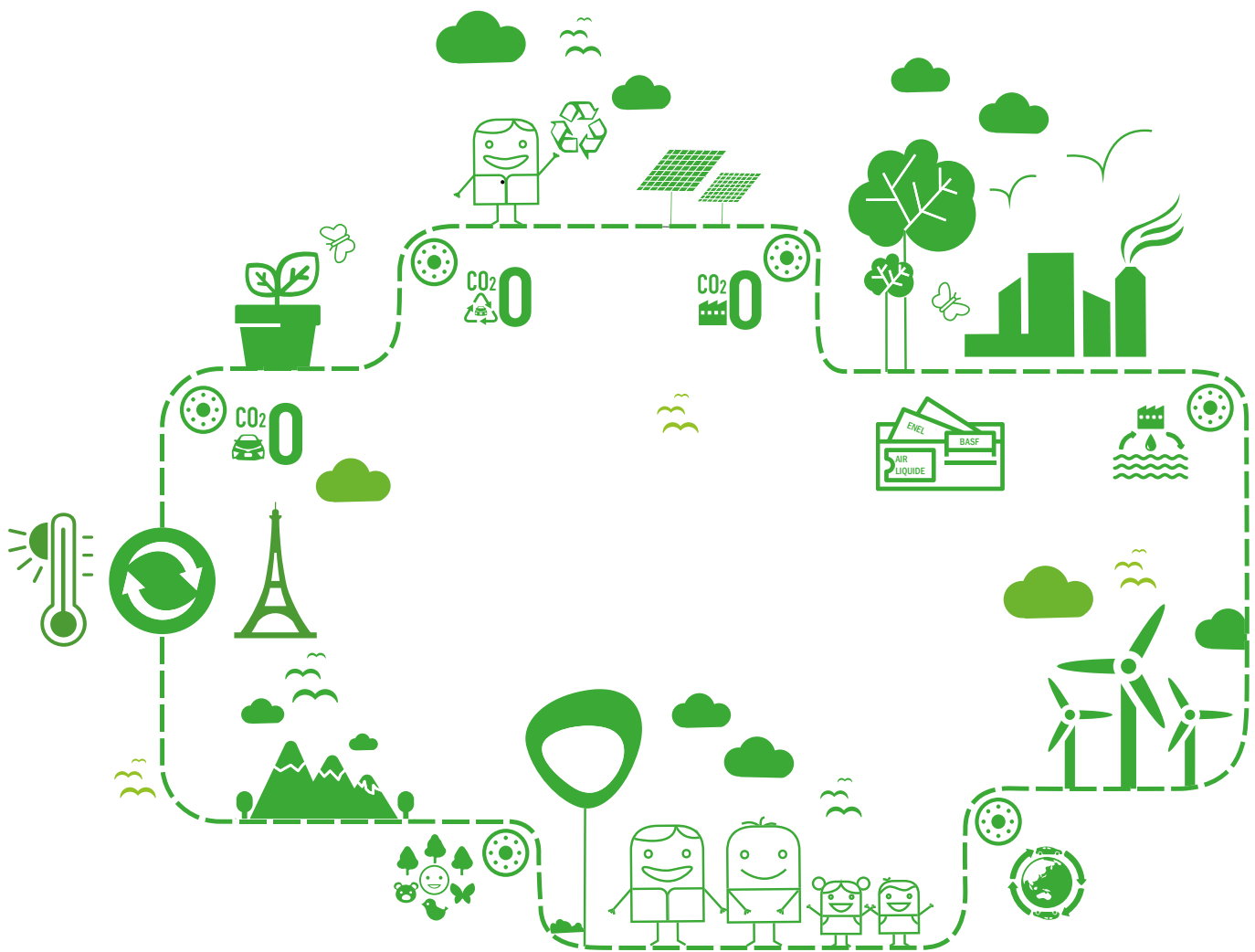


THE ALIGNMENT COOKBOOK

A Technical Review of Methodologies Assessing a Portfolio's Alignment with Low-Carbon Trajectories or Temperature Goal



In partnership with :



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EXECUTIVE SUMMARY

Rising interest in portfolio alignment assessments and implied temperature rise metrics. The concept of alignment emerged in response to the objectives of the Paris Agreement of 2015, through the expression “alignment to the Paris Agreement”. While there is no formal definition, the practice-focused literature on the topic suggests that “alignment” with the objectives of the Paris Agreement is a process through which an institution aims to contribute to all objectives of the Paris Agreement in the context of the broader sustainable development ([I4CE 2019](#)).

To support this process, a large number of at times very different tools and assessment methodologies have emerged over the last five years. Among this group, portfolio temperature alignment methodologies distinguish themselves by focusing on estimating the temperature pathway that the relative “climate performance” of an asset, portfolio, strategy or investor is consistent with, in relation to the international objective of limiting the increase in temperature well below 2 °C.

A rising number of investors are publicly reporting on the alignment of their portfolios with climate change related objectives, in particular with the trajectories needed to limit the increase in average global temperature to below 2 °C. In an increasing number of cases, the results are expressed using a temperature indicator, indicating what increase in average global temperature the portfolio or company is consistent with (such as 2 °C, 4 °C or 6 °C).

This type of assessment methodologies has been increasingly noted both in the main regulatory texts, as well as of investors’ practices. However, the underlying analytical frameworks and methodologies across different types of “temperature alignment assessment approaches” suffer from a lack of transparency – and at time consistency. This creates an obstacle to the credibility, comparison, and usefulness of the results.

The first of a series of reports on climate metrics for investors. This report is the first of a series of reports commissioned by the French Ministry for the Ecological and Inclusive Transition (MTES) and the WWF France to review the range of climate-related methods and metrics available to investors, covering the topics of both temperature alignment methodologies and metrics for climate risks. This first report focusses on temperature alignment approaches. Combined with existing research on tools for physical risk assessment ([I4CE, 2018](#)) and transition risk assessment (I4CE, forthcoming), the second report under this project will examine the feasibility of introducing minimum requirements for the use of such metrics for reporting on climate risks and alignment.

KEY OBJECTIVES OF THIS REPORT

The main objective of this report is to study, analyze and compare methods and frameworks available today to investors who wish to measure the alignment of their investment portfolio with a temperature trajectory, and more particularly translate and express the degree of alignment of their portfolio in an implied temperature rise (ITR) metric.

Objectives and scope of the report. This review proposes a conceptual and analytical framework on temperature alignment metrics with the aim of:

1. Specifying why investors are assessing the

alignment of their investment portfolio with a low-carbon trajectory/ temperature goal, what it means and implies;

2. Increasing transparency around the potential methodological choices, their implications and trade-

offs, and;

3. Enabling users of methodologies to make informed choices and readers of disclosure documents to better understand the informative value of data provided.

It is not the purpose of this report to comment on the wider process of aligning investment portfolios, i.e. on the relevance of specific actions that investors can take on the back of the assessment.

KEY FINDINGS

1. Creating a shared conceptual framework

This report examines the use of approaches to evaluate the “alignment”, “compatibility” or “consistency” of investment portfolios with a given trajectory that limits global temperature rise below a specific level (thereafter “temperature alignment assessments”).

Key findings 1: Under this definition, temperature alignment assessments are mathematical measures of the proximity between the climate performance of a portfolio, captured for example through its carbon footprint, the share of its investments in so-called “green” companies or climate scores, and one or several temperature benchmark(s) chosen or built based on one or several of temperature trajectories. This proximity is sometimes expressed using an implied temperature rise (ITR) indicator.

Key findings 2: Aligning a portfolio “with a temperature trajectory”, “with the temperature objective of the Paris Agreement” and “with the Paris Agreement” are not equivalent and require methodologies that rely on different principles.

- While assessing a portfolio alignment with a 2 °C trajectory can rely on any of the various 2 °C trajectories and methodological choices as long as these are internally-consistent, approaches that seek to assess a portfolio “alignment with the temperature objective of Paris” need to fulfill additional requirements, such as on the reference scenario(s).
- It remains to be shown whether “trajectory alignment” assessment methodologies could be used to demonstrate “compatibility with the Paris Agreement”, in a relevant, sound, and easily-understandable way.

Literature review and expert consultation.

This report is based on a literature review, interviews with experts from research institutions, non-governmental organizations, academia, data providers, and investors, as well as a detailed comparative review of the methods and frameworks available at the time of writing. The literature review and expert consultation have a multidisciplinary focus, dictated by the complexity of this subject at the crossroads of political, economic, financial, and scientific themes.

- For example, to date, methodologies mostly rely on global decarbonization scenarios and do not take into account national pathways towards a sustainable low-carbon and climate-resilient economy, which would be necessary for Paris Alignment assessments.

Key findings 3: There are heated debates around the usefulness of temperature alignment metrics as proxies for expressing transition risk and/or impact. There is continued debate of whether compatibility with a temperature pathway can be used to assess whether portfolio contributes directly to the ecological and energy transition (i.e. has a positive impact) or is exposed to transition risks. This remains an open question that requires additional evidence and research to be demonstrated.

Key findings 4: “Aligning” the activities of a financial institution or actor is a process at both the strategic and operational levels. Temperature alignment methods are one piece of the puzzle that can support alignment strategies of investors. These approaches can contribute to target-setting and building investment strategies to align portfolios through time. Therefore, they can be seen as a one of the multiple tools available to investors today to set up and monitor the results of an alignment strategy, amongst a range of other approaches such as green-brown metrics and scores.

2. Understanding the recipe of temperature alignment methodologies

Key findings 5: The general recipe of temperature alignment assessments comprises four general steps, each encompassing several methodological choices.

- **Step 1.** The starting point is measuring the climate performance, at company or portfolio level;
- **Step 2.** It is then necessary to choose one or several scenarios;
- **Step 3.** Decarbonization trajectories provided from these scenarios then need to be converted to micro-actors temperature alignment benchmark(s);
- **Step 4.** By comparing the results of step 1 and step 3, the temperature alignment assessment is then performed. The results of the proximity assessment are directly expressed through an indicator (an implied temperature rise (ITR) metric or other).

3. Enabling the users of methodologies to make informed choices

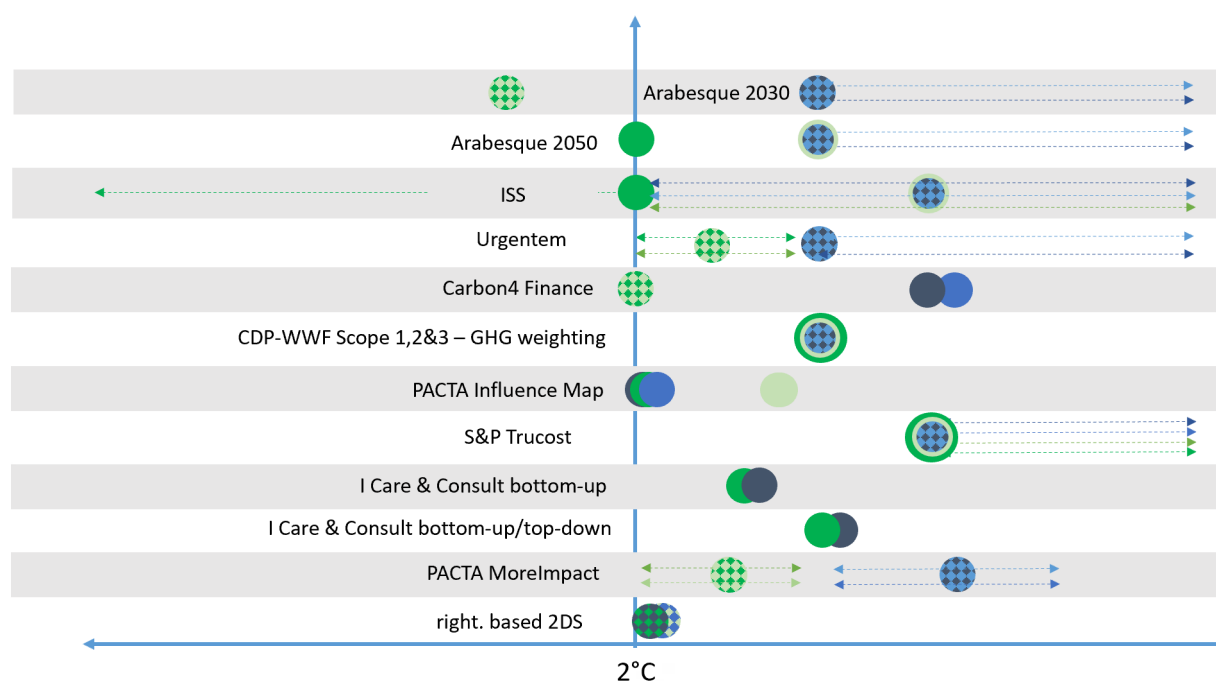
Key findings 6: Many permutations of the same recipe are possible; yet there is no ideal temperature alignment methodology. In practice, data providers and investors face a range of trade-offs given data availability. What is best from a theoretical perspective

may not be easily applicable. Ultimately, it is up to the users to choose methodologies that best fit their information needs given these trade-offs and up to regulators to become more precise on what are minimum technical requirements that methodologies should meet in order to be fit for purpose.

The main tradeoffs identified relate to: 1. What value chain perimeter to include in the assessment, 2. How to forecast the future climate performance of companies, 3. What scenarios to choose considering practical and conceptual implications, 4. How to derive temperature benchmarks.

Key findings 7: Across different methodologies, the results of the assessments can hardly be compared or added up for communication purposes (e.g. a financial center covers x billion of 2°C aligned portfolios). Currently available temperature alignment methods show little consistency in terms of results. The results themselves are hard to compare due to different coverage levels and assumptions. This is to be expected as each of these methods are designed to answer different questions. Therefore, it is essential to highlight the specific question answered when disclosing the results of this type of assessment.

Figure 1: Relative dispersion to 2°C trajectory, as depicted by the blue line (Light Green: LC100 2018, Dark Green: LC100 2019; Light blue: SBF120 2018; Dark blue: SBF120 2019). Round: central value, dashed arrows: range. Calculated by author. Detailed findings can be found on p.70.



Eleven methods were tested in this report on two indices, the Euronext LC100 and the SBF 120, in two different years, 2018 and 2019. The methodologies included in the test were selected based on their

1. Availability at present or shortly (road-test stage),
2. Applicability at the level of an investment portfolio,
3. Comparison with trajectory and/or implied temperature rise indicator and
4. Accessibility to all investors on a free-of-charge or paid-basis.

The main focus is on listed equity and corporate bonds. The NEC metric was also included as a comparison as it can be considered as alignment metric, even if it is not a temperature alignment metric *stricto sensu*, as defined in this report.

Key findings 8: This report is focused on temperature alignment assessments that have been developed for listed equities and corporate bonds. Yet, a range of methods has been developed for other asset classes. These approaches follow the same analytical steps, but are less mature than methods for corporate instruments.

Indeed, few providers cover other asset classes and do so only to the extent that “sector-specific” benchmarks can be derived based on existing scenarios. This is the case for real estate and mortgages (buildings benchmark); electricity generation and project finance (electricity benchmark); project finance and infrastructure (based on sector-relevant benchmark). The Science Based Targets initiative (SBTi) is developing a framework for financial institutions to set targets for their investment and lending portfolios. The 2020 iteration of the framework will cover real estate, mortgages, electricity generation project finance, and corporate debt and equity (SBTi, [2020](#)).

Going forward, developing a consistent temperature alignment framework for cross-assets portfolios raises the issue of benchmark consistency between corporate-level asset classes (listed equity or bonds), assessed using sector-specific benchmarks as provided by external scenario developers, on the one hand, and sovereign bonds assessed using different benchmarks derived at the national level based on other data sources, on the other hand. This has not been, so far, tackled by any data providers or investors.

4. What's next?

Key findings 9: Multiple layers of uncertainties compound themselves at each step of a temperature alignment methodology. In particular, expressing

the results through an Implied Temperature Metric (ITR) may give the impression that investing in the assessed portfolio may lead the world to this specific climate future. Yet, these approaches are very simplistic in comparison to IPCC climate models and approaches. Rather, the ITR metric can indicate the relative magnitude of the climate performance of one company or portfolio relative to another, if the same methodology has been used for both assessments. However, it does not compare in their current state of use the temperature outcomes of different portfolios in absolute terms. Therefore, more research is needed, in particular to better understand the uncertainty of temperature scenarios and ITR metrics.

Key findings 10: The results of temperature alignment assessments, especially when expressed with an Implied Temperature Rise metric (ITR), while easier to understand for non-experts compared to other metrics such as carbon footprinting, can give the impression to the user that the results from different methodologies are comparable. As highlighted above, this is not the case, as different methods answer slightly different research questions and are built based on different methodological choices. Therefore, an increasing number of actors are encouraging and working towards convergence of different metrics, in addition to increased transparency (SBTi-Finance, TCFD, NZAOA, IIGCC).

In addition, this type of indicators can create disproportionate expectations and misunderstanding for the non-specialist user of the metric, especially given their current uncertainties and weaknesses. The second report of this series (forthcoming) will discuss the feasibility of minimum quality criteria for temperature alignment and other types of climate-related assessments, in particular in the context of the expected revision of Article 173 – VI of the LTECV.

Key findings 11: Temperature alignment assessments are not an end in themselves. These methods are tools that need to be part of a wider process of financial institution strategic alignment to the objectives of the Paris Agreement, in particular the well-below 2°C temperature objective. While it is not the aim of this report to map out this process, organizations such as I4CE ([2019](#)) are working on these topics, that are likely to become increasingly relevant in the coming months and years.

READERS' GUIDE

This report was written for two primary audiences: decision-makers that wish to get a good understanding of temperature alignment assessments and how they are built; and practioners that wish to get an in-depth technical understanding of the options available in building such a methodology.

To get started (p.10 to p.40)		
Defining portfolio temperature alignment (p.10 to p.29)	<ul style="list-style-type: none"> • Why is there a need for increased transparency? • What does portfolio alignment with a temperature trajectory mean? • Is it a good proxy for investment impact or transition risk exposure? • From reporting to steering action? 	<p>p.10</p> <p>p.16</p> <p>p.22</p> <p>p.25</p>
Mapping temperature alignment methodologies (p.30 to p.61)	<ul style="list-style-type: none"> • What are the four general steps in building these methodologies? • What are the methodological choices that can be made within these steps? • How have data providers, investors and industry initiatives approach these? 	<p>p.32</p> <p>p.32</p> <p>p.34</p>
Understanding the implications of different methodological choices (p.62 to p.83)	<ul style="list-style-type: none"> • What are the key tradeoffs between data availability and usefulness? • How do the results of different methodologies compare? 	<p>p.63</p> <p>p.67</p>
To go further: let's get technical (p.84 to p.142)		
Starter: Assessing the climate performance of a portfolio (p.85 to p.102)	<ul style="list-style-type: none"> • What metric may be used to measure climate performance? • Scope 3 or not Scope 3? • What about data quality and the need for estimated data? • What about avoided emissions? • Towards capturing removed emissions? • How to forecast future climate performance? 	<p>p.86</p> <p>p.88</p> <p>p.91</p> <p>p.93</p> <p>p.96</p> <p>p.98</p>
Main course: Choosing one or several scenarios and associated trajectories (p.103 to p.119)	<ul style="list-style-type: none"> • What are the conceptual and practical considerations? • Are existing scenarios adapted to temperature alignment assessments? • Adapting third-party derived scenarios and temperature trajectories? 	<p>p.103</p> <p>p.109</p> <p>p.115</p>
Cheese Platter: Deriving micro-level temperature benchmarks (p.120 to p.127)	<ul style="list-style-type: none"> • How to express micro-level temperature benchmarks? • How to derive micro-level temperature benchmarks? 	<p>p.120</p> <p>p.125</p>
Dessert: Portfolio temperature alignment assessment (p.128 to p.142)	<ul style="list-style-type: none"> • Measuring the spread or speed? • How to express the results of temperature alignment assessments? • How to aggregate and weight the results at portfolio-level? • Using additional adjustment factors? 	<p>p.128</p> <p>p.131</p> <p>p.136</p> <p>p.140</p>
Detailed review of data providers' methodologies (p.143 - 166)		
Arabesque S-Ray Temperature Score (p.145); Carbon4 Finance 2° alignment (p.147); CDP-WWF Temperature Rating (p.149); EcoAct ClimFIT temperature (p.151); Urgentem (p.153); I Care & Consult SB2A/SBAM (p.155); ISS (p.157); MSCI Carbon Delta Global Warming Potential (p.159); right. based on science XDC model (p.161); S&P Trucost SDA-GEVA (p.163); 2° Investing Initiative PACTA (p.165).		

1. COOKING UP A PRACTICAL ASSESSMENT: DEFINING PORTFOLIO ALIGNMENT

The objectives of this section are to 1. Conduct a high-level comparative review of the concept of alignment with a temperature trajectory as set out in the main regulatory texts and review the practices of investors as observed in their reporting 2. Suggest a conceptual framework to create a common understanding around what portfolio alignment with a temperature trajectory means, 3. Highlight the debate on the appropriateness of portfolio temperature alignment as a proxy for transition risk and impact and 4. Define the key characteristics temperature alignment methodologies may exhibit to be useful in both ex-ante (target-setting and action-steering) and ex-post assessments (monitoring).

KEY TAKEAWAYS

Increasing interest in portfolio temperature alignment methodologies and implied temperature rise metrics. An increasing number of investors are publicly reporting on the alignment of their portfolio with temperature trajectories, increasingly expressed by an aggregated and synthetic temperature metric. In France, 18 institutions disclosed a portfolio temperature score in 2018, up from 6 in 2017 and 2 in 2016 ([Novethic, 2019](#)).

A trend supported by regulatory and voluntary disclosure requirements. This trend is partly driven by various regulatory texts and recommendations for investors that translate the Paris Agreement objective of keeping the increase in temperature well below 2°C into specific investor requirements. While implied temperature rise metrics receive little or no direct mentions in these texts, the concept of “alignment” is often cited (Article 173-VI, Climate Benchmark Regulation, and the European Taxonomy on Green Activities). In parallel, various investor initiatives are investigating portfolio temperature alignment and implied temperature rise assessments (IIGCC, Net Zero Asset Owner Alliance, TCFD).

A lack of clear and common definition. What “alignment with a temperature trajectory” means and implies for investors and investment portfolios remain unclear. As such, the methodologies

developed to assess the alignment of an investment portfolio with a temperature trajectory and translate the results into a temperature outcome are often very different. This finds its strongest expression in Implied Temperature Rise (ITR) indicators. They are an extension of temperature alignment methodologies, in that they express the results in an aggregated figure, supposedly simplified and easy to communicate. However, this simplification masks the methodological subtleties and assumptions embedded in such an assessment.

An assessment of the compatibility with a temperature trajectory. Methodologies examined in this report aim to assess the “alignment”, or “compatibility” or “consistency” of investment portfolios with a given trajectory that limits global temperature rise under a specific level (thereafter “temperature alignment assessments”). Strictly speaking, temperature alignment assessment is, therefore, a mathematical measure of the proximity between the climate performance of a portfolio, captured for example through its carbon footprint, the share of its investments in so-called “green” companies or climate scores, and one or several temperature benchmark(s) chosen or built based on one or several of temperature trajectories. This proximity is sometimes expressed using an implied temperature rise (ITR) indicator.

