RISK RATING

In order to assess the impact of climate on the company, the Climate Risk Rating is constructed by aggregating the assessment of the physical, carbon-related financial and climate liability risk levels:

- If the Climate liability Risk Adjusted Share (CLRAS) is relevant for the company, the three climate risk levels (physical risks, carbon-related financial risk and liability risks) are weighted equally;
- If the CLRAS is not relevant to the company, only the physical and carbon-related financial risk levels are considered and weighted equally. The physical and carbon-related financial risks are considered to be always relevant to companies as they can all be affected by the physical consequences of global warming and carbon pricing.

The weighted average of the three risk levels result in a score between 0 and 5. This score is translated into a rating with a letter grade between A and E.

11. Conclusion

Ethos' methodology makes it possible to assess the extent to which a company or a portfolio contributes to and is affected by the climate crisis. In a context where reporting requirements are constantly evolving and becoming more stringent, Ethos' climate transition ratings provides a concrete, realistic and credible snapshot of a company's dual materiality: its impact on the climate and the climate's impact on the company.

By creating the climate credibility score, Ethos also aims to establish a reliable and credible framework for corporate environmental reporting and target-setting that will prevent false and misleading climate claims from being taken seriously. At a time when more and more companies are announcing "climate-neutral products" or "net-zero targets for 2050", this methodology provides a way to add clarity to the credibility of such claims.

Ethos' methodology also contributes to the promotion of socially responsible investment – one of the goals of the Ethos Foundation – by enabling informed investment decisions. The ultimate goal is to further redirect investments towards companies and economic sectors that are compatible with the Paris Agreement or are on a credible transition pathway.

FUTURE DEVELOPMENTS

As with all climate methodologies, the Ethos methodology is subject to certain limitations and potential future developments. It has been built on the basis of the current state of knowledge of climate science, while remaining systematically applicable to a broad universe of companies analysed on the basis of available data.

One of the most obvious difficulties in developing Ethos's methodology was the lack of data availability and comparability. While reporting standards are emerging, the way in which companies report on their various emissions, their targets and on their activity vary significantly. Ethos therefore supports the standardisation of companies' reporting on climate indicators. In addition, only the most recent data from external data providers are taken into account. There is a risk that the company does not disclose past information in its most recent reporting, which could influence the results. To increase the robustness of the data, multiple sources of data are used to cross-check information.

The limitations also include the complexity of modelling future scenarios, both in terms of carbon budget allocations and of activity growth projections and the resulting sectoral applications. Ethos has chosen to use

external, science-based scenarios produced by recognised organisations, and to model the future economy as an extension of what exists today. With regard to the current methodological for forecasting the growth of a company's future activity and revenues, Ethos is aware that the forecasting method does not take into account sectoral forecasts or company-specific qualitative information into account. The results obtained are not intended to predict the future activity of companies, but rather to indicate the most likely evolution of their activity on the basis of their past activity. This option was chosen for practicability reasons as this rating is intended to be automated on the basis of available data sources. Ethos plans to adapt this approach in the near future by including sectoral growth rather of the current forecasting method.

Another limitation of this methodology is the use of emissions intensities rather than absolute emissions. This means that the methodology is designed to be used in a growth-oriented context. However, from a climate protection point of view, it is the absolute quantity of GHG emissions released into the atmosphere that is the important metric. Ethos is aware that a reduction in intensity can mask an increase in absolute emissions if the activity grows faster than the emissions increase. As a result, intensity-based budgets have been adjusted to lead to absolute emissions reduction. The advantages of using intensities appear to be greater, given the availability of the data, the alignment of the financial sector with this choice, and the granularity that intensities provide from a transition point of view, without taking into account the size of the company.

12. Glossary

ACT: The Assessing low-Carbon Transition is a climate target evaluation method that was founded by the French environmental agency ADEME and the CDP. The goal of this method is to evaluate the maturity of companies' climate strategies, regardless of their size or market, and to compare them with the requirements of a low-carbon world. More information can be found at <https://actinitiative.org/>

Business-as-usual intensities: Estimated future emissions intensities from the cut-off year to 2050 in a "business-as-usual" scenario, that is, when no emissions reduction targets are considered and if the company keeps its current emission intensity.

Carbon budget: The theoretical reduction that a company should hypothetically reach to be aligned with a 1.5°C scenario, given its sector. It takes the form of emissions' datapoints over the period 2010 until 2050, i.e. budgeted intensities.

Carbon budget over/undershoot: Comparison of the company's adjusted emission intensities with its sectoral budget for the period 2010-2050. If the company emits more than its budget planned over the 2010-2050 period, there is a budget overshoot. If the company emits less than its budget planned, there is a carbon budget undershoot.

Carbon sinks: Anything that absorbs or captures more carbon than it releases in the atmosphere. We also refer to carbon offsetting or carbon credits to talk about the use of carbon sinks.

Company activity: Physical or financial unit used to construct emission intensities that represent the activity of the company.

Company climate credibility score: Measure estimating the proportion of the targets that will most likely be achieved by the company, as a percentage of the targets set. One combined with the company's emissions intensities (business-as-usual and targeted), it gives the adjusted emissions intensities.

Cut-off year: Year at which the methodology considers that previous years are in the past and forward years are in the future for a given company. In this first version of the methodology released in 2023, the cut-off year for most companies is 2021 and will be incremented every passing year.

EDTM: The Exponential Damped Trend Method is a forecasting method that uses past trends in company's revenues to extrapolate projected future revenues with a trend.

GHG emissions: Release of GreenHouse Gases emissions in the Earth's atmosphere which have the property of absorbing heat, contributing to the greenhouse effect.

Gross / Net emissions: Gross emissions are a company's effective GHG emissions without taking into account carbon sinks. Net emissions are a company's gross GHG emissions minus the quantity of carbon sinks used by the company.

High-stake sector: Economic sector with usually high emission intensities or sector linked to topics where the decarbonisation stakes are high for society. The sector also needs to have an available sector-specific carbon budget to be considered high-stake by Ethos and a common standardized physical unit which represents the sectoral output. Companies mainly active in this type of sector are called high-stake companies.

Low-stake sector: Economic sector with usually lower emission intensities, i.e. emitting low amounts of GHG emissions per revenue generated, or linked to topics where the decarbonisation stakes are lower. Companies mainly active in this type of sector are called low-stake companies.

Adjusted emissions intensities: Estimated emissions intensities from the cut-off year to 2050 that consider the credibility of a company and adjust the emission reduction pathway accordingly.

Targeted emissions intensities: Estimated future emissions intensities from the cut-off year to 2050 considering reduction targets set by the company. Targeted intensities correspond to the company's climate strategy in emissions reduction if targets are 100% achieved.

13. Main references

The main references of the methodology are listed below. Other references are cited directly using footnotes in the text.

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