The reference point for temperature alignment assessments is not well defined. It is essential to differentiate different levels of alignment. Indeed, there is a difference between alignment with “one or several temperature trajectories (e.g. 2°C or well below 2°C)”; “the temperature objective of the Paris Agreement”; and “the objectives of the Paris Agreement”. In particular, not only the Paris Agreement refers to compatibility with trajectories that lead to well below 2°C temperature outcomes, there is an infinite number of trajectories that exist to limit temperature rise below 2°C. The Paris Agreement provides hints on the principles that the desired trajectory to a 2°C world should support, beyond the temperature objective itself, by including as well objectives related to adaptation and low-carbon development. To date, it remains to be shown whether a “trajectory alignment” type of assessment could be used to demonstrate “compatibility with the Paris Agreement”, in a relevant, sound, and easily-understandable way.

Heated debates around the usefulness of temperature alignment metrics as proxies for transition risk and/or investor impact. Is compatibility an indication of portfolio contribution to the ecological and energy transition and impact? Of lower transition risk exposure? Whether this type of assessment is a good proxy for transition risk or impact analysis can be debated and remains an open question that requires additional evidence to be properly demonstrated. “Compatibility” is already an objective in itself, as put in the article 2.1(c) of the Paris Agreement.

Ex-ante and ex-post assessment: from reporting on compatibility to target-setting and steering action. Provided it relies on sound and consistent methodological foundations, portfolio temperature alignment assessments are useful to monitor portfolio compatibility with one or several temperature trajectories and identify areas to focus or develop strategies to make investment flows “compatible” with a temperature objective. Therefore, this type of assessment can be used from an ex-ante (target-setting and steering action) and ex-post perspective (monitoring and reporting), and answers the questions:

- Ex-ante: The current climate performance of companies and portfolios can be compared to their desired performance in the future T+N as defined by the temperature alignment benchmark. This answers the question: how far is the company or portfolio performance today compared to where it should be according to the benchmark in T+N?
- Ex-ante: The forecasted climate performance of companies and portfolios can be compared to its desired climate performance in the future T+N as defined by the temperature alignment benchmark. This answers the question: Is the company or portfolio on the right path to reach the desired state in T+N?
- Ex-post: Looking backwards, has the portfolio or company followed the required trajectory in the past?
- Ex-post & Ex-ante: Compared to prior assessments, is the portfolio or company on a different prospective trajectory? This last question relates as well to ex-ante analysis: indeed, one can see it as a back-test of past forecasts, and therefore a measure of the reliability of the present forecasts.

1.1 BUILDING A SHARED CONCEPTUAL FRAMEWORK

A review of the main regulatory texts and investors' practices shows that portfolio temperature alignment assessments are increasingly fostered and used, but that the underlying analytical frameworks and methodologies are different and suffer from a lack of transparency. This creates an obstacle to the credibility, comparison, and usefulness of the results. This is why a growing number of actors are asking for greater transparency, and sometimes convergence, on these methods.

It is necessary to take a step back and identify against what trajectory investors want to assess their portfolios with, and how this assessment may be performed. Indeed, alignment “with a temperature trajectory”, “with the temperature objective of the Paris Agreement” and “with the Paris Agreement” are not equivalent, will refer to different reference trajectories and require temperature alignment methodologies that rely on different principles.

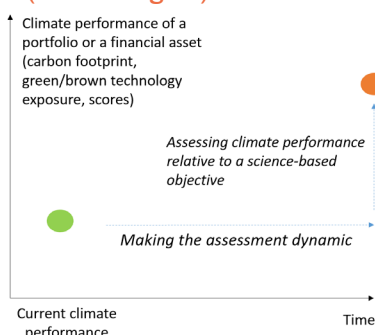
1.1.1. Increasing interest in 2°C alignment methodologies

Why measuring portfolio temperature alignment?

The concept of alignment emerged in response to the three objectives of the Paris Agreement, through the expression “alignment to the Paris Agreement” ([I4CE, 2019](#)). Methodologies to assess alignment with a low-carbon trajectory were therefore developed from the need to put into perspective the climate performance of an asset, portfolio, strategy, or investor with the international temperature rise limitation objective.

A multitude of metrics is available to investors to measure their climate performance. **Carbon footprinting and to a certain extent the green share of portfolios are the most widely used at the portfolio level. However, they cannot be used to make a dynamic and qualified assessment on the sufficiency/insufficiency of this performance, with regards to the long-term global temperature objective.** For example, does a portfolio invested at 20% in so-called «green» companies and whose carbon footprint is relatively low compared to a market benchmark go far enough? What is considered «enough» in the context of climate goals?

Figure 2: Putting portfolio climate performance into perspective (authors' figure).



Approaches are being developed to assess the alignment of portfolios with a temperature rise limitation goal, resulting in indicators meant to capture prospectively what “too much” carbon emissions or “not enough” “green” activities means, at the level of a company or a portfolio. **By dividing up the limits set by the trajectory between each economic player, including financial institutions, it becomes possible, at least conceptually, to assess and qualify their climate performance in the light of this objective.**

The rise of investors' reporting on portfolio alignment with a 2°C trajectory. The 2015 Paris Agreement sets the objective of limiting the rise in temperature well below 2°C. **For a variety of reasons examined from p.14, a growing number of investors have sought to analyze the degree of alignment, or non-alignment, of their portfolios with low-carbon trajectories, in addition to the use of other already existing climate metrics, such as carbon footprinting or green-brown share.**

- In a study for WWF on the application of Article 173-VI by insurers published in 2018, I4CE counted 13 insurers who analyzed the alignment of their portfolio with a 2°C trajectory ([I4CE, 2018](#)).
- In a 2019 report, the AMF found that 17% of asset managers and 50% of insurers analyzed gave satisfactory information on the achievement of long-term environmental objectives, including the establishment of indicative targets ([MTES, Direction Generale du Tresor, AMF & ACPR, 2019](#)).
- Of the 100 investors reviewed by Novethic, 32 mentioned “the process of measuring portfolio alignment on the trajectory of 2°C of global warming as foreseen in the Paris Agreement ([Novethic, 2019](#)).”
- The international awards for climate-related

disclosures show that not only financial institutions in France are concerned, but that relevant practices can also be identified beyond the specific French context ([International Awards for Climate Disclosures, 2019](#)).

Several mandatory and voluntary regulatory requirements that apply to investors also mention the concept of 2°C alignment (table 1), although with a different focus. For example, Article 173 (-VI) introduced the notion of «contribution» either to the international climate goals or to the national transition goals. The EU Benchmark regulation directly uses the notion of «alignment», whereas the TCFD is focused on «risk assessment».

Most of the below mentioned existing regulatory frameworks do not provide a detailed definition of the terms they employ. The concept of alignment had barely emerged during the drafting and publication of Article 173-VI for example, which was deliberately left unclear on this point to allow good practices to emerge. Indeed, a large majority of the approaches and methodologies available today on the subject were developed between 2015 and 2020. The Benchmark report, published in 2019 (TEG, 2019), is the only text that details specific minimum criteria to be taken into account in the construction of an investment product “aligned with the Paris Agreement”, such as the rate of decarbonization of the portfolio and percentage of activities invested in “green” assets.

Table 1: Review of the use of the alignment concept in the main investors’ texts (non-exhaustive)

Text	Mention
Article 173-VI	Article 173 (-VI) of the French Energy Transition Law requires institutional investors to report on climate-related risks, their contribution to the international climate goals and their contribution to the ecological and energy transition.
Climate Benchmark regulation; EU Taxonomy on Green Activity	Both the EU Taxonomy on Green Activity and Benchmark Regulation refer to the concept of alignment and are meant to provide guidelines and tools to help investors see clearer on this topic. In particular, the benchmark regulation sets out criteria for indices and benchmarks to be considered “Paris-aligned”. The Taxonomy defines what activities and the conditions under which they can be considered “green”. The links between the Taxonomy and alignment assessments are reviewed on p.20.
TCFD	The TCFD encourages investors to describe the positioning of their portfolio relative to the low-carbon economy through the production of forward-looking information. The TCFD highlights the importance of climate scenario analysis, it does not mention, however, the concept of “alignment”. It is indeed focused on risk analysis

Varied and heterogeneous metrics and methods. A wide range of methods are therefore used by investors to communicate on portfolio alignment with a temperature trajectory, with different conceptual underpinnings, recipes, and hypotheses. Most data providers have developed a “suite” of climate metrics, which often includes at least one temperature alignment metric, sometimes in the form of portfolio temperatures. No less than 12 aggregable portfolio alignment methodologies were identified within the framework of this report, of which 10 lead to a temperature metric.

In parallel, the growing number of investors reporting

on their 2°C portfolio alignment measurement process do so in «different forms» and sometimes using a combination of indicators. For example, of the 32 investors who communicate on this theme, 22 compare the energy or technological mix of the companies financed with one or several 2°C scenarios, 18 use a portfolio temperature metric, and 10 apply a budget logic and carbon trajectory translated into sector objectives when possible ([Novethic, 2019](#)). I4CE identifies four categories of 2°C alignment approaches in line with the classification of Novethic but further differentiates between temperature alignment approaches that have sectoral and geographical focus ([I4CE, 2018](#)).

The rise of Implied Temperature Rise (ITR) metrics

A range of metrics are used to express the results of temperature alignment assessments: a binary statement (aligned/ not aligned), a score, a percentage of misalignment, and an implied temperature rise (ITR) metric.

This last indicator has been gaining momentum recently. While Novethic counted 2 occurrences of such an indicator in its 2017 review of the 100 largest French investors, this number increased to 6 in 2018 and 18 in 2019 – a 900% increase! ([Novethic, 2019](#)).

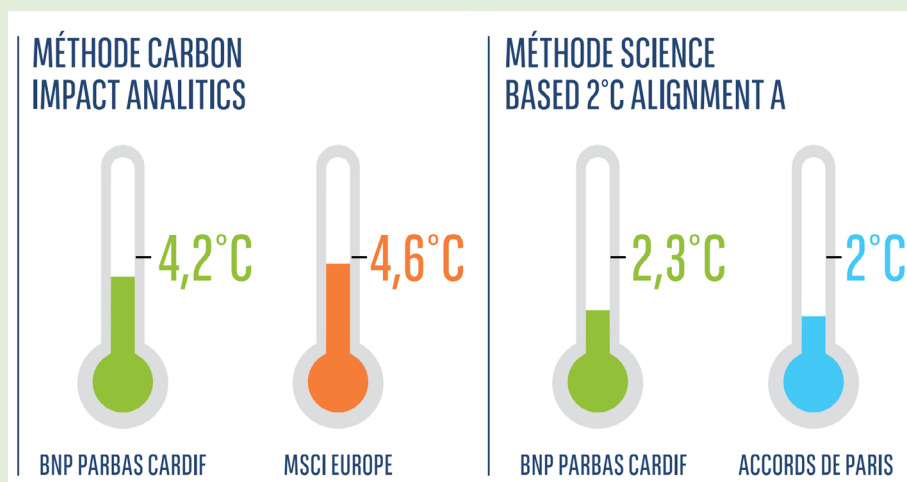
While the larger number of investors use this metric for “exploratory purposes”, portfolio ITR metrics are being discussed by institutions such as the WWF France and individuals such as Mark Carney (see p.16) as a synthetic and simple to communicate metric.

According to the assessment made by the French government after 3 years of application of article 173-VI, “this practice [...] consists in translating the current trajectory of an institutional investor’s investments into degrees of global warming, to illustrate the difference with a 2 °C trajectory. [...] The methodologies underlying this kind of indicator have inherent limits and can still be deepened and better explained, but they have the advantage of being synthetic and legible for financial actors.” ([MTES, Direction Generale du Tresor, AMF & ACPR, 2019](#)).

As often, the reality is more complicated than that. While they appear as powerful and easy-to-communicate indicators, ITR metrics hide layers of analysis, assumptions, and uncertainties. Moreover, each of them is constructed differently and have different assessment objectives. Therefore what seems to be easy to understand and suggests comparability hides a complex structure and is in reality harder to compare than it seems, at least in the current state of methodologies. It is therefore essential to disentangle the recipe of this indicator to understand what it says, or can say, about an investment portfolio.

For example, BNP Paribas Cardif found that two different temperature alignment methodologies, when applied to the same portfolios, gave different results (see below). The recipe of temperature alignment methodologies, including the ones translating the results in an ITR metric, is detailed from section 2 onward. In section 3, the implication of using different methods is tested on two indices, the Euronext LC100 and SBF 120, across 12 methodologies.

Figure 3: Different temperature methodologies give different results ([BNP Paribas Cardif, 2018](#)).



Calling for greater transparency. The diversity, the lack of consistency and transparency between approaches, metrics, and methodologies for assessing the 2°C alignment of an investment portfolio make it not only difficult to understand the results, but also compare them across investors and through time. As put by the French Regulators' in their review of reporting practices three years after the entry into force of Article 173 (MTES, Direction Generale du Tresor, AMF & ACPR, 2019):

“We can notice the great heterogeneity of [investors'] publications in terms of quality, quantity, relevance, and comparability. Beyond the differences in economic models, this can partly be explained by the lack of maturity of the indicators and methodologies used [...] which today are not sufficiently reliable or consistent with each other. These methodological limitations

are particularly visible in [...] the assessment of the contribution to long-term environmental objectives, namely the international objective of limiting global warming and the objectives of the energy and ecological transition [...].”

Some players, therefore, call for greater transparency, and potentially convergence of temperature alignment methodologies, at least of their conceptual underpinnings, use cases, and methodological principles. This could have the advantage of ensuring a minimum quality of the methods and frameworks; reducing the cost of implementing this type of assessment; and facilitating the task for the user of the reporting. Several initiatives are underway to promote better understanding, uptake, and/or convergence of alignment and portfolio metrics, as highlighted in table 2.

Table 2: Review of the main initiatives around temperature alignment (alphabetical order, non-exhaustive)

A high-level description of initiatives related to 2°C alignment	
Climate Action 100+	“is an investor initiative to ensure the world’s largest corporate greenhouse gas emitters take necessary action on climate change”. In particular, the Action objective states: “[...] reduce GHG emissions across the value chain, consistent with the Paris Agreement goal of limiting global average temperature increase to well below 2°C”.
	The European Commission 2018 “Action Plan on Financing Sustainable Growth” led to the publication of four reports by the Technical Expert Group. In particular, the Climate Benchmarks report provides specific minimum criteria for building “Climate- transition” and “Paris-Aligned” benchmarks. The EU Taxonomy outlines criteria to determine whether an activity is green.
The Institutional Investors Group on Climate Change	which convenes pension funds and asset managers with 33 trillion euros of combined assets under management, launched in May 2019 the Paris-Aligned Investment Initiative (PAII) to help investors understand what alignment means in practice as well as identify and review methodologies and approaches. The PAII is producing a framework to support asset owners and managers to align their portfolios and strategies to achieving the goals of the Paris.
The ISO14097 standard	currently being developed by AFNOR, the 2° Investing Initiative and UNFCCC, aims to “develop an analytical framework and principles for analyzing and reporting on investments and financing activities related to change climate ». This includes, among other things, alignment with low carbon trajectories and the Paris Agreement.
	Launched at the UN Climate Summit last September, the Net-Zero Asset Owner alliance is an “international group of institutional investors [with over US\$4.6 trillion AUM] delivering on a bold commitment to transition [their] investment portfolios to net-zero GHG emissions by 2050”. The Methodology Track has launched a call for methodology convergence around 16 principles (NZAOA, 2020).
The Science-Based Target Initiative for Financial Institutions	was launched in 2018 to help the 50+ investors that have publicly committed to set emissions reductions targets “to align their lending and investment portfolios with the ambitions of the Paris Agreement.”
TCFD	has formed a working group to assess the benefits and challenges of implied temperature rise and other forward-looking metrics that financial institutions could disclose to support financial decision making by their customers, clients and beneficiaries (Implied Temperature Rise taskforce).

Excerpt of Mark Carney remarks given at the 25th Annual Conference of the Parties, 10 Dec. 2019
([link](#))

To date, approaches to measuring and managing the financial implications of climate change for investments have been inadequate. Carbon footprints are not forward-looking, divestments only focus on the most carbon-intensive sectors, green investments are still small scale, and the impact of shareholder engagement is hard to measure.

One of the most promising options is to assess the “warming potential” of investment portfolios. For example, GPIF, the world’s largest pension fund, estimates that its assets are currently consistent with a 3.7 °C path.

Such a forward-looking measure can help asset owners and asset managers understand the transition pathways of their investments and develop strategies to align financial flows with the necessary transition to net zero.

Degree warming will reveal who is on the right and wrong side of history. It will provide a signal to governments about where the economy is on the transition path and therefore the effectiveness of their policies.

It will empower consumers, giving them more choice in how to invest to support the transition.

With our citizens, particularly the young, demanding climate action, it is becoming essential for asset owners to disclose the extent to which their clients’ money is being invested in line with the values of those clients.

Before working towards methodological convergence, it is necessary to take a step back to identify what investors want to assess their portfolios against and the different methodological options on which this type of assessment may rely. The following section explores this aspect and builds a practical conceptual framework on the meaning of portfolio and investors’ temperature alignment.

1.1.2. Temperature alignment approaches: a measure of “compatibility”

Measuring the compatibility with a temperature trajectory. According to I4CE ([I4CE, 2019](#)): «you should not be mistaken about the nature of the exercise and the interest of calculating this metric. *This measure should above all make it possible to reflect on what a 2 °C-compatible economy and finance should look like.* **An assessment of the “alignment with a temperature trajectory” is an assessment of the “compatibility” or “consistency” with a given trajectory limiting temperature rise under a specific level.**

Several approaches, and tools rely on the concept of “alignment” or “2 °C-compatible economy” but do not make use of temperature trajectories. These approaches assess the gap between the climate performance of portfolios and companies today and what they should be in a 2 °C-compatible world, defined through different proxies. The primary focus of this

report is methods that allow assessing compatibility or alignment *with a temperature trajectory*, see p.20 for other approaches.

Temperature alignment assessments are defined in this report as a family of methods available to investors who wish to understand the compatibility of their investment portfolio with one or several of the trajectories limiting temperature rise under specific levels. Such assessments comprise of four different elements: 1. A metric measuring the climate performance of portfolio or companies, 2. A scenario from which trajectories are derived, 3. A translation of these macro-economic trajectories to micro-actors benchmarks and 4. A calculation protocol to assess the proximity of the portfolio or company relative to its trajectory.

Strictly speaking, temperature alignment assessments are a mathematical measure of the proximity between the climate performance of a portfolio, expressed for example through its carbon

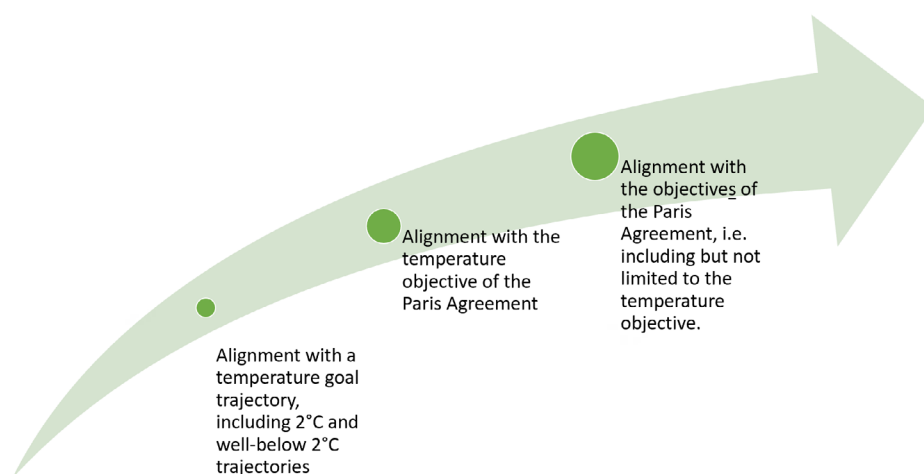
footprint, the share of its investments in so-called “green” companies or climate scores, and one or several temperature benchmark(s) chosen or built based on one or several of temperature trajectories. This proximity is sometimes expressed using an Implied Temperature Rise (ITR) indicator.

It is essential to start by defining what we want

to assess our portfolio against. Indeed, there is a difference between alignment with one or several 2°C temperature trajectory; the temperature objective of the Paris Agreement; and the objectives of the Paris Agreement (figure 4).

Each of these concepts is reviewed in turn. Table 3 summarizes the main differences between the three.

Figure 4: Three levels of temperature alignment



1. Alignment with a temperature trajectory, e.g. 2°C.

Temperature alignment assessments measure a portfolio or company compatibility with one or several trajectories chosen from an infinity of trajectories compatible with a given temperature outcome, e.g. 2°C-compatible trajectories.

A multitude of trajectories, with different shapes, limit the increase in temperatures below 2°C. Likewise, a multitude of trajectories leads to a world of 3°C, 4°C, etc. The «alignment», or not, of a company or portfolio, therefore depends on the chosen trajectory, amongst other things. These trajectories are built on several hypotheses that describe different plausible futures in terms of population and economic growth, mitigation options, and so on.

Thus, several trajectories can lead to the same temperature rise in 2100, each embedding different hypotheses such as technological choices. The shape of the trajectories differs on several elements: the speed and decarbonization rate of the economy, the year and the amount of the carbon peak, the time horizon at which the trajectory must be net-zero, and the reliance on removed emissions. Therefore, the results of climate alignment assessments depend partly on the underlying trajectories against which the

proximity is assessed.

Besides, compatibility between a portfolio climate performance and a temperature trajectory can be measured using a range of calculation protocols, over different time horizons and perimeters as explained from p.32. For example, compatibility can mathematically be measured, strictly speaking, based on the operational scope or taking into account full value chains, over the shorter term or encompassing a longer time horizon, in absolute or in relative terms.

Therefore, temperature alignment methodologies (e.g. 2°C alignment methodologies) encompass any approaches that compare the proximity between the climate performance of a portfolio, or an asset, with one or several temperature trajectories, including 2°C temperature trajectories, regardless of the embedded principles within the selected set of trajectories upon which the assessment is performed and independently of the underlying methodological principles, as long as these are internally-consistent.

2. “Alignment with the temperature objective of Paris”.

While 2°C alignment approaches can rely on any 2°C trajectories and methodological choices as long as these are internally-consistent, approaches that seek

to capture “alignment with the temperature objective of Paris” need to fulfill additional requirements. . **Not only the Paris agreement sets an objective of compatibility with well-below 2°C trajectories, but it is also more prescriptive in terms of the principles embedded within the desired well-below 2°C trajectory (I4CE, 2019). “2°C alignment” and “alignment with the temperature objective of Paris” are therefore different concepts.**

The key characteristics of the used trajectories and methods are highlighted in table 3. A full explanation can be found in [I4CE, 2019](#).

3.Alignment with “the objectives of the Paris Agreement”

The concept of “alignment with the Paris Agreement objectives» takes on a broader dimension ([I4CE, 2019](#)).

As the temperature target is just one of the aspect of the three long-term objectives of the Paris Agreement:

- Transform the economy and society to reach zero net absolute emissions in the second half of the century in order to limit the increase in temperatures well below 2°C;
- Encourage the adaptation of individuals, companies, economies, and societies to the impact of climate change in the short- and medium-term;
- Make consistent, or «align», all financial flows with long-term climate objectives.

Therefore, approaches that seek to assess portfolio and company “compatibility with the Paris Agreement objectives” would need to integrate a minima additional considerations relating to the desired trajectories to achieve the temperature goal, but also aspects relating to adaptation and broader sustainable development objectives.

Table 3: Key principles of temperature alignment assessments depending on the type of “alignment” assessed (adapted from I4CE, 2019).

	Trajectory (ies) principles	Methodological principles
Temperature trajectories alignment (e.g. 2°C trajectories alignment)	Any as long as it is compatible with the relevant temperature outcome (e.g. 2°C).	Any, as long as internally-consistent: alignment as a mathematical measure of proximity.
Alignment with the temperature objective of the Paris agreement	<ul style="list-style-type: none"> • Trajectories limiting the increase to 1.5°C, with global peaking of emissions “as soon as possible” followed by a rapid reduction of emissions to achieve carbon neutrality in the second half of the century. <p>Precautionary principle:</p> <ul style="list-style-type: none"> • Trajectories with no or limited overshoot; • Lower reliance on GHG removal technologies. 	<ul style="list-style-type: none"> • Internal consistency; • Covers all sectors; • Adopt a value-chain approach; • Takes into account locked-in emissions; • Base evaluations on estimates of how to optimize the long-term transformation of the economy at least cost; • Update through time; • Takes into account uncertainty.
Alignment with the objectives of the Paris agreement	<p>Same as above + take into account nationally determined climate-resilient low-carbon development pathways:</p> <ul style="list-style-type: none"> • Take nationally determined pathways as a starting point; • Take into account adaptation and broader sustainable development objectives. 	<ul style="list-style-type: none"> • Same as above; • Covers all activities (whole portfolio/ asset classes); • Captures incremental changes and long-term transformative outcomes.

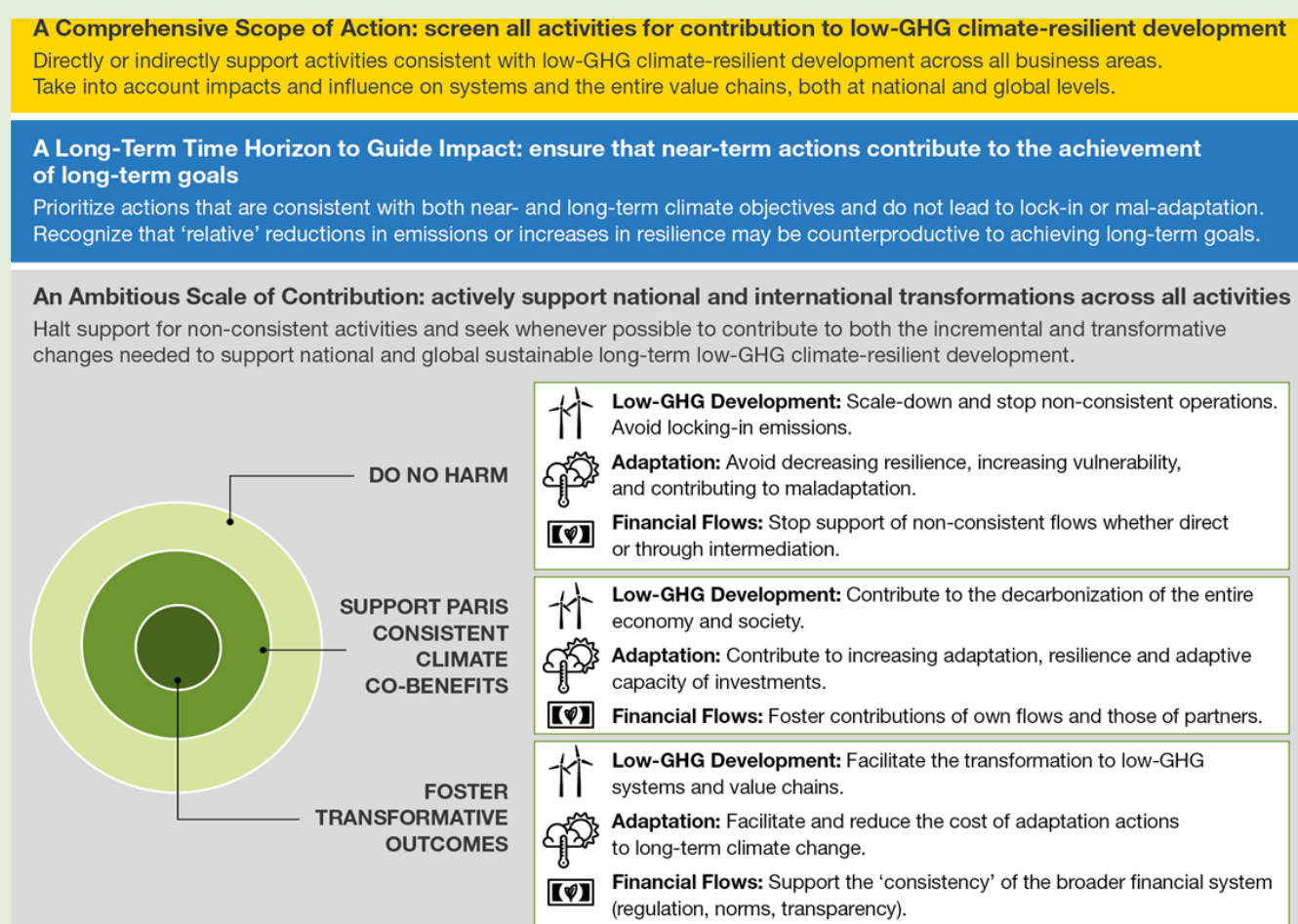
To date, it remains to be shown whether a “trajectory alignment” type of assessment could be used to demonstrate “compatibility with the Paris Agreement”, in a relevant, sound, and easily-understandable way, as explained in section 3.

In focus: From portfolio to organizational alignment with the Paris Agreement

Alignment with the objectives of the Paris Agreement encompasses not only the compatibility of an investment portfolio with the temperature objective but also the level of contribution of an institution to all three objectives of the Paris Agreement in the context of the broader sustainable development.

In 2019, I4CE released a framework “designed to assist economic actors to understand the implications of alignment with the Paris Agreement for their overarching strategies, as well as operational frameworks and procedures”. The framework specifies three dimensions for action as shown in figure 5 below.

Figure 5: Three dimensions of investors’ actions for Paris Alignment ([I4CE, 2019](#))



According to this framework, being aligned with the Paris Agreement would require that financial institutions “scale-down and halt activities inconsistent with the three goals of the Paris Agreement and contribute whenever possible to national attainment of low-GHG climate-resilient development”. This requires institutions to both ensure that all of their activities are consistent with long-term goals as well as “best leverage their potential to support low-GHG climate-resilient transformations in their countries and sectors of operations”.

According to I4CE, “the scale of contribution of financial institutions will vary as institutions may be involved in different types of business lines that have impact-oriented objectives or more commercial objectives”. However, “whether institutions are principally focused on sustainable development impacts or commercially oriented, a commitment to ‘Paris Alignment’ is a commitment to adopt the high level of ambition that is

embodied in the Paris Agreement ([I4CE, 2019](#))”.

Currently, temperature alignment assessments are insufficient to address this third aspect of I4CE's framework, as none of them guarantee that an entire portfolio “do no harm” as per the above-mentioned criteria or assess the level of contribution of this same portfolio. These assessment approaches may be useful to provide one portfolio-wide outlook, however they need to be complemented by other tools and assessment frameworks.

The difference between alignment with a low-carbon trajectory and “sustainable” activities exposure

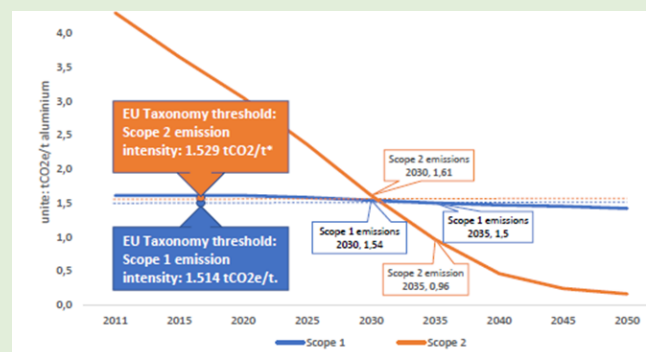
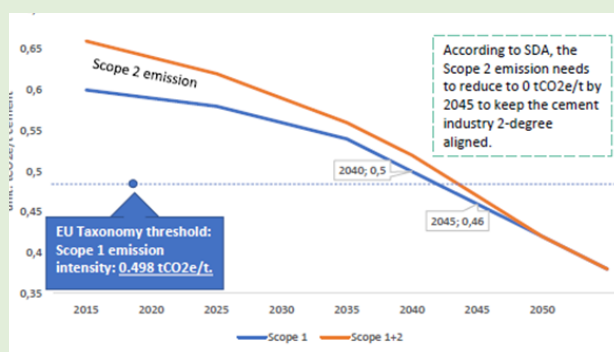
The focus of this report is on climate alignment methodologies that assess the compatibility of portfolios with temperature trajectories. This slightly differs from approaches, tools, and regulations that define and assess the exposure of portfolios to activities deemed already “aligned”, “2 °C compatible”, or “green”.

The EU Taxonomy on Sustainable activities, published in March 2020, is “a tool to help plan and report the transition to an economy that is consistent with the EU’s environmental objectives ([TEG, 2020](#)).” It defines a list of economic activities and the conditions under which they can be considered “sustainable”. In particular, it differentiates between economic activities that are already compatible with a 2050 net-zero carbon economy, or “green activities”; activities that enable low-carbon performance or emission reductions, or “enabling activities”; and activities that must enhance their performance, without lock-in to carbon-intensive companies or processes to be compatible. Data sources include (Natixis, 2019):

- Abidance by standard/label/regulation (reforestation, CCS, new buildings);
- Use of best available technology (solar PV, electric vehicles, aluminum recycling);
- Emission thresholds, by intensity or absolute (cement, growing of crops), built on different sources (cement sector based on the 10% best performers on the EU ETS e.g.).

These criteria are more or less ambitious depending on the activity, especially when compared to the decarbonization trajectories defined in scenarios such as the IEA ETP. For example, the cement emission threshold corresponds to the 2040-2045 emission intensity levels under a 2 °C scenario ([Natixis, 2019](#)). Therefore, the percentage of investments that are “taxonomy-aligned” indicates the exposure of a portfolio to activities that are already compatible with a 2 °C economy at a specific point-in-time.

Figure 6: Comparing the levels of ambition within the taxonomy with the IEA ETP 2017 trajectory for two selected sectors (left: cement, right: aluminium)



The main difference between these approaches and “alignment with a temperature trajectory” assessments is that the former defines “sustainable” activities rather than the trajectory that all companies and portfolios should follow through time. A 100% exposure to “aligned” activities as per the Taxonomy definition is not necessary for a portfolio to be compatible with a 2 °C trajectory, at least on the short to medium run. Indeed, trajectory alignment methodologies rely on the assumption that a portfolio exposed to “brown” assets that decarbonize and are phased out at the appropriate speed can be, in theory, considered 2 °C aligned.

In practice, as investors are using different methodologies relying on different scenarios, including uncertainty at all steps of the assessment process, the brown component of portfolio still need to be considered carefully to ensure that it is really compatible with a 2 °C trajectory.

1.2. ALL LIGHTS ON THE USE CASE: WHAT CAN TEMPERATURE ALIGNMENT METRICS BE USED FOR?

Portfolio temperature alignment (e.g. 2°C alignment) is defined, in Section 1.1, as “compatibility” or “consistency” with a given trajectory limiting temperature rise under a specific level (e.g. 2°C). “Compatibility” is already an objective in itself, as put in the article 2.1(c) of the Paris Agreement. Is compatibility an indication of portfolio contribution to the ecological and energy transition and impact? Of lower transition risk exposure? It is argued in the first part of this section that whether this type of assessment is a good proxy for transition risk or impact analysis can be debated.

Provided it relies on sound and consistent methodological foundations, portfolio temperature alignment assessments are useful to monitor portfolio compatibility with one or several temperature trajectories and identify areas to focus or develop strategies to make investment flows “compatible” with a temperature objective. Therefore, this type of assessment can be used both from an ex-ante (target-setting and steering action) and ex-post perspective (monitoring and reporting), as highlighted in the second part of this section.

1.2.1. From compatibility to impact and risk assessment?

A proxy to measure portfolio transition risk (and opportunity) profile? Temperature alignment assessments are sometimes presented as a measure of the degree of transition risk and opportunity exposure. Indeed, it relies on forward-looking scenarios, just as the climate scenario analysis promoted by the TCFD for risk analysis. Temperature alignment assessments may, under certain circumstances, inform on the over- or under-exposure of a portfolio to sectors and companies which could potentially be affected by the transition under one or several specific scenarios. However, the overall usefulness of temperature alignment assessments for transition risk analysis is debated and is not as clear-cut.

- Transition risk is mainly created through the **uncertainty around the transition trajectory** that the economy will take in reality. In that perspective, it is more informative to consider a several different transition trajectories covering both 1. Trajectories leading to different temperatures (i.e. from the same family such as different IEA scenarios), and 2. Trajectories leading to the same temperature but taking different shapes and assumptions (i.e. IEA scenarios vs. Greenpeace, or coordinated transition vs abrupt and uncoordinated transition), including trajectories depicting a disorderly transition.

- Under certain trajectories, green assets, or “aligned” companies may also be prone to transition risk, for example changing policy schemes as has been demonstrated in the past through sudden changes in feed-in tariffs, notably in the UK and Spain/Portugal.

Other sources of transition risks include competition among different green technology solutions, not all may be among the winners in the end. In addition, a portfolio aligned to an orderly 2°C scenario may present high transition risks if the transition is actually brutal and disorderly.

- Transition risk analysis, when done at asset-level, needs to take into account the **ability of the company to adapt to the identified risk** (i.e. change of products sold) as well as its capacity to avoid the risk (i.e. by handing down price shocks to consumers or by negotiating exemptions). For a detailed discussion on this topic, see [2° Investing et al., 2017](#).

- **Temperature alignment assessments are not sufficient in itself.** They do not provide information on the probability or the extent of the potential losses attributable to transition risks. Furthermore, research suggests that carbon intensity is a proxy of only limited use for transition risk analysis ([2° Investing Initiative, 2015](#)). Thus, an analysis of a portfolio’s transition risk profile requires additional research elements and indicators. A forthcoming report from I4CE will discuss in detail methodologies that aim to assess transition risks for portfolios.

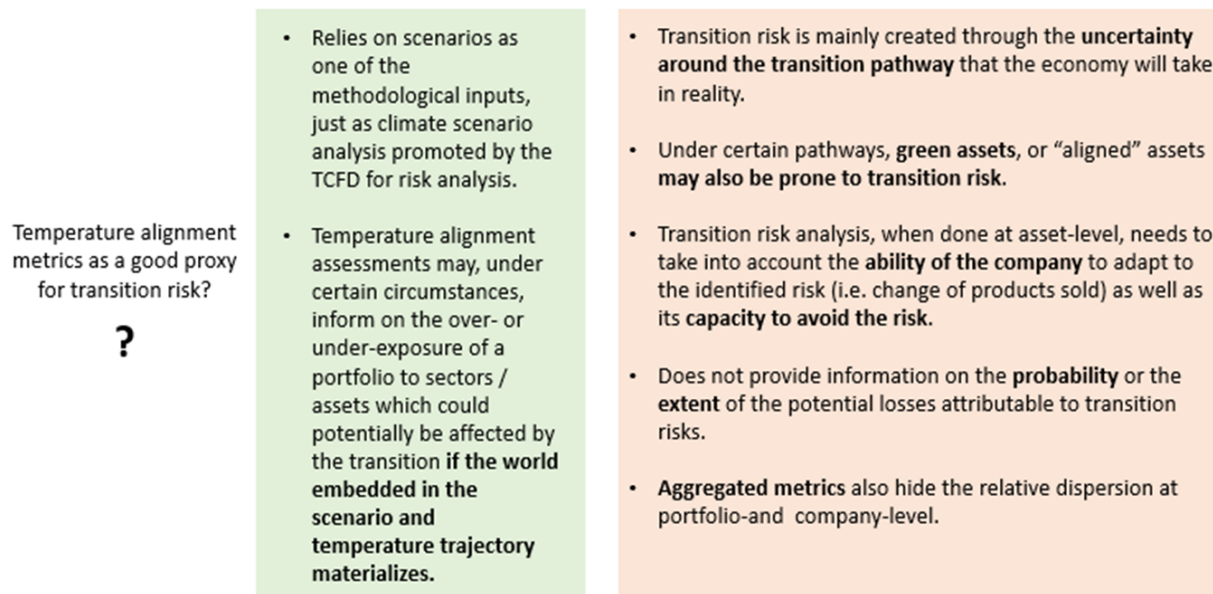
- Portfolio temperature metrics are sometimes used to express the degree of alignment as a single metric. These are not an adequate measure of the degree of portfolio exposure to transition risk and opportunity. Indeed, an aggregated metric does not provide information on dispersion: for example, two different portfolios may be rated as 2°C-compatible. Yet, one may be composed of only 2°C compatible companies, another of 1.5°C and 4°C compatible companies. A portfolio aggregated metric hides this.

- **Aggregated metrics also hide the relative**

dispersion at the company-level. As put forward in Kepler Cheuvreux et al. Carbon Compass report (2015), “just as there are several metrics used to assess the financial performance of an investment, the multifaceted nature of carbon and climate change

should be captured through multiple metrics”. For example, a 2°C-compatible company may have a small number of “unaligned” products that, even if they represent a small portion of revenue, may be targeted by NGOs and lead to significant reputational issues.

Figure 7: Summary figure - the overall usefulness of temperature alignment assessments for risk analysis can be debated.



A proxy to measure portfolio impact and contribution to the low-carbon transition? Alignment and temperature analyses have also been promoted in the context of investor reporting on their potential impact and “contribution” to the low-carbon transition. In parallel, the rise of decarbonization pledges and targets from financial institutions often have an “impact” objective. Yet, whether temperature alignment metrics are a good proxy for portfolio impact and contribution can be and is debated.

The ongoing debate focusses on three points, in the context of setting science-based targets for financial institutions and defining impact on the basis of temperature alignment assessments: 1. Reduction of emissions in the real world, 2. Chain of causality, and 3. Additionality.

- **First, certain actors argue that to make an impact claim, it is necessary to demonstrate that the action of aligning portfolios with a low-carbon trajectory results in actual reduction of emissions in the real economy, and not a redistribution of emissions between investors.** In a world where only a limited number of investors aim to align their investments with a low-carbon trajectory and contribute to the transition, there is no scientific evidence today to demonstrate that the actions taken to reduce the carbon exposure

of their portfolios lead to a real-world carbon reduction – it may well depend on the type of action taken (2° Investing Initiative, 2019). Other actors argue that if a large enough number of institutions take targets and align their portfolios with a 2°C trajectory, this may lead to the creation of a critical mass over time and the wide-spread adoption of 2°C targets by companies (CDP, Global Compact, WRI and WWF, 2020).

A 2°C aligned portfolio is in theory likely to have lower overall carbon emissions (cumulated over the time horizon analyzed) than a non-aligned portfolio with the same sectoral distribution, provided an appropriate assessment perimeter, and may be considered more “climate-friendly”. It does not mean that through a portfolio that decarbonizes over time a financial institution has a positive impact or contributes to the transition in the real economy. If all portfolios were 2°C “aligned” according to the same methodology, provided sound and consistent methodological foundations, the world would be, theoretically, on a 2°C trajectory. Yet, this is not feasible unless companies transform themselves – provided that at the moment, the world is on a 3.2°C trajectory (UNEP, 2019), meaning that the aggregate climate performance of all economic actors is not on a 2°C track. Therefore, can investors’ actions to make their portfolios compatible with a 2°C world put the world on the right track?

Emission reductions needs to be assessed ex post based on concrete outcomes on the ground and at the local and sector level. Most current temperature alignment methodologies provide an outlook of the compatibility of a portfolio with one or several global scenarios. However, the decarbonization of the global economy will differ from one country to another and from one sector to another. One asset that may decrease emissions in one country might increase them in another. For example, gas power plants might be aligned with a 2°C trajectory in some countries but will be misaligned in others. Measuring the real economy emission reductions thus requires additional more granular assessment tools and processes

- **Second, alignment is a result, yet the chain of causality is difficult to prove.** Let's say an investor has a 2°C aligned portfolio A and a 2°C misaligned portfolio B - what evidence-based claims could he make concerning his own «impact»? If companies in portfolio A have, in the aggregate, a better impact than companies in portfolio B, it does not mean this is because of investors' actions. In practice, what really counts for climate-friendliness and impact, is the investor strategy beyond the simple portfolio composition (e.g. engagement, signaling, etc.). These aspects are however in general not considered in the methodologies for the assessment of alignment with a temperature trajectory. Certain actors, therefore, argue that it is necessary to start collecting ex-post evidence to devise adequate methodologies that capture this ([2° Investing Initiative, 2020](#)).

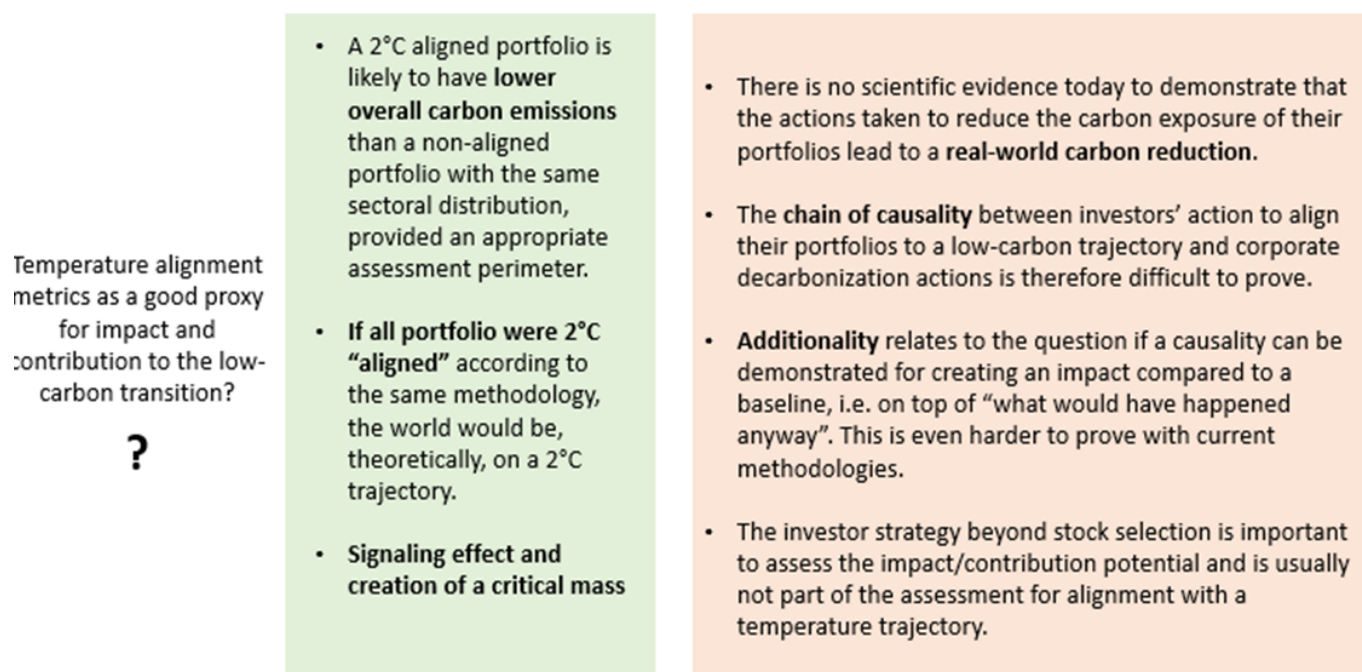
- **Finally, questions remain as to the “additionality” of investors' actions.** As put by ISS, Climate-Kic, and 2° Investing Initiative ([2019](#)): “Additionality relates to the question if causality can be demonstrated for creating an impact compared to a baseline, i.e. on top of “what would have happened anyway”. This means that an investor's action can lead to emission reductions

without necessarily being additional. An example is an investor providing a subsidized loan for a low-carbon project thus enabling the said project (impact). However, the investor's action is only additional, if the project would not have been built anyway. As such, if another investor would have provided a loan for equal conditions enabling the project, the action while having an impact in the narrow sense of the term, would not have been additional.”

The contribution of the investor will therefore depend on the approach adopted. For example, an approach consisting in investing in and engaging with highly-emitting companies, divesting from these once they make the necessary transition to a low-carbon world, and reinvesting in highly-emitting companies could be, in theory, considered more impactful and as better contributing to the transition of economies than another approach focusing on the divestment from highly-emitting companies and investing in less-emitting or climate-friendlier companies. Yet, its “alignment” performance would most likely be worse using the currently available temperature alignment methodologies. Outcomes of temperature alignment assessments thus need to be explained by investors and presented in the perspective of the specific investment strategy that they have adopted.

Finally, since it is clearly the regulator's intention to produce a real-word decarbonization outcome, more academic research is needed to positively confirm whether from a collective temperature alignment assessment of investors' portfolios a collective contribution of investors, instead of an individual contribution, can be derived. It goes without saying that this would necessitate taking into account a critical AUM size threshold effect that is required in order to start producing a tangible decarbonization impact in the real economy as a result of collective investment allocation decisions.

Figure 8: Summary figure - the overall usefulness of temperature alignment assessments for impact analysis can be debated.



Therefore, provided all the current debates around the usefulness of such metrics and approaches to assess portfolio and company exposure to transition risk on the one hand, and potential impact and contribution to the low-carbon transition on the other, this report focusses on devising appropriate methodologies to measure “compatibility” with a temperature trajectory and with the temperature objective of the Paris Agreement, as explained in part 1.1.2 of section 1.1. “Compatibility” is already an objective in itself, as put in the article 2.1(c) of the Paris Agreement. However, whether compatibility is a good proxy for impact or transition risk remains an open question that requires additional evidence to be properly demonstrated.

In the next section, we highlight how temperature alignment assessments can be used from an ex-ante (target-setting and steering action) and ex-post (monitoring) perspectives.

1.2.2. From reporting to steering action

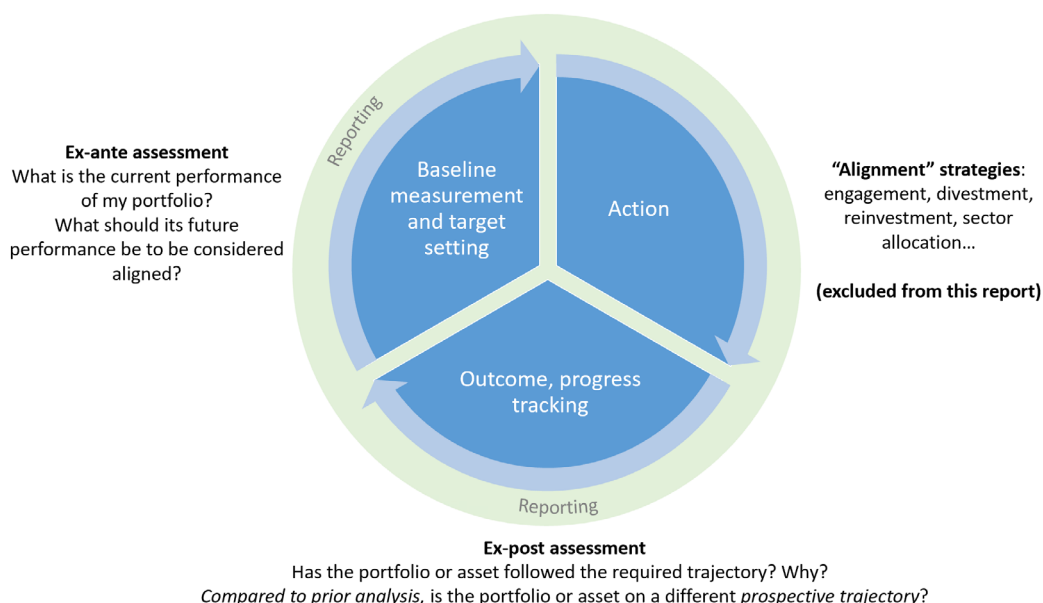
From reporting to steering action: the portfolio transition framework. Portfolio temperature alignment assessments have mostly been used by investors, so far, for exploratory purposes and reporting. This

is particularly the case for assessments that lead to results expressed through an Implied Temperature Rise (ITR) metric: while Novethic counted 2 occurrences of such an indicator in its 2017 review of the 100 largest French investors, this number increased to 6 in 2018 and 18 in 2019 ([Novethic, 2019](#)).

Increasingly, investors use temperature alignment approaches, expressed through a range of indicators, to select asset managers or structure “aligned” or 2°C compatible portfolios. More recently, these approaches are explored in the context of target-setting and building investment strategies to align portfolios through time. Therefore, these methodologies are becoming instrumental in steering action and transitioning portfolios, amongst a range of other approaches such as green-brown share and scores.

Ex-ante and ex-post assessments. Is the objective of the portfolio temperature alignment assessments to monitor the evolution of its portfolio compatibility with a 2°C trajectory (ex-post) or to assess the current position of the portfolio to set targets and trigger actions (ex-ante)? It is likely that in practice an investor wishes to have both lenses – for simplicity purposes, we differentiate two types of assessments.

Figure 9: Summary figure: Temperature alignment assessments within the portfolio transition framework



Ex-ante assessment corresponds to a target-setting and “action” objective. What is the gap between the current climate performance of my portfolio and what is expected, on what prospective trajectory is it compared to the reference trajectory, and what can I do to steer it on the desired trajectory?

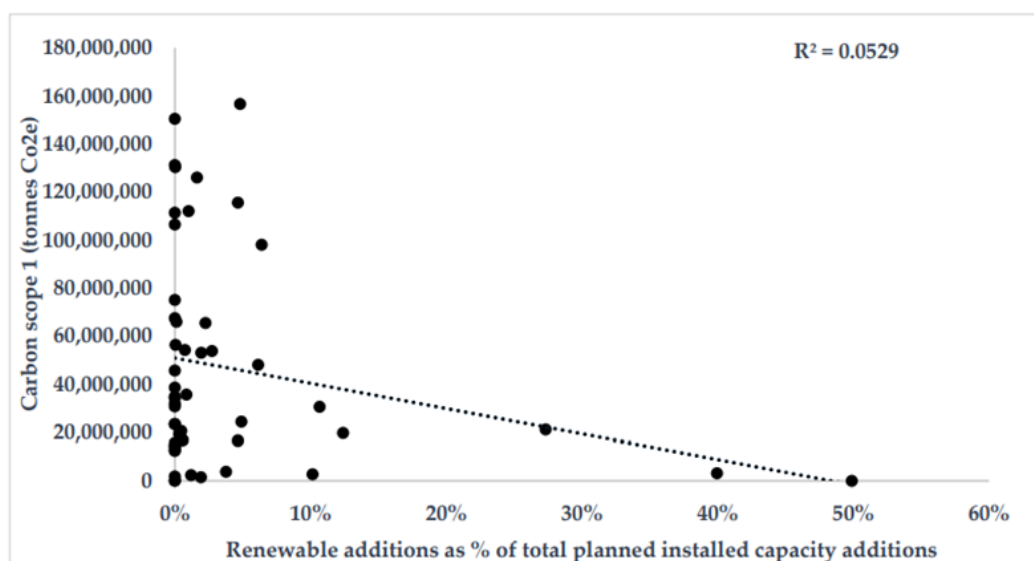
- The current climate performance of companies and portfolios can be compared to their desired performance in the future T+N as defined by their temperature alignment benchmarks. This answers the question: how far is the company or portfolio performance today compared to where it should be according to the benchmark in T+N?
- The forecasted climate performance of companies and portfolios can be compared to its desired climate performance in the future T+N as defined by the temperature alignment benchmark. This answers the question: Is the company or portfolio on the right path to reach the desired state in T+N?

While the attempt to forecast the future climate performance of companies and portfolios introduces, by definition, uncertainty, it may still yield interesting and additional insights.

Indeed, the current climate performance of a company or portfolio is not a good indicator of its future performance.

As put by Thomä et al. (2018), “point-in-time indicators of the share of high-carbon power production for electric utilities show no correlation – positive or negative – with planned renewable power capacity additions. In other words, electric utilities that are more high-carbon currently do not necessarily invest more or less in low-carbon alternatives in the future. This lack of correlation [...] suggests that temporal boundary choices are critical for determining the climate unit of accounting [...].”

Figure 10: Current climate performance is not a good proxy for future performance (Thomä et al., 2018): “the correlation between Scope 1 GHG emissions of a sample of 50 global listed electric power utilities and the share of renewable power in planned capacity additions, based on S&P Trucost Scope 1 data and GlobalData power investment data”.



Ex-post assessment corresponds to a monitoring objective. It helps answer two complementary questions:

- Has the portfolio or company followed the required trajectory in the past? Why?

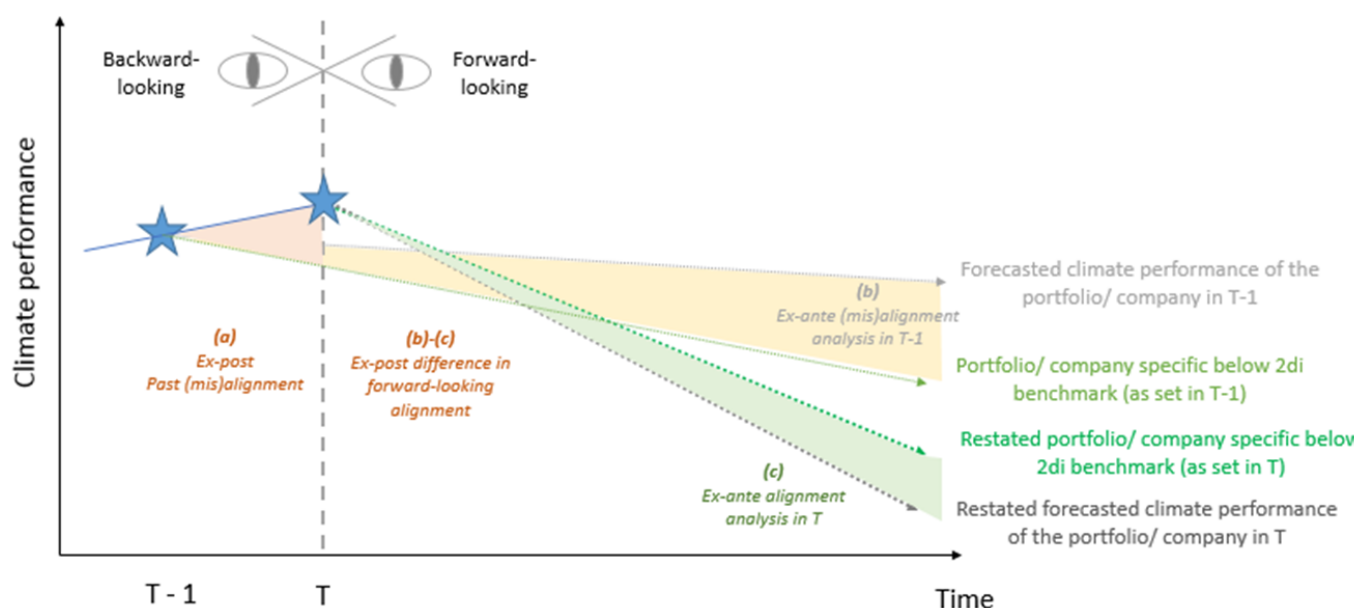
- Compared to prior assessment, is the portfolio or company on a different prospective trajectory? Why? This last question relates as to ex-ante analysis: indeed, one can see it as a back-test of past forecasts, and therefore a measure of the reliability of the present forecasts.

Figure 11: Simplified graphical representation of the different types of ex-post and ex-ante assessment.

Ex-ante: Is the company or portfolio on the right path to reach the desired state in T+N: green area (c)

Ex-post: Has the portfolio or company followed the required trajectory in the past: red area (a)

Ex-post & ex-ante: Compared to the past, is the portfolio on a different prospective trajectory: (b)-(c)



In light of the different ex-ante and ex-post type of assessment highlighted above, the following characteristics are desirable for a temperature alignment methodology.

Table 4: Key desirable methodology characteristics depending on the assessment question

Type of assessment	Characteristics of methodology
Ex-ante	
How far the company or portfolio performance today is compared to where it should be according to the benchmark in T+N?	Current climate performance of asset/portfolio Most recent forward-looking alignment benchmark(s)
Is the company or portfolio on the right path to reach the desired state in T+N?	Current climate performance of asset/portfolio Forecasted future climate performance of asset/ portfolio Most recent forward-looking alignment benchmark(s)
Ex-post	
Has the portfolio or company followed the required trajectory in the past? Why?	Time-series of climate performance of asset/ portfolio Attributional methodology (sector allocation/ stock selection) Historical alignment benchmark(s) if available (see expert track)
Ex-ante and ex-post	
Compared to prior assessment, is the portfolio or company on a different prospective trajectory? Why?	All of the above

Both ex-ante and ex-post assessment rely, at least partly, on forward-looking assessment. This raises the question: What should the time horizon be? It depends on whether one seeks to measure compatibility with “one or several temperature trajectories”, “the temperature objective of the Paris Agreement” or “the Paris agreement” through the temperature alignment assessment (see p.16 for definition and key differences between the three).

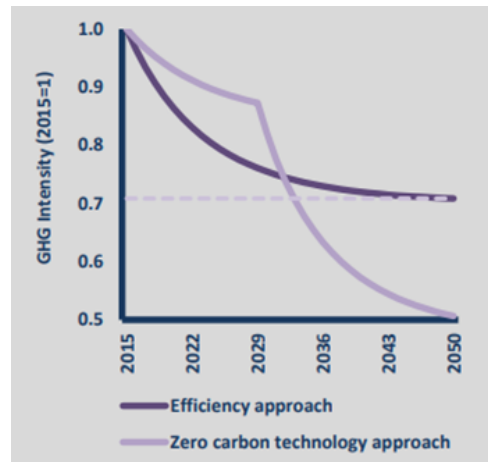
- Compatibility with one or several temperature trajectories (e.g. 2° trajectories): As long as the assessment time horizon is specified, any time horizon can be chosen to assess “compatibility”.
- Compatibility with the “temperature objective of the Paris Agreement” and with “the Paris Agreement”: The Paris Agreement seeks to limit temperature rise well below 2°C by the end of the century. Therefore, the time horizon of this type of assessment should capture both incremental changes and long-term transformative outcomes. Temperature alignment may be assessed over different time horizons: short-term (1-2 years); medium-term (5-10 years) and long-term (10 years +). Using a short time horizon only is not sufficient in capturing trends and necessary transformations in each industry required for the transition to happen. It could have a perverse effect, by favoring marginal decreases that would soon reach

a floor, or even leading to lock-in.

In this context, the concept of «decarbonization glass floor», coined by 2° Investing Initiative, is central. Indeed, both incremental and disruptive innovations are necessary to align different sectors of activity and the economy more generally to the energy and ecological transition. A purely mathematical gap analysis made with too short a time bias will have the effect of favoring those who put in place short-term measures, often incremental and easy to reach, and may not capture the efforts made to develop disruptive innovations, such as fuel switching and the development of alternative materials, necessary to decarbonize efficiently and widely in the long term. Adopting a short-term horizon may thus send the wrong incentives and therefore be dangerous when a long-term perspective is used.

There are, however, many methodological trade-offs involved in using a long-term perspective, explored on p.65. Assessments that rely on the long-term only may suffer from increased uncertainty inherent to forecasting a company’s future climate performance. Therefore, it is best to look at several time horizons, including the medium (5-10 years) and long-term (10 years+) and be transparent on the time horizon used.

Figure 12: the illustrative decarbonization glass floor under two scenarios (2° Investing Initiative, 2017)

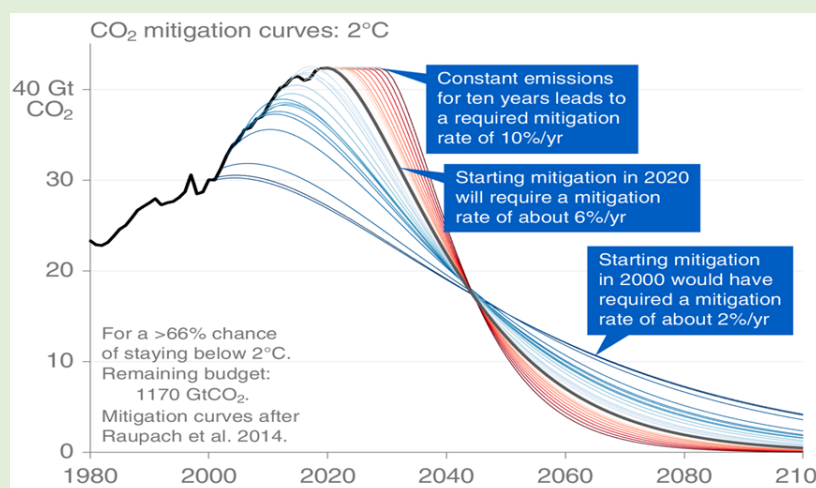


Expert track: Restating the benchmark and attributing changes

Attribution of change in ex-post assessment and benchmark updates. The total carbon budget remaining to limit temperature rise under a certain limit decreases through time, as we have “overspent” it every year so far. Therefore, the remaining global carbon budget gets lower every year and the decarbonization rate required for a portfolio or company to be 2°C aligned gets steeper.

- **Implication 1:** For this reason, it is essential to use the most recent scenario possible when performing temperature alignment assessments. Indeed, given the current trend of the world towards a 3.2°C world and yearly overshoot, using an older benchmark makes it easier to achieve 2°C “alignment”. Temperature alignment claims may not be made based on older benchmarks because doing so would not take into account the overshoot that has accumulated between the publication date of the benchmark used and the time of the assessment.

Figure 13: The more we wait, the higher the required cuts in emissions to limit temperature increase (Robbie Andrew, 2020). According to the UNEP Gap report (UNEP, 2019), “had serious climate action began in 2010, the cuts required per year to meet the project emissions levels for 2°C and 1.5°C would only have been 0.6 and 3.3% per year on average. Since this did not happen, the required cuts are now 2.7% and 7.6% per year from 2020



- **Implication 2:** In this context, even if a portfolio is aligned with a 2°C trajectory in a given year, it may not be aligned anymore when the decarbonization benchmark is recalculated and re-stated, everything else being equal. Therefore, when monitoring yearly whether an investment portfolio is still in line with a 2°C trajectory, it is important to state to what extent the changes are attributable to changes in the underlying benchmark used, everything else being equal, and to changes in the actual portfolio.

2. THE COOKBOOK: MAPPING TEMPERATURE ALIGNMENT METHODOLOGIES

The objectives of this section are to 1. Explain the general recipe of temperature alignment assessments, 2. Review available methods and approaches on the market. 3. Explicit the specific choices that can be made within each of these steps and their implications.

KEY TAKEAWAYS

In this section, different practical temperature alignment approaches are reviewed. In particular, the general recipe of portfolio temperature alignment assessments is outlined, based on literature and methodological review and discussions with experts. Generally-speaking, portfolio temperature alignment methodologies seek to quantify the gap between portfolio climate performance, current and future, and one or several reference decarbonization trajectories, or temperature benchmarks.

In many instances, the distinction is made between alignment methods by technology or by GHGs. For example, within the TEG Benchmark report ([2019](#)), the difference is made between “technological alignment that refers to technical scenarios and assesses if the technological solutions are represented in a satisfying proportion” and “emissions dynamic assessment, measuring if the direct, indirect emissions and emissions savings lead to trajectories compatible with climate trajectories”.

However, there are many more differences than just the alignment metric chosen to express the decarbonization pathway. The devil is in the details. How do you define portfolio climate performance? What metric and perimeter should be used? How do you choose the scenario(s) and the reference trajectories? Is the gap measured at a specific point-in-time or through time? How are the results expressed? The general recipe of temperature alignment assessments comprises of four general steps, each encompassing several methodological choices.

Step 1. The starting point is measuring the climate performance, at company or portfolio level;

Step 2. It is then necessary to choose one or several scenarios;

Step 3. Decarbonization trajectories provided from these scenarios then need to be converted to micro-actors’ temperature alignment benchmark(s);

Step 4. By comparing the results of step 1 and step 3, the temperature alignment assessment is then performed. The results of the proximity assessment are directly expressed through an indicator (an implied temperature rise (ITR) metric or other).

Many permutations of the same recipe are possible. It is indeed possible to imagine as many alignment and temperature methodologies as the number of possible permutations between each of the methodological choices available and applicable. Several methodologies, frameworks, and approaches are reviewed, by making the difference between:

- Approaches and frameworks that have been developed to help companies set decarbonization targets in line with science and the international temperature limitation objective (methods as approved by the Science-Based Targets Initiative: Sectoral Decarbonization approach; GEVA...).
- Industry-led company-level assessment frameworks that build upon the above methods and combine them with additional datasets to assess the

climate performance of companies in the face of the energy and ecological transition (ACT, TPI...);

- Methodologies developed by data providers or investors' themselves that can be aggregated at portfolio-level, building on company-level methodology or not (all data providers, an increasing number of investors that develop their method);
- Regulatory and industry initiatives that seek to harmonize and put in place specific criteria to help investors measure and steer their portfolios towards a well below 2°C trajectory (TEG Benchmark, SBTi-Finance, NZAOA...).

After reviewing the methods currently available on the market and their key differences, the range of

methodological choices available at each step of the recipe is highlighted in this part. For more technical details, please refer to part 4.

It is worth noting the multiple layers of uncertainties that compound themselves at each step of a temperature alignment methodology. In particular, expressing the results through an Implied Temperature Metric (ITR) may give the impression that they can be directly compared with the IPCC results. It is worth stressing that these approaches are very simplistic in comparison to IPCC climate models and approaches. The ITR metric can indicate the relative magnitude of the climate performance of one company or portfolio relative to another. However, in their current state, they can hardly be interpreted in absolute terms as temperature outcomes of different portfolios.

2.1. A TASTE PALETTE OF TEMPERATURE ALIGNMENT METHODS: HIGH-LEVEL REVIEW

There are four high-level steps in performing portfolio temperature assessments. Each of these steps is reviewed in this section, along with the specific methodological choices that can be done within each of these. How different actors, including data providers and investor-level initiatives, have tackled these questions is then highlighted in the second part of this section.

2.1.1 The general recipe of alignment and temperature methods

The recipe: four general steps. At the highest level, there are four high-level steps for building a temperature alignment method. These steps are broadly common to most methods reviewed as part of the report, although each methodology has its specificities.

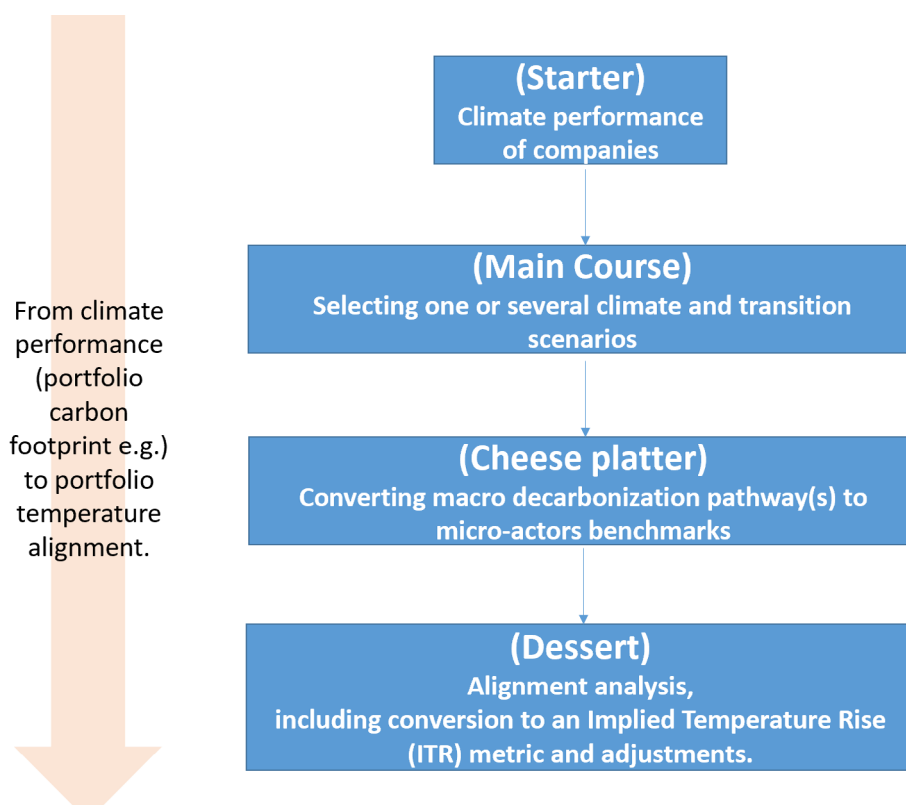
1. The first step is to **measure the climate performance, at company or portfolio level**;
2. It is then necessary to **choose one or several scenarios**;

3. Decarbonization trajectories provided from these scenarios then need to be **converted to micro-actors temperature alignment benchmark(s)**;

4. By comparing the results of step 1 and step 3, the **temperature alignment assessment** is then performed. The results of the proximity assessment are directly expressed through an indicator (an implied temperature rise (ITR) metric or other).

The results are aggregated at the portfolio-level, either before or after the temperature alignment assessment is performed. Finally, adjustments to the results can be made, for example to reflect the relative importance of different sectors in the low-carbon transition.

Figure 14: A four-course meal



From climate performance assessment towards portfolio temperature alignment. A relatively large and increasing number of investors already seek to measure the climate performance of their portfolio, using a range of metrics, including but not limited to carbon footprinting, green share, and climate scores. (Kepler et al, 2015). When the final assessment

objective of portfolio temperature alignment assessment is putting in context the portfolio climate performance, there is an added difficulty.

Indeed, it is necessary to take into account and understand the additional steps (steps 2, 3, and 4 on figure 14) to devise an appropriate calculation

protocol for portfolio climate performance (step 1). **These steps do not work in isolation.** For example, if the decarbonization benchmark (as devised in step 3) is expressed in GHGs emissions per unit of GDP, what is the best way to measure GHG emissions across a portfolio?

Historically, temperature alignment methods have been differentiated based on the metric they use to express the decarbonization benchmark, be it technology or GHGs. For example, the TEG Climate Benchmark report differentiates between “technological alignment that will refer to a technical scenario and assess if the technological solutions are represented in a satisfying proportion” and “Emissions dynamic assessment, measuring if the direct, indirect emissions and emissions savings lead to pathways

compatible with climate trajectories ([EU TEG, 2019](#)).”

However, **there are many more differences to temperature alignment methodologies than just the alignment metric chosen.** The devil is in the details. How do you define portfolio climate performance? What perimeter should be used? How do you choose scenarios and reference trajectories to create temperature alignment benchmarks? Is alignment measured at a specific point-in-time or through time? How to translate temperature alignment into an Implied Temperature Rise (ITR) indicator?

The ingredients: from high-level steps to specific methodological choices. Within each of the high-level steps, methodology developers need to make specific choices.

Table 5: Key methodological questions (see the technical deep-dive p.84 for a detailed review)

State primary assessment question (compatibility with one or several temperature trajectories, with the temperature objective of the Paris Agreement or with the Paris Agreement); Ex-ante and/or ex-post assessments	
Starter: Assess the climate performance of the portfolio – see p.85 of the technical deep-dive	
What metric should be used?	GHGs; activity/ technology; energy mix; normalization metric
What value-chain perimeter to use?	Scope 1; Scope 1 & 2; Scope 1, 2 & 3; “Relevant scope”
Should avoided emissions be included?	No/ yes; how to manage double-counting issues?
Should “removed” emissions be included?	No/yes; as separate assessment or netted?
Asset-level forward-looking data?	No, yes; how (extrapolation, targets, asset-level database)?
Main Course: Selecting appropriate scenarios and reference trajectories see p.103 of the technical deep-dive	
What scenarios and how many?	Conceptual/ practical considerations; one or several
How to adapt a third-party derived pathway?	Additional sectors; geographical breakdowns; restatements
Cheese Platter: Building micro-level temperature benchmarks see p.120 of the technical deep-dive	
How to express the benchmark?	Absolute, efficiency, intensity metrics
How to allocate the benchmark to companies/ portfolio?	Additional sectors; geographical breakdowns; restatements
Dessert: Alignment assessment and temperature assessment see p.128 of the technical deep-dive	
Should the spread or speed be measured?	Static/ dynamic; trend/gap/cumulated gap
How to express the results?	Binary, score, percentage, temperature
Adjustments	Sectoral constraints, sector weights, bounding
Apportioning and aggregation	Ownership, portfolio weights

2.1.2 Each cook has its specialty: existing recipes as developed by the industry

Many permutations of the same recipe are possible.

It is possible to imagine as many temperature methodologies as the number of possible permutations between each methodological choices highlighted in table 5. A large number of actors have been working and developing tools and frameworks to help investors assess their portfolios against temperature trajectories, structure investment approaches, and set targets. Existing approaches are reviewed in this section. It is possible to differentiate:

- **Approaches and frameworks that have been developed to help companies set decarbonization targets** in line with science and the international temperature limitation objective (methods as

approved by the Science-based Targets Initiative: Sectoral Decarbonization approach; GEVA...).

- **Industry-led company-level assessment frameworks** that build upon the above methods and combine them with additional datasets to assess the climate performance of companies in the face of the energy and ecological transition (ACT, TPI, NEC...);

- **Methodologies developed by data providers or investors' themselves that can be aggregated at portfolio-level**, building on company-level methodology or not (all data providers, an increasing number of investors that develop their own method, NEC...);

- **Regulatory and industry initiatives that seek to harmonize and put in place specific criteria** to help investors measure and steer their **portfolio** towards a well below 2°C trajectory (TEG Benchmark, SBTi, NZAOA...).

Figure 15: A thriving ecosystem

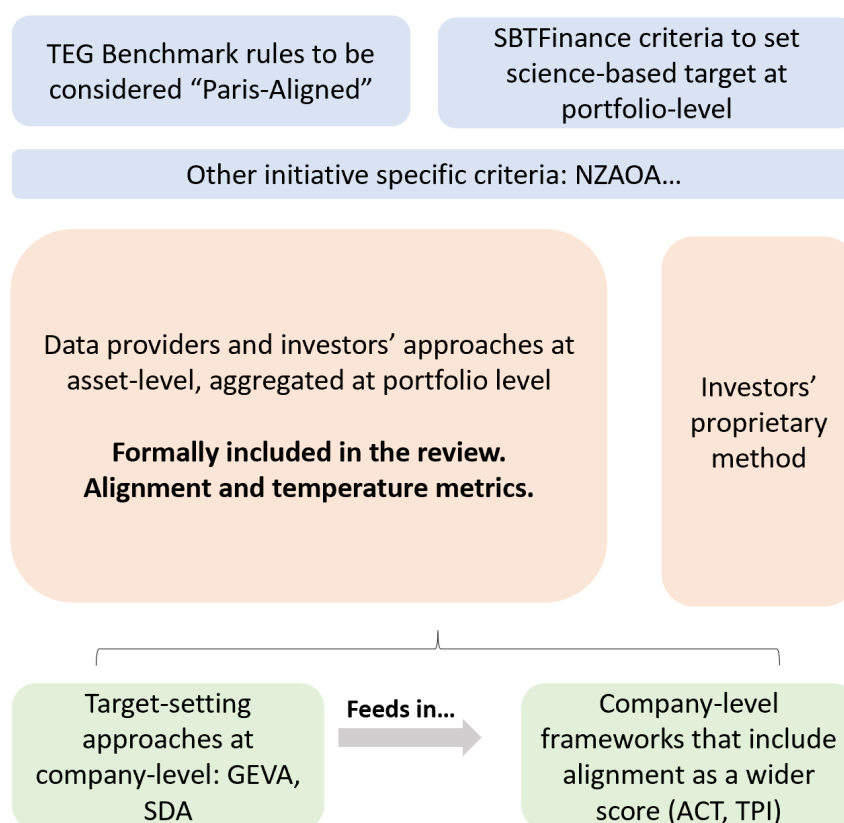


Table 6: High-level review of the main methods and frameworks on alignment and temperature metrics (focus on listed equity and corporate bonds).

Company-level initiatives and methods to set decarbonization target			
Science-based targets initiative (link) – see p.39 for SBTi-Finance specifically.	<p>The Science-Based Targets Initiative is a collaboration between CDP, the United Nations Global Compact (UNGC), World Resources Institute (WRI), and the World Wide Fund for Nature (WWF), and one of the We Mean Business Coalition commitments. Its objective is, among others, to “define and promote best practice in science-based target setting”. Science-based targets are emissions reduction targets that are aligned with reduction trajectories for limiting temperature rise to 1.5°C or well-below 2°C compared to pre-industrial temperatures. In particular, the SBTi helps define and validates science-based targets for companies on a range of criteria such as duration, ambition, and coverage. A large number of methods developed by data providers and investors to measure portfolio temperature alignment temperature build on SBTi methods at the company-level for target-setting.</p>		
	Step 1: Climate performance	Step 2 & 3: Scenarios and benchmarks	Step 4: Alignment and temperature
	<ul style="list-style-type: none"> • Methods rely on GHGs; • All companies must include Scope 3 in their emissions inventory; if Scope 3 represents more than 40% of aggregate emissions, the company must set a Scope 3 target; • Avoided emissions may not be included; • The time horizon for targets is 5 to 15 years, with the exception of Scope 3 supplier engagement targets (5-year time horizon). 	<p>Multiple methods can be used to derive a science-based target, or well below 2°C benchmark. The three main methods are:</p> <ul style="list-style-type: none"> • The sectoral decarbonization approach is based on the 2°C scenario of the IEA (ETP B2DS 2017) and requires companies of the same sector to have their emissions intensity by a unit of production converge by 2060. Target emission intensity varies based on company base year emission intensity, projected activity growth and sectoral budget. • GEVA: Companies are required to reduce their greenhouse gas emissions per value added by 7% per year (compounded). This method is acceptable only if it leads to absolute emissions reduction. • Absolute contraction: all companies reduce their absolute emissions at the same rate, irrespective of initial emissions performance (2.5% YOY min). 	<p>NA: methods under the SBTi are used to set targets, not to measure alignment or temperature.</p> <p>In 2019, SBTi introduced a temperature classification of all approved Scope 1 and 2 targets indicating whether they are 1.5, well below 2, or 2°C-aligned..</p>
Company-level assessment to assess the climate performance of companies in the face of the ecological and energy transition			
ACT (link , link)	<p>The ACT (Assessing Low Carbon Transition) Initiative of ADEME and CDP was developed to assess corporates’ climate strategy of various size and activities in the face of the required low-carbon transition and associated sector-specific decarbonization trajectories. In theory, an investor could aggregate the scoring at the portfolio-level; however, the objective of ACT is not to build a database with large coverage, but rather sector-specific “climate accountability” frameworks that can then be used by companies and investors to trigger action.</p> <p>The corporate’s “degree of alignment” is expressed by a three-dimensional grade, that takes into account its transition performance (1 – 20), coherence with narrative sectoral decarbonization pathways (A to E) and its trend (+, =, -). This grade is built on the back of c. 20 indicators answering five higher-level questions and spread across nine areas subsequently weighted based on sector-specific importance.</p>		

	<p>In 2016, 23 companies in the electricity generation, retail and automobile manufacturing sector participated in a pilot. In 2017, 30 small and medium French companies in the electricity generation, retail, automobile manufacturing, transport, and building and food sectors were evaluated using the framework. Work is underway to develop additional sectors (O&G, cement, transport coming soon; generic, agriculture, agro-industry, steel to be launched; chemicals, glass and paper in 2021). As a partner of the initiative, the World Benchmarking Alliance uses ACT methodologies to develop sector benchmarks and rankings available for free : one for 25 automobile manufacturers was published in December 2019, one for 50 electric utilities companies will be published in Q3 2020, other sectors will follow e.g Oil and Gas in 2021.</p> <p>Specifically on the coherence with sectoral decarbonization trajectories:</p>		
	Step 1: Climate performance	Step 2 & 3: Scenarios and benchmarks	Step 4: Alignment and temperature
	<ul style="list-style-type: none"> • Rely on GHGs; • Relevant value-chain scope (e.g. scope 3 for automobile manufacturer); • Forward-looking data based on targets; asset-level data; past trends. 	<ul style="list-style-type: none"> • Use the SDA approach of the SBTi to derive sector- and company-specific benchmark; • Use IEA 2DS and ETP scenario; coming soon: B2DS; • Various modifications and extensions of the SDA benchmarks, including geographical weightings. 	<ul style="list-style-type: none"> • Commitment gap & action gap: reporting year + 5.
Transition Pathway Initiative (link)	<p>The TPI is a global, asset-owner led initiative that assesses companies' preparedness for the transition to a low carbon economy. The methodology was developed by an international group of asset owners in partnership with the Grantham Research Institute on Climate Change and the Environment at the London School of Economics, supported by data from FTSE Russell. The initiative assesses companies on two dimensions based on publicly available information: management quality and carbon performance. In particular, the carbon performance module looks at how companies' carbon performance now and in the future might compare to the international targets and national pledges made as part of the Paris Agreement.</p> <p>Specifically within the carbon performance module (238 companies covered to date):</p>		
	Step 1: Climate performance	Step 2 & 3: Scenarios and benchmarks	Step 4: Alignment and temperature
	<ul style="list-style-type: none"> • Rely on GHGs; • Relevant value-chain scope; • Forward-looking data based on targets. 	<ul style="list-style-type: none"> • 3 benchmark scenarios for most sectors: Paris pledges, 2°C, and below 2°C; • Use the SDA logic of the SBTi to derive sector-specific benchmarks (not company-specific). 	<ul style="list-style-type: none"> • Compare companies' emissions intensity per unit of production as forecasted in 2030 (or 2050 for oil & gas) with their sector-specific benchmarks (gap assessment).
Portfolio alignment and temperature methodologies developed by data providers (full details in appendix p.143)			
Arabesque	Step 1: Climate performance	Step 2 & 3: Scenarios and benchmarks	Step 4: Alignment and temperature
	<ul style="list-style-type: none"> • Rely on GHGs; • Scope 1 & 2; • Current emissions intensity per revenue. 	<ul style="list-style-type: none"> • 4 temperature benchmarks based on IEA ETP; • Sector-specific benchmarks; • Portfolio-level benchmark based on the sector composition of portfolios. 	<ul style="list-style-type: none"> • Compare companies/ portfolio current emissions intensity per unit of revenue in 2030 and 2050 with sector/ portfolio specific-benchmark (gap assessment).
Carbon4 Finance	<ul style="list-style-type: none"> • Rely on GHGs; • Scope 1, 2, 3 and avoided emissions; • Forward-looking score that takes into account company-strategy. 	<ul style="list-style-type: none"> • Includes sector-specific elements (SDA-like) in company-level assessments; • Portfolio-level benchmark: sigmoid curve between min 1.5°C (= best score), average score of LC100 (2°C); 3.5°C (=average score); and max 6°C (=worst score). 	<ul style="list-style-type: none"> • Compare portfolio-level score with an expected score for each temperature level (gap assessment).

	Step 1: Climate performance	Step 2 & 3: Scenarios and benchmarks	Step 4: Alignment and temperature
CDP-WWF Temperature Rating	<ul style="list-style-type: none"> • Rely on GHGs, Scope 1, 2 and 3; • Forward-looking data based on targets. 	<ul style="list-style-type: none"> • Creation of a scenario set that matches a normative precautionary preference in regard to overshoot and CDR; • Development of best-fitting linear regression models. 	<ul style="list-style-type: none"> • Compare implied decarbonization trend in target with required trend under different temperature trajectories (trend assessment)
EcoAct	<ul style="list-style-type: none"> • Rely on GHGs; • Scope 1, 2 and 3; • Forward-looking data based on absolute targets. 	<ul style="list-style-type: none"> • 3 temperature benchmarks based on IPCC; • Temperature benchmarks are sector-agnostic. 	<ul style="list-style-type: none"> • 6 temperature categories based on implied decarbonization rate in absolute target over commitment period, scope 3 target, validated science-based targets and main operating sectors (trend assessment).
Urgentem (previously Engaged Tracking)	<ul style="list-style-type: none"> • Rely on GHGs; • Scope 1, 2 and 3 for portfolio-level, Scope 1 for sector- and company-level assessments; • No forward-looking data. 	<ul style="list-style-type: none"> • IEA ETP, IPCC 1.5 °C SSP1, SSP2 and LED; • Sector-agnostic at portfolio-level; sector-specific at sector and company level. 	<ul style="list-style-type: none"> • No aggregated alignment metric per se is provided to date (focus on decarbonization trajectories as derived in steps 2 and 3)
I Care & Consult	<ul style="list-style-type: none"> • Rely on GHGs; • Relevant value-chain scope; • Forward-looking data based on targets, historical extrapolation and credibility weighting. 	<ul style="list-style-type: none"> • Rely on the SDA approach of the SBTi where applicable; • Sector- and company-specific; • B2DS, 2DS and RTS. 	<ul style="list-style-type: none"> • Based on the cumulated over(under)shoot of emissions between 2010 and 2050.
ISS	<ul style="list-style-type: none"> • Rely on GHGs; • Scope 1 and 2 for all sectors; includes Scope 3 for oil & gas only; • Forward-looking data based on historical trends and targets.. 	<ul style="list-style-type: none"> • IEA ETP 2, 4 and 6 °C • Emissions intensity per unit of revenue (all sectors) or production unit (utilities) to converge in 2050; absolute contraction of Scope 3 emissions of oil & Gas companies. 	<ul style="list-style-type: none"> • Comparison between the required company-specific decarbonization trend and its forecasted trend between the year of assessment and 2050. • Cumulated over(under)shoot vs company-and portfolio-specific pathway.
right. based	<ul style="list-style-type: none"> • Rely on GHGs; • Scope 1, 2 and 3 for all sectors; • Forward-looking data based on economy-wide trends in emissions intensity decoupling (can also be based on targets). 	<ul style="list-style-type: none"> • Can be applied on a range of scenario; • IEA ETP 2DS and B2DS; • Sector-specific for scope 1, sector-agnostic for scope 2 and 3. 	<ul style="list-style-type: none"> • Calculate what the implied temperature rise would be if all companies operated as GHG intensively to 2050 as 1. the one under consideration; and 2. As the company's sector of operations under a given scenario; the difference between the two is an expression of temperature alignment.
S&P Trucost	<ul style="list-style-type: none"> • Rely on GHGs; • Scope 1 & 2 for all sectors, Scope 3 downstream for oil& gas and automobile manufacturers. • Forward-looking data based on targets, historical extrapolation and asset-level data. 	<ul style="list-style-type: none"> • IEA ETP and IPCC; • Rely on SDA approach of the SBTi where applicable (homogenous sectors); on the GEVA approach if not (heterogeneous sectors). 	<ul style="list-style-type: none"> • Based on the cumulated over(under)shoot of emissions between 2012 (or latest available) and T+5 (currently 2025).

	Step 1: Climate performance	Step 2 & 3: Scenarios and benchmarks	Step 4: Alignment and temperature
PACTA 2° Investing	<ul style="list-style-type: none"> Technology exposure for power utilities, oil & gas, coal and automobile; and GHG intensity for cement, steel, shipping and aviation. Relevant value-chain scope; Forward-looking data based on asset-level datasets. 	<ul style="list-style-type: none"> IEA ETP and WEO; Temperature benchmarks expressed in absolute terms; Sector- and company-specific benchmarks. 	<ul style="list-style-type: none"> PACTA: alignment at technology level. At least two methods (Influence Map and MoreImpact) to aggregate at sector and portfolio-level – expressed as percentage alignment and an Implied Temperature Rise metric. Currently 2018-2023 (t - t+5)
Selected (non-exhaustive) portfolio-level methodologies developed by investors that significantly differ from the above methods and approaches			
NEC BY SYCOMORE AM	<p>The Net Environmental Contribution (NEC) metric has been developed since 2015 by Sycomore AM with the support of I Care & Consult and Quantis and is proposed by the NEC initiative since 2019. It measures the extent to which a given business model is aligned with the energy and environmental transition. As of 2020, a NEC score has been calculated on more than 2,400 issuers. It is not a temperature alignment, or alignment with a temperature trajectory metric, stricto sensu, as it does not use measure the proximity between climate performance and a decarbonization pathway, but it is an alignment metric encompassing wider environmental impact.</p>		
	Step 1: Climate performance <ul style="list-style-type: none"> Wider than climate: environmental performance covering 5 issues (climate, water, resources and waste, air quality and biodiversity); Climate performance is included in 14 frameworks out of 15, with a weight ranging from 20% to 100% and often dominant (eg. basic materials, electricity, heat, fuel or mobility frameworks); Relevant scope across full value chains; From damaging activities to solutions, enabling to provide a net score integrating both negative and positive impacts. 	Step 2 & 3: Scenarios and benchmarks <ul style="list-style-type: none"> No forward-looking benchmarks per se based on scenarios, yet past- and forward-looking capability by calculating NEC score over time and providing NEC trajectories; The maximum performance level for an industry is defined as the best, significantly scalable solution that is clearly aligned with the environmental transition and with the Paris Agreement's climate objective (e.g. wind power), and each maximum performance point is calibrated on the NEC scale by comparing order of magnitude of impacts. 	Step 4: Alignment and temperature <ul style="list-style-type: none"> Not a temperature alignment method stricto sensu. Score from -100% for most damaging to +100%, for most contributing to the transition; 0% is the current average of the environmental performance of an activity to fulfil a given function (e.g. energy, transport, buildings...). Based on companies' exposure to different activities.
FMO	<p>FMO published in November 2019 a technical paper on how to align portfolios with 1.5°C trajectories (FMO, 2019). Its approach is original because it relies on absolute emissions reductions at portfolio-level.</p>		
	Step 1: Climate performance <ul style="list-style-type: none"> Based on GHGs; No forward-looking data as it is a method to derive a trajectory rather than measure alignment. 	Step 2 & 3: Scenarios and benchmarks <ul style="list-style-type: none"> Calculate the fair share of FMO's portfolio based on value-added in absolute terms; Apply the absolute emissions percentage decrease under a 1.5°C scenario to the current portfolio footprint to derive the pathway. 	Step 4: Alignment and temperature <p>NA: This method is used to derive a 1.5°C trajectory rather than measure alignment or temperature.</p>

Regulatory and industry initiatives to set targets, harmonize alignment and temperature methodologies

NZAOA	The Net-Zero Asset Owner Alliance issued a call for comment in April 2020 (NZAOA, 2020) to “allow interested parties [...] to express their views and support the NZAOA efforts to advance state-of-play with respect to Net-Zero (Paris-aligned) Portfolio Target Setting.” Methodologies should be based on 45 principles, including 13 “must-haves” across 16 categories. We review a subset of principles below.		
	Step 1: Climate performance	Step 2 & 3: Scenarios and benchmarks	Step 4: Alignment and temperature
	<ul style="list-style-type: none"> Based on GHGs: Scope 1 and 2, and 3 for sectors where these are material (>40% total emissions). Use of forward-looking data. 	<ul style="list-style-type: none"> Transparency on the choice of climate scenarios; accommodate a set/corridor of scenarios; special attention should be given to 1.5 °C scenarios (P1 and P2). 	<ul style="list-style-type: none"> Forward-looking carbon KPI (relative to production and absolute) and temperature KPI at issuer and portfolio levels.
Setting targets: SBTi-Finance	<p>In 2018, the SBTi launched its SBTi-Finance project to develop a framework for financial institutions to set targets for their investment and lending portfolios. The framework includes methods, criteria, a target setting tool, and a summary guidance document. After road-testing in 2019, SBTi-Finance has identified emissions-based methods (sector decarbonization approach, or SDA), capacity-based methods (if and when they meet all criteria), SBT portfolio coverage, and a new SBTi-Finance temperature rating approach (based on CDP’s earlier target classification work).</p> <p>SBTi highlights a range of methods and approaches that can be applied to set targets at portfolio-level, depending on the asset class. Identified methods include:</p> <ul style="list-style-type: none"> SDA Approach (real estate, mortgages, electricity generation and project finance, corporate instruments); Capacity-based methods (SBTi intends to allow targets developed using capacity-based approaches if and when they meet all SBTi-Finance criteria); SBT Portfolio coverage (corporate instruments): financial institutions engage a portion of their investees to have their own science-based targets such that they will reach 100% coverage by 2050; Targets temperature Rating (corporate instruments): see CDP-WWF Temperature Rating above. <p>Financial institutions are welcome to use other methods to develop their targets. SBTi intends to accept other-method-based targets if and when they meet all SBTi criteria.</p>		
TEG Paris-Aligned Benchmarks	The EU High-Level Group on Sustainable Finance released its Benchmark Report in September 2019 (TEG, 2019), which amongst other things, sets a list of criteria for newly-created climate benchmarks based on two levels of ambition: Climate-aligned and Paris-aligned benchmarks. We list a selected set of Paris-aligned benchmark criteria below.		
	Step 1: Climate performance	Step 2 & 3: Scenarios and benchmarks	Step 4: Alignment and temperature
	<ul style="list-style-type: none"> Based on GHGs, Scope 1, 2 and, 3 (gradually introduced), normalized by EV. No forward-looking data. 	<ul style="list-style-type: none"> Based on IPCC 1.5° report: 7% decarbonization rate YOY. 	<ul style="list-style-type: none"> Compare the decarbonization rate of the index between T-N and T with required rate (7% yoy decarbonization)
EU Sustainable Activity Taxonomy	The EU Taxonomy, published in March 2020, is “a tool to help investors, companies, issuers, and project promoters navigate the transition to a low-carbon, resilient and resource-efficient economy (link).” It sets performance thresholds (or “technical screening criteria”) for economic activities that make a substantive contribution to one of six environmental objectives, do no significant harm to the other five, where relevant, and meet minimum safeguards. It is not a “temperature alignment” approach stricto sensu but it sets a benchmark for what can be considered 2 °C compatible today.		
	Step 1: Climate performance	Step 2 & 3: Scenarios and benchmarks	Step 4: Alignment and temperature
	NA	<ul style="list-style-type: none"> Derives sector-specific criteria to consider an activity “sustainable”, based on 1. Regulations, 2. Emissions threshold and 3. Use of best-available technology. 	<ul style="list-style-type: none"> Taxonomy alignment as the current exposure to activities as required for a net-zero European economy by 2050. Not forward-looking.

What about other asset classes?

This report is focused on temperature alignment assessments that have been developed for listed equities and corporate bonds. Yet, a range of methods has been developed for other asset classes. These approaches follow the same analytical steps, i.e. 1. Measurement of the asset (e.g. country or project) climate performance, 2. Choosing one or several scenarios, 3. deriving decarbonization benchmark(s) and 4. Comparing the two to derive the temperature alignment.

Sovereign bonds. A subset of data providers has developed methods applicable to sovereign bonds. A range of methodological choices are specific to this asset class:

- **Perimeter of the climate performance assessment:** should a country's climate performance be assessed on its Scope 1, 2, and 3 (i.e. government's energy and electricity consumption and value chain emissions of purchases) or based on the whole economy emissions? In that second case, should emissions of exports and imports be netted or should a territorial production logic be followed? How to forecast a country's future climate performance – based on historical extrapolations or targets (nationally-determined contributions) ([Kepler Cheuvreux, 2016](#))?
- **Choice of decarbonization trajectory used as benchmarks:** The Paris Agreement reversed the logic of anterior agreements, by allowing Parties to determine their national contributions in achieving the global temperature goal, rather than attempting to allocate the remaining budget using a top-down perspective. Countries now have the responsibility to define their own medium-term and long-term decarbonization strategies through Nationally Determined Contributions and “mid-century, long-term low greenhouse gas emission development strategies”. However, further efforts are needed to improve the quality and availability of national plans to develop 2 °C scenario only on that basis ([I4CE, 2019](#)). Therefore, several calculators provide country-specific trajectories, or the repartition of efforts, based on different interpretations of equity and responsibility ([Climate Equity Reference Calculator](#), [Climate Fair shares](#), [Paris Equity Check](#), [Climate Change Performance Index](#)). This relies, however, upon user-defined subjective decisions.

One data provider has developed their country-level trajectories that are statistically-derived to avoid subjectivity: Beyond Ratings' CLAIM method “computes the allocation of 2 °C compatible national carbon budgets which have a priori the highest probability of emerging from international discussions, whatever being the criteria on which the latter might be based ([Beyond Ratings, 2018](#)).”

Other asset classes. Few providers cover other asset classes and do so only to the extent that “sector-specific” benchmarks can be derived based on existing scenarios. This is the case for real estate and mortgages (buildings benchmark); electricity generation and project finance (electricity benchmark); project finance and infrastructure (based on sector-relevant benchmark). The SBTi highlights the use of the SDA approach to set targets within these asset classes ([2020](#)). Carbone 4 launched in June 2020 a methodology to assess “alignment with the Paris Agreement” of infrastructure portfolios ([Carbone 4, 2020](#)).

Putting it all together in cross-assets portfolios raises the issue of benchmark consistency between corporate-level asset classes (listed equity or bonds) on the one hand, assessed using sector-specific benchmarks as provided by external scenario developers such as the IEA, and sovereign bonds on the other, when assessed using different benchmarks derived at the national level based on other data sources, such as the Climate Equity Reference Calculator.

This has not been, so far, tackled by any data providers or investors. It could be, however, through the CLAIM model of Beyond Ratings that provide integrated national and sector-level decarbonization benchmarks based on statistical assessment and available through the [Climate Technology Compass](#).

2.2. LET'S GET TECHNICAL: A STEP-BY-STEP REVIEW OF EACH INGREDIENT

After reviewing the methods available on the market currently and their key differences in section 2.1.2, the range of methodological choices available at each step of the recipe is highlighted in this part. For more technical details, please refer to part 4.

- How is the climate performance of the companies and portfolios derived? Temperature alignment assessments often, but not always, rely on forward-looking data on the future climate performance of companies and portfolios. For more details, see section 2.2.1.
- What scenario(s) can be used to derive the decarbonization benchmark(s)? One of the main differences in temperature alignment assessments relates to the use of sector-agnostic, sector-specific, or company-specific trajectories. For more details, see section 2.2.2.
- How is (are) the portfolio- and asset-specific benchmark(s) derived? Macro trajectories from scenarios are distributed to micro-actors. The derived 2°C benchmark represents the temperature alignment objective, for example used for target-setting. For more details, see section 2.2.3.
- How are temperature alignment and/or implied temperature rise (ITR) metrics calculated? The gap between the climate performance of a portfolio/ company and its temperature benchmark(s) can be assessed using different calculation protocols. For more details, see section 2.2.4.

2.2.1 Starter: Deriving the current and future climate performance of companies and portfolios

Current climate performance: choosing the metric and perimeter. As highlighted on p.32, when the final research objective is to perform portfolio temperature alignment, it is necessary to take into account and understand the additional assessment steps in the temperature alignment methodology to choose the best way to calculate a portfolio climate performance, as these steps do not work in isolation.

In particular, existing methods can be classified along two axes, summarized in table 7:

- **Type of climate performance metric used:** GHGs or technology;
- **Value chain perimeter:** only operational scope, all value chain, or relevant scope.

There is a range of additional differences, in particular around the inclusion of estimated data in the absence of company reporting or of avoided emissions, i.e. emissions avoided by third parties by the use of “greener” products and services. These are reviewed in detail from p.93.

The main rule is that the climate performance of a company or portfolio need to be assessed based on the same metric, value chain scope and other criteria than the temperature benchmark(s) to which it will be compared, to ensure internal consistency and comparability. This means that either 1. climate performance needs to be assessed on the scope criteria as available data points as provided by scenarios, or 2. the trajectories provided by scenarios have to be recalculated for their perimeter to be comparable with the way climate performance is calculated.

Table 7: Main methodological choices in assessing companies and portfolio current climate performance. See p.86 for detailed discussion.

Axis 1	Carbon/GHGs	Technology mix
Data providers	All including PACTA for certain sectors	PACTA (2° investing initiative)
Flexibility to reach climate objective	High, potentially lower credibility	Low (prescriptive technology mix)
Attribution of change to decarbonization efforts	Lower, potential risk of lock-in	Higher
Differentiation between green / brown technology, activity, assets	No – carbon/GHG metrics are by definition aggregated	Yes
Captures efficiency efforts	Yes – but changes cannot be attributed directly (aggregated)	No
Applicability to a large range of sectors	High (all sectors) in theory but in practice incomplete (e.g. Scope 3)	Lower (emission intensive sectors: oil & gas, electricity generation, transport)
Axis 2	Scope 1 & 2	All (or relevant) scope
Data providers (non-exhaustive)	Arabesque, ISS, S&P Trucost (except for a number of sectors)	Carbon4 Finance, I Care & Consult, PACTA, CDP-WWF Temperature Rating, right.based
Applicability/ uncertainty	Higher applicability/ lower uncertainty: more reporting. May lead to sub-optimal decisions as for a large number of sectors Scope 3 (value-chain) emissions are the most important (e.g. auto, oil & gas...)	Lower applicability/ higher uncertainty: less reporting; potential mismatch with scenario sector classification that may require additional manipulations depending on the alignment method used; potential double-counting of emissions that may require additional manipulation depending on the alignment method used.

Forward-looking performance – different estimation methods. Simple portfolio climate performance metrics are static, and often backward-looking as there is a lag between carbon emissions, company reporting, inclusion in a database, and application at portfolio-level. Therefore, most temperature alignment assessments rely on estimates of the future climate performance of companies and portfolios. These estimates are theoretical projections of the emission profile taking into account the company's declared intentions or other factors, in absence of any further

strategic changes ([Amundi, 2020](#)).

A small number of methods, however, do not attempt to forecast future climate performance because of the difficulties in doing so – and compare today's climate performance with a future desired state as given by the scenario. We review the time horizon chosen by different methods on p.143. Figure 16 highlight how can forward-looking data be derived and the assessment questions it answers.

For more details, please refer to the technical deep-dive, section 1:

- What metric may be used to measure climate performance and alignment? p.86
- Scope 3 or not Scope 3? p.88
- What about data quality and the need for estimates where reporting is lacking? p.91
- What about avoided emissions? p.93
- Towards capturing removed emissions? p.96
- How to forecast future climate performance? p.98

Figure 16: Summary table on forward-looking data (see p.98 for a deep dive, [2° Investing Initiative, 2018](#); [2° Investing Initiative, 2019](#); [CDP & ADEME, 2017](#); [TPI, 2020](#))

	Time horizon	Pros	Cons	Ways it has been used by existing methods
None	NA	Answer the question: what is the gap between the current climate performance of the company or portfolio with what its performance expected to be under different scenarios by/over a specific time horizon (Arabesque).		
Extrapolation based on historical performance	Any	Easier, applicable across all sectors/ companies/ metrics/ time horizon	Does not capture potential non-linearity, no predictive power, reliance on disclosure	<ul style="list-style-type: none"> • Use as such to answer the question: can the company or portfolio be considered aligned if it continues on its current trend (ISS) • Check whether targets are realistic (S&P Trucost, I Care & Consult) • Use in to forecast the longer-run climate performance of companies or portfolio, i.e. post target/asset-level time horizon, to 2050 or 2060 (I Care & Consult)
Macro-economic trend	Any	Easier, applicable across all sectors/ companies/ metrics/ time horizon	Does not capture potential non-linearity, no predictive power, not sector or company specific.	<ul style="list-style-type: none"> • Use to answer the question: can the company or portfolio be considered aligned if it decouples its emissions at the same rate as the economy under different future scenarios (right. based).
Reliance on stated objectives/ targets	Mostly short to medium run (5 to 15 years)	Applicable across sectors (creates a system of equivalency).	Implementation difficulties and extra (subjective) hypothesis in terms of harmonization, reliance on disclosure; medium term.	<ul style="list-style-type: none"> • Use as such to answer the question: If the company/ portfolio achieves its stated objectives, can it be considered aligned? (CDP-WWF Temperature Rating, EcoAct, right. based) • Targets can also, in certain cases, be considered a proxy of future performance. A “credibility” discount can be applied based on how credible/ likely it is that the company will reach its target (I Care & Consult, S&P Trucost, ISS).
Asset-level databases & CAPEX	Mostly short to medium run (depends on sector)	Consistent boundaries, can cover non-reporters, aggregation and usability	Incomplete data, hard to consolidate subsidiaries, do not cover all sectors, differing time horizons, potential time lag, may come at an extra cost.	<ul style="list-style-type: none"> • Use as such to answer the question: Can the company or portfolio be considered aligned if the underlying companies follow their announced or revealed development plans? (2° Investing Initiative PACTA) • Can be used to triangulate targets and check whether they are credible (S&P Trucost).
Green patents and R&D	Undefined	Forward-looking, gives an indication of a company's strategy	Lack of data; variation in results may not be linked to future climate performance (marketing secrecy, culture, sector bias).	<ul style="list-style-type: none"> • Use to forecast future performance: If the companies' patents and R&D efforts are successful and zero carbon, can the company be aligned? (MSCI Carbon Delta) • Integrate within a larger score (Carbon4 Finance) • Is the portfolio/ companies financing sufficient innovation and R&D to support the transition? (see work on financing roadmaps of 2° Investing Initiative)

Expert track: Corporate neutrality targets and temperature alignment assessments

Since the Paris Agreement endorsed the global objective of “zero net emissions” during the second half of the century, an increasing number of companies have communicated publicly on their neutrality objective. By September 2019, over 50 companies had a net-zero emissions target by 2050, according to the SBTi ([CDP, 2019](#)).

These net-zero, or carbon neutrality targets, “differ on at least four aspects: 1. time frame [...]; 2. Scope of activities included (e.g. operational vs value-chain emissions); 3. Climate impacts from those activities (e.g. CO₂ emissions vs non-CO₂ radiative forcing) and 4. The climate mitigation approach used by companies to meet their targets (e.g. decarbonization, use of offsets, etc)”. This last aspect is “perhaps the most important” ([CDP, 2019](#)).

In particular, it is debatable whether corporate-level targets that rely on carbon removals or offsets should be included, or not, within temperature alignment assessments, for example in estimating forward-looking performance. Companies’ strategy to reach “carbon neutrality” encompasses a range of varied approaches, metrics, and concepts. Without a common framework at the international or national level, this leads to a certain confusion around the meaning of such postulates, and by extension around the desirability and best way to use them within portfolio temperature alignment assessments.

For example, the SBTi does not count, currently, offsets as reductions towards companies’ science-based targets. CDP ([2019](#)), as part of the SBTi, provides a draft for consultation on establishing four guiding principles to assess the effectiveness of corporate neutrality targets.

The first two principles, namely effectiveness and consistency, are the most relevant in the context of temperature alignment assessment and are highlighted in the table 8 below. In this draft version, while targets that rely on carbon removals through off-setting may be considered if they are permanent and do not come at the expense of decarbonization, targets that rely on avoided emissions or reductions are not considered consistent with 1.5°C mitigation trajectories. This is because avoided emissions follow different accounting rules (see p.93).

Table 8: Draft assessment of corporate mitigation approaches to climate neutrality (excerpt, from [CDP, 2019](#)).

	Effectiveness to neutralize impacts from the company on the climate	Consistency with 1.5°C mitigation trajectories
Decarbonization	High	Consistent, as long as decarbonization happens in line with 1.5°C trajectories
Balance of emissions with removals within the value chain of the company	Depends on the permanence of the removals	Consistent only when removals are permanent and limited to balance residual emissions
Balance of emissions with carbon credits sourced from activities that remove carbon from the atmosphere		
Balance of emissions with carbon credits sourced from activities that avoid or reduce emissions	Limited	Not consistent
Balance of emissions with avoided emissions from the use of sold-products		

Therefore, climate neutrality targets are only useable to forecast future performance if they are associated with specific details on how this is to be achieved – therefore allowing to disentangle the different actions and implications on reaching the target. A validated science-based target does not cover offsets e.g. For others, it is less clear (see Carbon Tracker discussion in the Oil & Gas sector, [2020](#)). Also, the permanence of offsets or carbon removals that rely on afforestation projects is hard to assess ([SEI, 2020](#)).

As a consequence, some data providers use a precautionary approach and do not include corporate targets on which it is unclear whether it includes offsets or avoided emissions. The Net Zero Initiative led by Carbone 4 ([Carbone 4, 2020](#)) suggests a detailed framework to help companies report and establish targets separately on carbon mitigation, avoided emissions and removals, within the value chain perimeter or not of the reporting company.

Table 9: Being vigilant on targets and how they are achieved when including them in alignment assessment - examples

Sector	Example
Oil & gas	BP's Net Zero Ambition includes cutting upstream production emissions to zero on a net basis by 2050. Provided that its scope 3 emissions are 360 million tonnes in 2019, it is difficult to understand how this objective will be reached, and through what mix of carbon removals and offsets (Carbon Tracker, 2020).
Airlines	Under the Carbon Offset and Reduction Scheme for International Aviation (CORSIA), the gross absolute emissions from international aviation may grow beyond 2020 but the net absolute emissions (after offsetting) should level off. TPI does not use any airline targets that are based on net absolute emissions reductions, to align with IEA scenarios (TPI, 2019).

The logic is the same at the portfolio- and investor-level, when setting science-based targets and devising a strategy as to how to meet them. As put in the SBTi draft criteria for financial institutions, “the use of offsets is not counted as emissions reduction toward the progress of financial institutions’ science-based targets” ([2020](#)). Therefore, portfolio-level temperature alignment methodologies must rely primarily on decarbonization.

This is not to say that offsetting is not a valid strategy in the context of a broader investor climate strategy if a number of conditions are respected ([AMF, 2019](#)). A high-level analysis suggests that from 2020 to 2030, offsets could represent 12% of the necessary reductions to maintain temperature rise under 2 °C based on IPCC pathways. This is quite substantial, at least in the short term, to prevent emissions overshooting ([Judo CARES, 2020](#)).

In addition, activities typically financed by offsets, such as clean stoves, have been identified as important mitigation options that could “in the short term contribute significantly to limiting global warming to 2 °C and 1.5 °C [in addition to having] substantial co-benefits on health and local air quality” ([UNEP, 2019](#)). This is not directly captured in sector-specific trajectories as provided by scenario developers such as IEA.

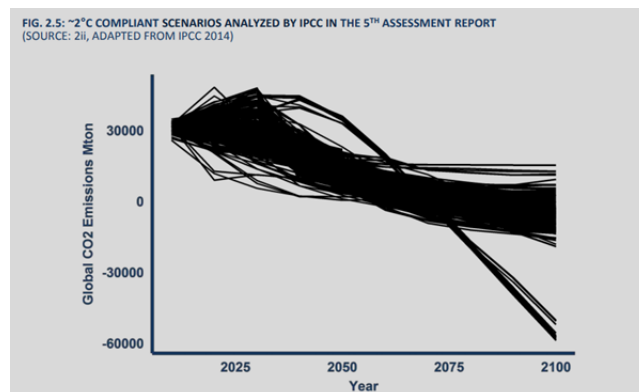
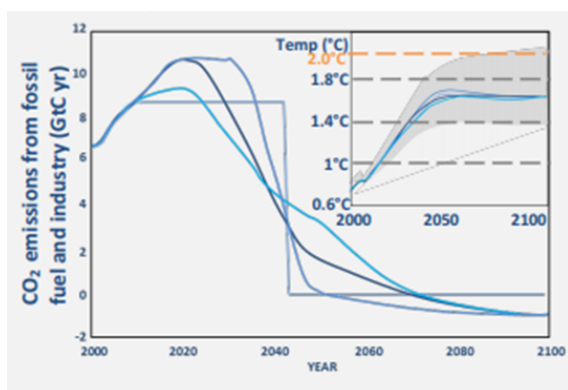
Therefore, while not taken into account in temperature alignment assessments, the use of offsets, if well-managed, can be an additional way to close the finance gap towards low-carbon and removal technologies in the short-term, if a number of conditions are met and if it is used to prepare full decarbonization in the medium to long-term. Further research is needed in this area.

2.2.2. Main course: Choosing one or several scenarios

A scenario «operationalizes» a given carbon budget and answers the question: how can a temperature objective be reached, under different constraints and assumptions, by distributing the remaining carbon budget on a temporal, geographic and/or sectoral basis? It is a story that describes a hypothetical future amongst a range of others that lead to the same temperature objective. A scenario models a specific world and its assumptions and construction rules drive the shape of the pathway(s) against which the portfolio temperature alignment assessment is then done, and therefore the results.

Several trajectories can lead to the same temperature rise in 2100, each embedding different hypotheses, such as technology choices and the role of efficiency and sobriety. In practice, therefore, there is a range of trajectories leading to the same temperature outcome, and these ranges may overlap with each other – for example, trajectories in the upper range that lead to a 2 °C rise can overlap with trajectories in the lower range leading to a 3 °C rise. **The trajectories resulting from each scenario differ on several elements:** the speed and decarbonization rate of the economy, the year and the amount of the carbon peak, the time horizon at which the trajectory must be net-zero, and the reliance on removed emissions. The shape of the trajectory is a function of the underlying assumptions, and therefore worldview, that the scenario represents.

Figure 17: A range of trajectories are compatible with the same temperature limitation objective. The four trajectories on the left panel all limit temperature rise under 2 °C by 2100. These trajectories differ in terms of temporality and carbon peak. The later and higher the carbon peak, the faster need decarbonization be after the peak and the higher the reliance on removed emissions (2 ° Investing Initiative, 2017)



Therefore, a portfolio may be aligned with one 2 °C trajectory but not with another. Therefore, the choice of the trajectory directly determines the result and is an essential choice in this type of assessment. Thus, it would be more robust to use a range of trajectories leading to the same temperature outcome. However, as put by CDP & WWF International (2020), “while valuable to describe the range of uncertainty and variability between scenarios, such an approach has several main drawbacks for the intended use here: 1) to apply a ‘score’ to targets, a method must return a single unambiguous score, [...] [2] Results [calculated based on a range of trajectories leading to the same temperature outcome] can be difficult to understand for non-experts since bins tend to have overlapping ranges”

While in theory the choice of the scenario depends on conceptual considerations, users are usually limited by practical considerations, in particular

sectoral granularity. The output of different scenarios is expressed at different levels of temporal, geographical, and sectoral granularity. In particular, current temperature alignment assessments mainly differ in the use of sector-specific or sector-agnostic trajectories. The conceptual implications of choosing one or the other are highlighted on p.103.

In practice, most data providers and investors rely, where possible, on sector-specific trajectories. Therefore, **using scenario(s) that have the relevant level of data granularity for the perimeter chosen.**

Thus, it is possible to classify alignment and temperature methodologies based on the scenario they use and additional calculations performed to adjust the outputs and make them more useable:

- Most sector-specific assessments use the IEA ETP or WEO as these families of scenarios have a higher level of sector disaggregation, sector coverage,

and availability of production data and are updated frequently. In addition, the IEA publishes several scenarios based on the same models (either WEO or ETP family) leading to different temperatures, which therefore provides a consistent set of trajectories for portfolio temperature alignment assessment that result in an Implied Temperature Rise (ITR) metric.

- The IPCC pathways are mostly used by methodologies that are sector-agnostic. Indeed, the outputs are not accessible in a well-disaggregated format, whether it is carbon emissions, economic output, or physical production. Yet, the IPCC 1.5 SR report provides a 1.5°C trajectory with no or limited overshoot, most suitable for assessments that seek to measure alignment with the temperature objective of the Paris Agreement, especially the P1 illustrative pathway that does not rely as much on carbon removal technologies.
- The nationally determined contributions of States under the Paris Agreement cannot be used directly to derive 2°C benchmarks for temperature alignment assessments as they do not limit temperature rise

under 2°C ([UNEP, 2019](#)). Therefore, using them as benchmarks require extra manipulation, which creates uncertainty.

Adjusting scenarios and scenario outputs. These scenarios were not developed to support temperature alignment assessments. Therefore, it is normal that the scope, focus, or outputs are not perfectly suited to be used directly as inputs in this type of assessment. **In light of this challenge, data providers and investors have used a range of methods to adjust and/or derive 2°C and other temperature trajectories suited to their specific assessment needs.**

These methods seek to overcome the following challenges: 1. Sector granularity; 2. inadequate temperature objective, 3. Integration of national plans, and 4. taking into account avoided emissions. **Adjusting and combining third-party derived trajectories raises consistency questions – and may not guarantee that the overall economy-wide carbon budget is respected, as highlighted from p.115.**

For more details, please refer to the technical deep-dive, section 2:

- How to choose (a) scenario(s) based on practical and conceptual considerations? p.108
- How to adapt externally-derived scenarios and trajectories? p.115

Expert track: Sector-agnostic and sector-specific trajectories

Two families of approaches. Should temperature alignment trajectories used to derive the alignment benchmarks be sector-specific or agnostic?

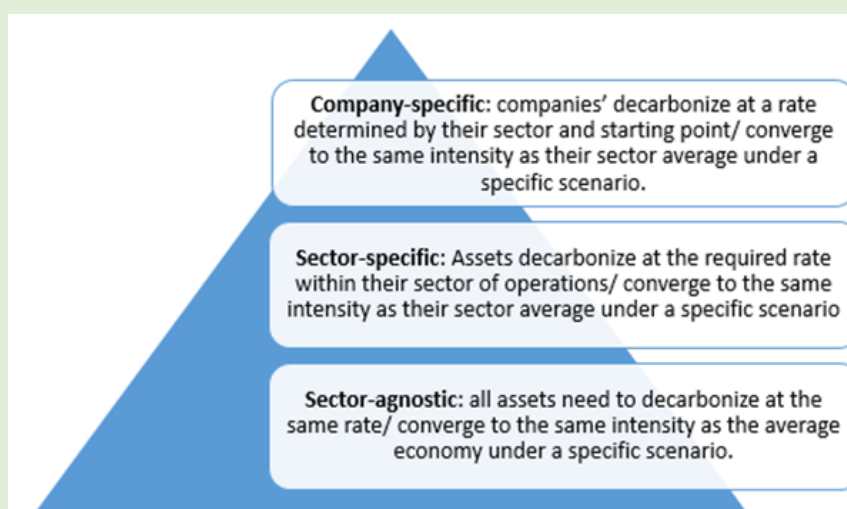
Sector-agnostic trajectories are easier to use when assessing large, diversified portfolios or indices.

- This implies that the entire portfolio should decarbonize at the same rate as the overall economy needs to decarbonize to be considered aligned with a given temperature trajectory.
- In that approach, the temperature alignment of a cement producer and a media company is measured against the same macro-economic trajectory even if they operate in sectors with very different profiles in the context of the energy and ecological transition.
- Depending on the temperature alignment methodology used, this may favor portfolios invested in sectors with lower GHG-intensity or with faster decarbonization rate/ lower decarbonization requirements under a given trajectory than average or exposed to geographies that need to decarbonize at a faster rate than the global average.

Sector-specific trajectories are easier to use when assessing portfolios with relatively large exposure to sectors for which specific decarbonization trajectories exist.

- Portfolio-level assessment performed based on sector-specific trajectories captures the individual performance of different companies within the portfolio, regardless of the sectoral allocation. Portfolio temperature alignment is therefore a function of the temperature alignment of the underlying companies in which a portfolio is invested.
- As a consequence, a hypothetical portfolio only invested in cement manufacturers could be considered aligned with a 2°C trajectory even if the aggregated portfolio climate performance is not in line with the global economy decarbonization trajectories. This situation arises when these cement manufacturers are themselves aligned with the cement sector 2°C trajectory.
- This approach finds its roots in the SBTi that help corporates set and validate alignment targets. It can also rely on company-specific benchmarks, as the SDA approach that not only takes into account companies' sector of operations but also current climate performance.
- One of the limitations is that it relies on a set of sector-specific trajectories that represent a normative way to share the remaining carbon budget based on specific hypotheses.

Figure 18: From sector-agnostic to company-specific trajectories (authors' schematic representation)



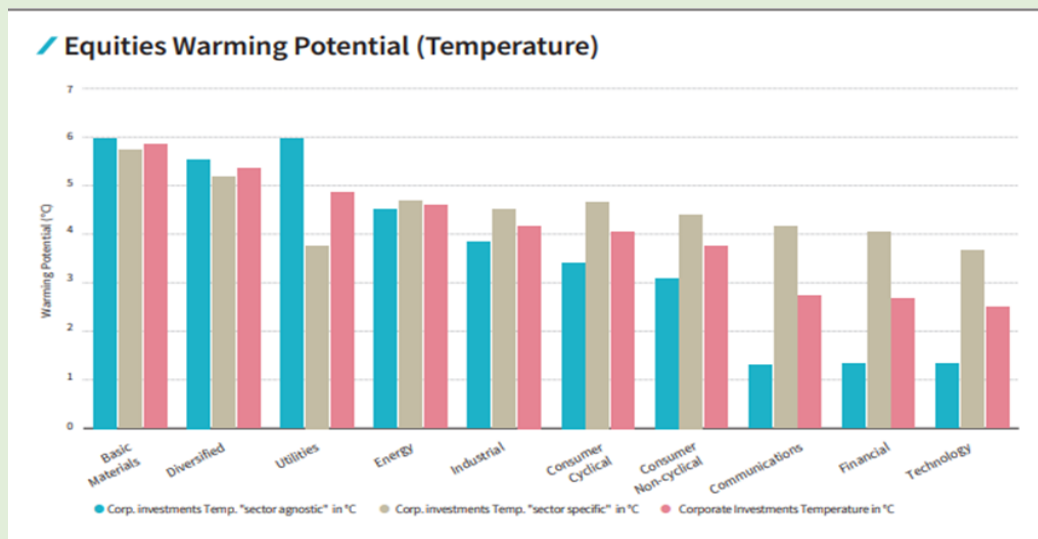
Finding a middle ground? Making portfolios compatible with the temperature objective of the Paris Agreement may rely on sector-specific (and even asset-specific) trajectories to capture the differentiated challenges and capability of sectors in the face of the low-carbon transition ([I4CE, 2019](#)).

At the same time, the use of sector-specific trajectories does not allow to capture portfolio sector composition as part of the temperature alignment results – a portfolio could be aligned with a 2°C trajectory even if

invested only in sectors of relatively little relevance to climate change, if the companies in which it is invested decarbonize at the appropriate rate as defined by their sector of operations.

Therefore, data providers and investors have introduced additional calculation protocols to reflect within the temperature alignment metric the relative importance of different sectors to the low-carbon transition, reviewed on p.140. These include introducing additional weighting when aggregating the results at the portfolio level or adjusting a portfolio temperature alignment results based on its sector composition. Besides, a small number of data providers use hybrid approaches by averaging sector-specific and sector-agnostic results to produce the final alignment metric (figure 19).

Figure 19: the difference between the sector-specific and sector-agnostic approach - Carbon Delta for Axa Group (2019)



2.2.3. Cheese Platter: Deriving micro-level temperature benchmarks

Deriving temperature benchmarks. Transition scenarios distribute the available carbon budget over time and sectors along different trajectories that if followed, lead to a given decarbonization and temperature limitation objective. These macro trajectories need to be distributed to micro-actors to create temperature benchmarks. **The derived benchmarks represent the temperature alignment objective, for example in the context of target-setting.** This step, called allocation, may be done in two ways.

1. Contraction-based approaches: the benchmark(s) are derived by applying a reduction rate, as given by scenario(s) and associated trajectories, to the current climate performance of the portfolio or asset.

- A sector-agnostic or sector-specific contraction rate is applied to all companies. It is also possible to derive a geography-specific contraction rate. These approaches can also be applied when the climate performance of the company or portfolio is expressed through a technology/ activity metric. In this case, a reduction rate is applied to “brown” assets and an

expansion rate to “green” assets.

- Often, the same (sector-agnostic or sector-specific) rate is applied to companies irrespective of their current performance and past efforts. A portfolio invested 100% in renewable energy will need to decarbonize at the same rate as a portfolio invested in fossil fuel utilities. Even if seldom done, in theory these rates can be adjusted so that they represent the starting performance of the company or asset.

- The reduction rate applied can be absolute – e.g. under a 1.5 °C scenario, absolute emissions need to decrease by 2.5% per year between 2020 and 2030 – or relative – e.g. under a 1.5 °C scenario and a 3.5% GDP growth assumption, emissions per economic units need to decrease by 7%. When the reduction rate is relative, the portfolio or company climate performance should be expressed in relative terms too. This yields the questions of 1. Whether to use a temperature benchmark expressed in absolute and intensity terms (see p.120) and 2. what normalizing metric to use if the benchmark is expressed in intensity terms (see p.124).

2. Convergence-based approaches have historically been applied at sector-level, promoted by the sectoral

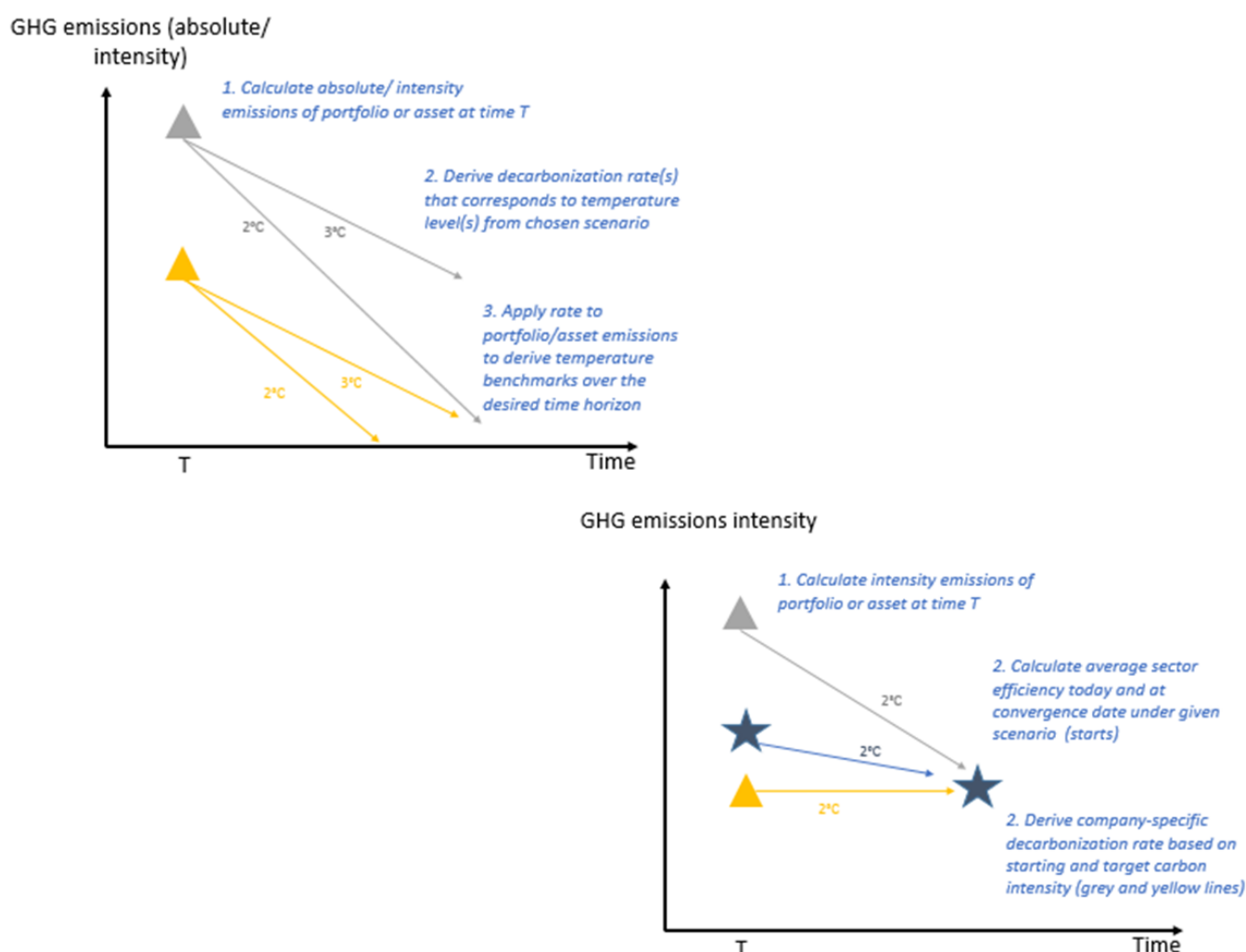
decarbonization method of the SBTi ([CDP, WRI & WWF, 2015](#)). All companies within a given sector reduce their emission intensity, measured per physical unit, to a common value by a given year as dictated by global temperature trajectories.

- This approach takes directly into account the current performance of companies. Under the SDA approach, a company that is 100% renewable today need not reduce further its emissions, given that its emissions intensity is already lower than what is expected in 2060 under a 2°C scenario for the utility sector. This approach relies on additional hypotheses though, such as the convergence date and future production levels, and is only applicable to a limited set of sectors.
- To increase sector-coverage, the convergence approach has been used in economic intensity terms, i.e. normalizing the scenario(s) trajectories by GDP

and expressing the temperature benchmark(s) by an economic metric, e.g. revenue. The convergence approach has also been applied, at least implicitly, at portfolio-level, by measuring the gap in climate performance between portfolios and their temperature benchmark.

- Convergence approaches cannot be based on absolute temperature benchmarks. Indeed, companies and portfolios of different sizes cannot be expected to converge to the same level of absolute emissions. One of the issues is that temperature alignment approaches that rely on benchmarks expressed in intensity terms, such as GHGs per unit of production or GHGs per unit of economic value, do not guarantee that the overall carbon budget is respected. See p.53 for a detailed explanation and ways to remediate this.

Figure 20: The difference between a contraction approach (top panel) and convergence approach (bottom panel)



For more details, please refer to the technical deep-dive, section 3:

- How to express the temperature benchmark(s)? p.120
- How to distribute macro-level trajectories to micro-level benchmarks? p.125

Table 10: Contraction approaches

Typology	Description
<p>Absolute contraction approach</p> <p>Examples: <u>SBTi absolute approach:</u> agnostic <u>FMQ:</u> geography-specific <u>2° C Investing Initiative</u> <u>PACTA:</u> sector-and company-specific <u>EcoAct:</u> both <u>Urgentem:</u> both</p>	<p>Apply absolute emissions reduction rate required to limit temperature rise under different levels, as given by scenario, to absolute carbon footprint at portfolio, sector or company level. The emissions reduction rate can be adapted for geographical and sectoral bias if needed, depending on scenario data availability. This approach is also applicable at the technology level: apply a reduction rate for brown assets and expansion rate to green assets.</p> <p>Assessment question: Best approach for compatibility with the temperature objective of the Paris Agreement as it leads to absolute emissions reduction regardless of economic expansion or contraction.</p> <p>Applicability: Can be applied to Scope 1, 2 and 3 without worrying about double-counting as well as removed emissions; easy to understand; lower data requirements.</p> <p>Can be considered “unfair”:</p> <ul style="list-style-type: none"> • Portfolios and companies cannot “grow”, except if marginal net growth is zero-carbon or within sectors that have their carbon budget growing under specific scenarios. Therefore, the choice of the base year may favor some over others; • All portfolios and companies need to decrease their emissions by the same rate regardless of their current performance and past efforts. This assumption can be adapted – see p.126 how it is done in the PACTA method.
<p>Emission intensity contraction approach</p> <p>Examples: <u>TEG Paris-aligned benchmarks:</u> agnostic <u>SBTi GEVA approach:</u> agnostic <u>S&P Trucost</u> uses GEVA for heterogeneous sectors: agnostic</p>	<p>Apply emissions intensity reduction rate required to limit temperature rise under different levels to the emission intensity of portfolio, sector or asset, expressed as absolute emissions divided by economic metric. The emission intensity reduction rate is expressed in carbon emissions per unit of GDP. The portfolio or company required trajectory can be expressed using a range of normalizing economic metrics (revenue, value-added, total capital, enterprise value...). The emissions reduction rate can be adapted for geographical and sectoral bias if needed, depending on scenario data availability.</p> <p>Assessment question: Captures “efficiency”, i.e. whether a portfolio and/or company is decoupling economic value and emissions at a rate sufficient to be considered aligned with a temperature trajectory.</p> <p>Applicability: Can be applied to Scope 1, 2 and 3 without worrying about double-counting and removed emissions; relatively easy to understand; relatively higher data requirements to normalize emissions trajectories and footprint.</p> <p>Does not guarantee absolute emissions reduction (see p.53 for details):</p> <ul style="list-style-type: none"> • If GDP grows at a higher rate than forecasted in the scenario; • If the economic performance of the company or portfolio grows faster than absolute emissions increase (e.g. if EV grows faster than absolute emissions). <p>Can be considered “unfair”: all portfolio and companies need to decrease their emissions by the same rate regardless of their current performance and past efforts. This assumption can be adapted although none of the methodology reviewed do so. See expert track p.126.</p> <p>Necessitates additional assumptions in the choice of the economic metric used to normalize portfolio and company performance – each introducing bias. See expert track p.124 for a discussion.</p>

Table 11: Convergence methods

Typology	Description
<p>Sector-agnostic convergence</p> <p>Examples: Implicit within Carbon4 Finance methods (although includes indirectly specific component of sector-specific convergence methods, see below)</p>	<p>Derive a metric or score that reflects the expected performance, or temperature benchmark, of a portfolio aligned with different temperature targets. For example, Carbon4 Finance derives a portfolio-level rating that comprises of the ratio avoided/induced and qualitative elements that correspond to different temperature level.</p> <p>Assessment question: What should be the portfolio climate performance, expressed through a given metric, to be considered aligned with different temperature targets? As the assessed portfolio is compared to the different benchmarks, these rely on an implicit convergence assumption.</p> <p>Applicability:</p> <ul style="list-style-type: none"> • No issues of double-counting – as long as the benchmark and portfolio score/ metric are calculated in the same way. • Rely on a proprietary metric that can include qualitative elements and avoided emissions. • Benchmark at portfolio-level rather than asset-level. Adjustments can be made to reflect sector composition (see p.140).
<p>Sector/company-specific convergence</p> <p>Examples: <u>SBTi SDA Approach:</u> sector/company-specific by physical intensity <u>Most providers:</u> Arabesque: economic Carbon4 Finance: elements within company scoring CDP-WWF Temperature Rating: both ISS: both S&P Trucost: physical for heterogeneous sectors IC&C: physical right. based: economic</p>	<p>Emissions intensity (physical) benchmarks: For homogenous sectors, derive the required emissions intensity per unit of production in a given sector to the chosen convergence date; some method, including the SDA, derive the asset-specific trajectory by taking into account its starting point and desired convergence level and date.</p> <p>Emissions intensity (economic) benchmarks: same methodology as above except that the carbon intensity is expressed per unit of economic value, e.g. revenue.</p> <p>Assessment question: Towards what sector-specific carbon efficiency/intensity should companies converge within a given date to be considered in line with different temperature trajectories (if possible, taking into account the initial performance of companies)?</p> <p>Applicability:</p> <ul style="list-style-type: none"> • The physical intensity (SDA) approach is only applicable to homogenous sectors with a clear production metric (kwh, # vehicles...) and with sector-decarbonization trajectories available in scenario(s); • The economic intensity approach can be distorted by price variations effects • The most relevant scope or only scope 1 can be included. If scope 1, 2 and 3 are included, different benchmarks should be used to avoid double-counting.

Expert track: Intensity-based benchmarks and absolute carbon budget

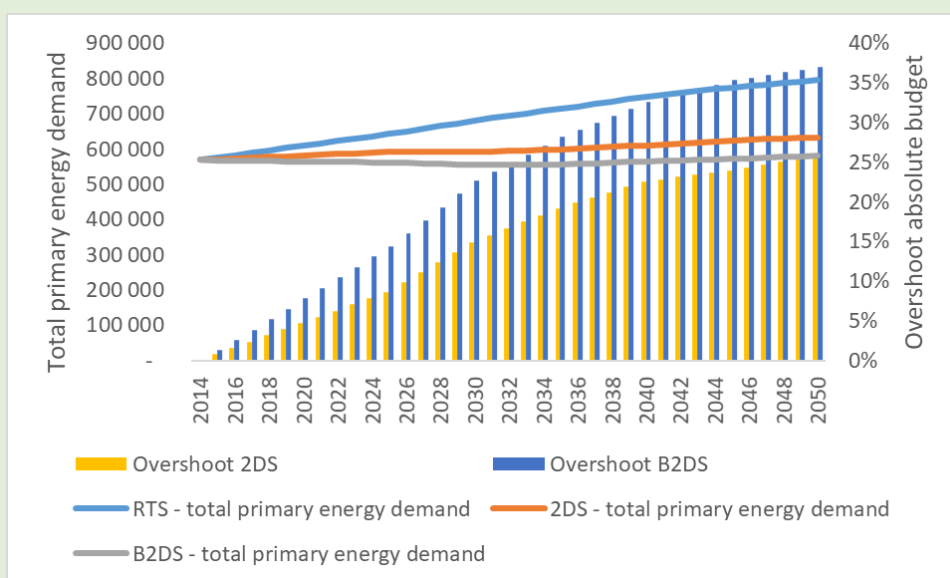
The issue. Portfolio temperature alignment approaches that rely on benchmarks expressed in intensity terms, such as GHGs per unit of production or GHGs per unit of economic value, do not always guarantee that the macro-level carbon budget is respected. Why is that and how to remediate this?

Let's take the IEA B2DS scenario and the oil & gas upstream production activity. The sectors' emissions intensity benchmark is calculated by dividing the overall absolute carbon budget allocated to energy products by forecasted energy demand, as given in the scenario. If all energy companies managed to reach this emission intensity and no additional criteria were included in the assessment, the sector would be considered aligned with its temperature benchmark. This does not guarantee that the absolute budget is respected, though, as *both the emissions intensity and demand for energy products need to decrease*.

The graph below shows the percentage overshoot in carbon budget that would result from energy companies decreasing their emissions intensity as needed under the 2DS and B2DS scenarios but increasing their production of energy as forecasted under the RTS, business-as-usual scenario.

Under this extreme case, the overall carbon budget would be surpassed by 12% and 17% under the 2DS and B2DS respectively, in cumulative terms, between 2014 and 2050. Therefore, can one really say that the energy sector is “aligned” with the 2DS and B2DS scenarios under these circumstances?

Figure 21: Percentage overshoot in carbon budget if the Oil & Gas upstream sector reaches the required intensity under the B2DS scenario but keep absolute production levels as forecasted under the RTS scenario. (Author's calculation based on IEA, 2017).



The same issue arises when using an economic intensity metric at the portfolio-level. For example, one of the TEG Paris-Aligned criteria states that to be considered aligned, total emissions intensity at the portfolio-level per unit of enterprise value should decrease by 7% on a yearly basis. The 7%, also mentioned by the SBTi GEVA method, stems from the IPCC SR1.5 report: under a 1.5°C scenario, absolute emissions need to decrease by 2.5% per year between 2020 and 2030 that is by 7% assuming a 3.5% GDP growth rate. If GDP grew at a higher rate than what is forecasted, using this intensity benchmark would lead to an emissions overshoot and higher temperature rise.

On the other hand, “if a company is decreasing its [absolute] emissions due to proportional decreased activity and maintains its emission intensity, this company is likely not sustainable.” “Therefore, to have a true understanding of how appropriate the trajectory is, it is necessary to understand at least their absolute and intensity trajectories ([Faria and Labutong, 2019](#)).”

What solution? So how can a method capture the interplay between economic growth and finite carbon budgets? It is important to distinguish between a company that gains market share within a sector that stays the same (e.g. through M&A or gain market share at the expense of other actors) and a company that grows, everything else being equal, and leading to the expansion of the sector total output. The issue discussed here arises only in the second case.

There are at least four ways to embed these considerations:

1. Compare the results under different growth scenarios. Alternatively, disclose and make transparent the underlying hypothesis: e.g. “2 °C aligned under the condition that growth stays lower than x”. This would make it easier to cross check the results ex-post and be of use in the context of engagement discussions.

2. Use an absolute approach together with the intensity approach to ensure that both are consistent with alignment and temperature benchmark(s). In the above example, this requires calculating the share of production or Scope 3 emissions for each oil & gas company based on specific assumptions (e.g. current market share) and assessing its future production plans or carbon emissions forward-looking performance against this. This method attributes the budget based on the fixed market share assumption but compares it to the company’s production plans. It is therefore essential to recalculate the budget every year based on new market conditions.

3. Include safeguards in the intensity approach as within the SDA approach. This means embedding future production plans in the calculation of the intensity benchmark – at least on the short term, where Capex and announced plans datasets are available. If an oil & gas company expands its production plans in a way that leads to an increased sector production compared to the production levels embedded in the scenario, its target emissions intensity required to be considered aligned with a 2 °C trajectory becomes lower. This method is harder to implement because forward-looking data that could be used to estimate future market share is not always readily available and very uncertain. In addition, no difference is made between a company that gains market share through M&A, at the expense of another company, or everything else being equal

4. Adjust temperature benchmarks expressed in intensity by using a different denominator than total output as modelled in the scenario to represent a “more realistic” change in output. In the oil & gas above, this could mean deriving the B2DS benchmark intensity by taking as a nominator the remaining carbon budget to the oil & gas industry under the B2DS scenario and as a denominator the forecasted sector production under the RTS scenario.

2.2.4. Dessert: Putting it all together to assess temperature alignment

Static and dynamic assessments. To assess the temperature (mis)alignment of a company or portfolio, its climate performance is compared to the temperature benchmark(s), derived using one of the methods highlighted in table 10 and 11. The way the comparison is performed can take various shapes and forms that will ultimately drive the results and their meanings.

The main philosophical difference is between static and dynamic assessments. A dynamic assessment assesses the climate performance of a company or portfolio over a period of time; whereas a static assessment is performed at one point in time and captures “distance (or proximity) to target”.

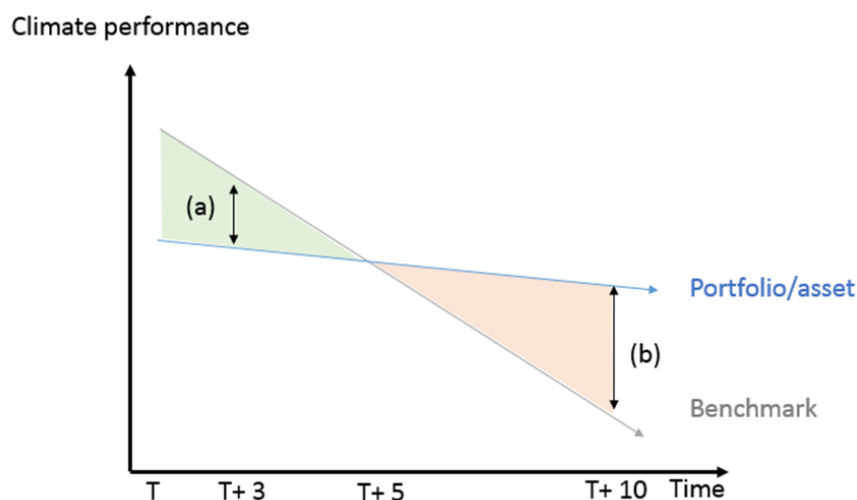
Why is it important? Static assessments are very sensitive to the year of assessment chosen – and do not inform on past and future climate performance. Therefore, a portfolio may be 2°C “aligned” in 2030

– but it does not mean that it’s cumulative past and future performance lead to a 2°C world in the aggregate.

Dynamic assessments capture the cumulated climate performance over the period under consideration. Therefore, a “bad” performance in one year can be compensated by a “better” performance in another. Therefore, a portfolio that is 3°C aligned in 2030 can be considered 2°C aligned over the period 2020-2030. Dynamic assessments can be performed based on a trend comparison of the company or portfolio climate performance relative to the rate of change needed to maintain temperature rise under a specific level. It can also be done cumulatively by calculating the total area under and above the two curves.

The choice of time horizon is central to both types of assessments. As highlighted above, the choice of the year at which the gap assessment is performed drives the results of static assessments. For dynamic assessments, both the start and finish date are important.

Figure 22: The difference between static and dynamic assessment. If measured at T+3 (static), the portfolio climate performance is considered to be better than that of the benchmark (a). If measured at T+10 (static), the portfolio climate performance is considered to be worse (b). Within a dynamic assessment between T and T+10, the cumulative portfolio performance is considered to be worse, as the red area is larger than the green area. Within a dynamic assessment between T and T+5, the portfolio performance is considered to be better, as the green area is larger than the red area.



Is it conceptually possible to say that a portfolio is aligned with a 2°C trajectory today in 2020? That is, what does the comparison, or gap assessment, between current climate performance of companies and a well below 2°C macro benchmark at a point in time T tell us?

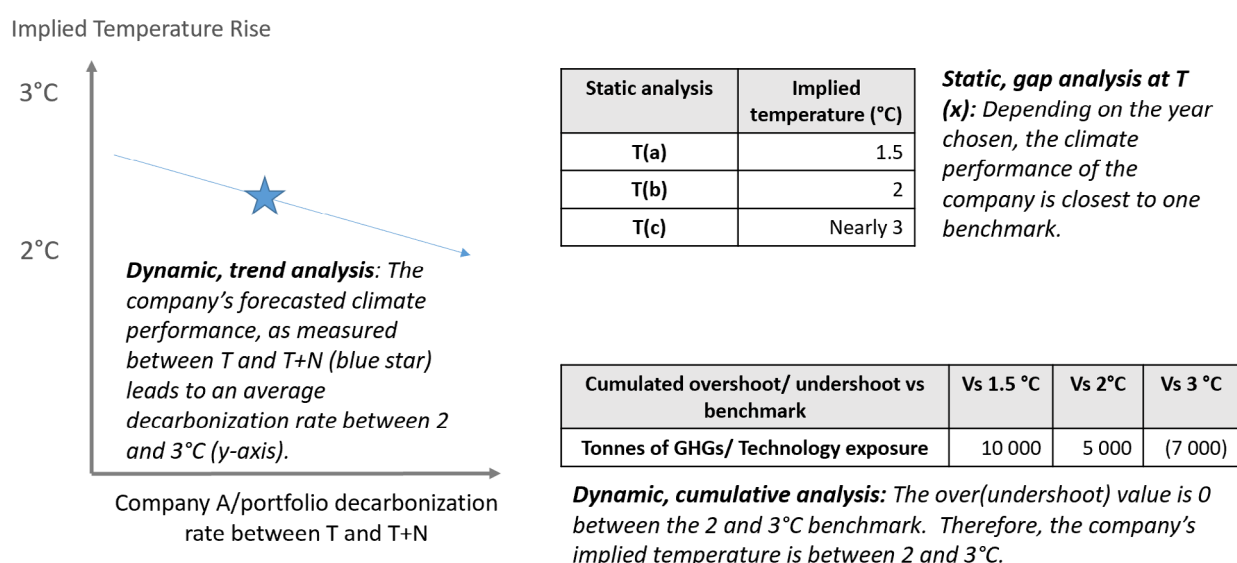
A company or portfolio is, by construction, always aligned with any given trajectory “today”, when the scenario begins the same year as that of the company's reporting. Indeed, the starting point of each scenario is the current average situation. **In this specific case, the assessment therefore only measures the difference between the actual company or portfolio performance and today's average. It does not say anything about the past (ex-post) or future evolutions (ex-ante).**

However, scenarios often start in the past. For example, the IEA ETP 2017 scenario starts in 2014. Therefore, comparing the 2017 performance of a company or portfolio with the 2017 benchmark gives a sense of whether the company or portfolio has done its part historically, between 2014 and 2017. It is therefore essential to understand the starting date of the scenario.

Finally, the results of the temperature alignment assessment, i.e. of the comparison between one or several temperature benchmarks and the climate performance of a company or portfolio, **can be expressed** in qualitative binary terms (“2°C aligned or not” e.g.), percentage or absolute difference with a temperature trajectory and **through an implied temperature rise (ITR) indicator**. It is worth noting the multiple layers of uncertainties that compound themselves at each step of temperature alignment methodologies, thereby calling into question the desirability to translate the results of such assessments into a single metric (see expert track p.59).

In particular, ITR metrics translate into a temperature score the extent of a portfolio or company (mis) alignment. It goes one step beyond indicators that express the results of 2°C alignment assessments in percentage terms (e.g. % or absolute quantity of GHG emissions above the temperature benchmark, calculated as the gap between the climate performance of an asset/portfolio and a temperature benchmark, over the scope of the assessment). **Whether the translation of the degree of (mis) alignment to an ITR metric is informative remains debatable, for a range of reasons detailed below and on p.132 of the technical review.**

Figure 23: Deriving an ITR metric based on the results of temperature alignment assessments (schematic, authors' view)



First, the extent of the (over)undershoot above a benchmark that represents a desired temperature trajectory (e.g. 2°C) is more actionable than an ITR metric as it highlights the extent to which emissions need to be reduced, or “green” activities expanded, to be 2°C-aligned.

Second, as explained above, the ITR metric is derived based on the extent of the overshoot between the climate performance of a company or portfolio and a temperature benchmark. Therefore, **both indicators are often available in methodologies that compute an ITR metric. Why then use the ITR metric?**

One can argue that it is easier to communicate to a wider range of stakeholders because it creates a graphic system of equivalency with the international temperature rise limitation objective. On the other hand, it is worth recognizing that temperature alignment approaches are very simplistic in comparison to IPCC climate models and approaches.

Therefore, this system of equivalency is approximate at best, misleading in the worst cases (see p.132 For a detailed discussion):

- **Time myopia:** First, both static and dynamic temperature alignment assessments are very dependent on the year of assessment/time horizon chosen.
- **System myopia:** Second, the temperature metric assumes that everyone else (portfolio/ companies/ parts of the economy not captured by model e.g. citizens) do their part as well and/or rely on specific modeling assumptions on the behaviors of the rest of the economy.
- **Compatibility:** A below 2°C company or portfolio does not necessarily lead to a below 2°C world and may exhibit increasing absolute emissions if the method does not include safeguards.
- **Rising uncertainties:** Temperature trajectories, as given by scenarios, are not linear. For example, the carbon budget in 2030 is not simply 50% higher within a 3°C versus a 2°C pathway.

For more details, please refer to the technical deep-dive, section 4:

- Measuring the spread or speed? p.128
- Expressing the results in an Implied Temperature Rise indicator? p.131
- How to aggregate and weight the results at portfolio-level? p.136
- Using additional adjustment factors? p.140

Table 12: Dynamic and static assessments

	Dynamic		Static
Type	Trend assessment	Cumulated overshoot/undershoot	Gap assessment
Comments	<p>Bias can be introduced through benchmark non-linearity depending on the time horizon chosen. The assessment could be segmented in different time periods to capture non-linearity.</p> <p>This type of assessment is either backward-looking or relies on estimating the future climate performance of the company or portfolio.</p>	<p>Captures non-linearity of benchmarks: captures the cumulated over (under)shoot between the benchmark and climate performance of asset/portfolio.</p> <p>This type of assessment is either backward-looking; forward-looking based on current performance; or based on estimated future performance.</p>	<p>Does not capture the non-linearity of benchmarks. The choice of year of assessment drives the results.</p> <p>An asset/portfolio that is closest to the benchmark in time T is not the one that is necessarily the most aligned in the aggregate.</p> <p>This type of assessment can be done either at time T (current) or T+N.</p>
Temperature	By comparing the trend required under different temperature scenarios with the historical or forecasted trend of the company or portfolio, determine the temperature range within which it falls and possible interpolate to derive a specific number.	Determine the temperature benchmark that minimizes the over(under)shoot to 0.	Distance-to-target: determine how far the climate performance of the company or portfolio is from a given temperature benchmark at time T. May be based on interpolation.
Examples (non-exhaustive)	<p><u>CDP-WWF Temperature Rating:</u> Time horizon: Target start-end date Future performance: targets</p> <p><u>EcoAct:</u> Time horizon: Target start-end date Future performance: targets</p> <p><u>TEG PAB:</u> Time horizon: T- 1 to T Start date of trend: T-1 Future performance: None</p> <p><u>Urgentem:</u> Time horizon: 2017-2060 Future performance: None</p> <p><u>2° Investing Initiative PACTA:</u> Time horizon: T-T+5 (currently 2023) Future performance: asset-level database</p>	<p><u>S&P Trucost SDA-GEVA:</u> Time horizon: 2012-T+5 (currently 2025) Future performance: targets, extrapolation, asset-level database</p> <p><u>I Care & Consult SB2A:</u> Time horizon: 2010 – 2050 Future performance: targets, extrapolation</p> <p><u>Right. based:</u> Time horizon: 2018-2050 Future performance: user-defined</p> <p><u>ISS:</u> Time horizon: 2018-2050 Future performance: extrapolation, targets</p>	<p><u>Transition Pathway Initiative:</u> Time horizon: Last data point available for a company, compared to the 2030 value of the benchmark (or the 2050 value only in oil and gas)</p> <p><u>Arabesque:</u> Time horizon: 2030; 2050 Forward-looking performance: None</p>

Expert track: A zoom on uncertainties

Layers of uncertainties. Temperature alignment metrics, including implied temperature rise (ITR) metrics, may give a false sense of certainty to the uninformed reader, as it relies on multiple layers of assumptions that build upon each other, in particular:

1. The measurement of the climate performance of companies and portfolio;
2. The estimation of their future climate performance, when a forward-looking assessment is used;
3. Uncertainties embedded in the scenarios themselves;
4. Assumptions to disaggregate the macro trajectories to micro benchmarks;
5. Assumptions regarding the calculation of temperature alignment;
6. When an ITR is used, calculation of the temperature metric itself.

In a nutshell, the result of the recipe is only as good as the ingredients and the recipe itself. The main uncertainties are reviewed in table 13, as well as uncertainty mitigation mechanisms that have been, or could be used by data providers, method developers, and investors.

Table 13: Qualitative description of key uncertainties and uncertainty mitigation options (non-exhaustive)

	Key uncertainty	Uncertainty mitigation options (non-exhaustive)
Current and past climate performance	<p>Reported data quality may vary. In addition, in the absence of reporting, some providers and investors may choose to use estimation models to fill the gaps. These estimation models each have pros and cons in terms of data quality.</p> <p>Options include (non-exhaustive):</p> <ul style="list-style-type: none"> • Rely on checks performed by data providers; use internal checks and outlier analysis; • Use only data that has been assured; re-calculate emissions based on asset-level datasets or other sources; • Do not use estimation models (rely on reported data); backtest estimation models 	
Forward-looking climate performance	<p>By definition, forecasting the future climate performance of companies or portfolios is an uncertain exercise. The range of uncertainties is hard to quantify as historical time-series hardly exist yet to back-tests forecasts with actual performance.</p> <p>The longer the time horizon the higher the uncertainty. At the same time, an assessment that cuts off arbitrarily at an earlier date assumes implicitly that the portfolio and company do not overshoot its budget thereafter.</p> <p>Options include (non-exhaustive):</p> <ul style="list-style-type: none"> • Perform sensitivity analysis: a variation of x% in the forecast of the future climate performance leads to a x% change in implied temperature/ alignment. • Calculate the results for different forward-looking data. • Derive a “confidence corridor”. See La Française AM methodology (2020) for an example. • Triangulate forward-looking data as calculated using different methods: e.g. check that targets are realistic by comparing with the historical rate of change. • Apply a “credibility discount” to forward-looking data. 	
Scenarios and trajectories	<p>The calculation of the remaining carbon budget to limit temperature rise under a given level on which scenarios have different levels of probability associated with them. For example, the IPCC SR 1.5 report states that the remaining carbon budget to limit temperature rise compared to the pre-industrial level with a 66% chance is 420 Gt. However, when incorporated earth system feedback, the budget would be reduced by 100 GtCO₂. Integrating additional uncertainties could impact the remaining budget as well.</p> <p>Options include (non-exhaustive):</p> <ul style="list-style-type: none"> • Choose scenarios with a higher chance level of limiting temperature increase under a certain level; • At minimum, disclose the chance level of scenarios used. 	

Micro-benchmarks	<p>Absolute benchmarks ensure that the global carbon budget or technology share is respected, regardless of underlying economic conditions. In addition, contraction methods are more stringent and more likely to lead to the desired outcome. However, it is hard to justify these in the face of “fairness” – therefore, providers and investors prefer to use convergence by intensity benchmarks. These introduce uncertainties in terms of keeping the macro-budget.</p> <p>Options include (non-exhaustive):</p> <ul style="list-style-type: none"> • Update the benchmarks as often as possible and perform attribution assessment to determine what drives the changes in results yoy (company actual decarbonization, change in scenario, change in market share...). • Use both intensity and absolute metrics.
Implied Temperature Rise assignment	<p>In some cases, results of temperature alignment assessments are translated into an Implied Temperature Rise (ITR) metric. While it appears as easier to communicate because it gives the impression that the results can be directly compared with the IPCC results, it is worth recognizing that these approaches are very simplistic in comparison to IPCC climate models and work. The temperature can give an indication of the relative magnitude of performance of one company or portfolio vs another. However, it can hardly be used in absolute terms nor to compare the outcomes of different methodologies, in their current state.</p> <ul style="list-style-type: none"> • Time myopia: The assessment is very dependent on the time horizon chosen, especially for static alignment. Dynamic assessment assumes that the rate of change and/or cumulated overshoot remains the same post-assessment date. • System myopia: The temperature metric assumes that everyone else (portfolio/ companies/ parts of the economy not captured by model e.g. citizens) do their part as well. • Uncertainty: Increasing uncertainty levels for higher temperatures. • Compatibility: A below 2 °C portfolio does not necessarily lead to a 2 °C world – some methods can attribute a below 2 °C temperature to portfolios whose absolute emissions increase through time. <p>Options include (non-exhaustive):</p> <ul style="list-style-type: none"> • Disclose range rather than a specific temperature to avoid interpolations; • Use dynamic rather than static approaches; • Transparency around all assumptions taken.

3. FOOD IS SERVED: IS THERE AN IDEAL RECIPE?

The objectives of this section are to 1. Highlight whether specific methodological choices are more suited to different types of compatibility assessments, 2. Underline the trade-offs that arise because of data availability, and 3. Test whether these choices have practical implications on the results of these assessments on two real-world indices.

KEY TAKEAWAYS

There is no ideal alignment and temperature methodology. Many permutations of the same recipe are possible; yet there is no ideal temperature alignment methodology. In practice, data providers and investors face a range of trade-offs given data availability. What is best from a theoretical perspective may not be easily applicable. Ultimately, it is up to the users to choose methodologies that best fit their information needs given these trade-offs and up to regulators to become more precise on what are minimum technical requirements that methodologies should meet in order to be fit for purpose.

Testing the practical implications of methodological choices. To date, different temperature alignment methodologies exhibit a range of methodological choices that can differ widely, mostly because of the range of trade-offs that arise when seeking to maintain internal consistency. Therefore, it is interesting to compare these methodologies, in order to identify the practical implications of their similarities and divergences. The objective is to test selected methodologies on actual indices to see what insights can be derived from them and to what extent different methodological choices drive the results.

Eleven methods were tested in this report on two indices, the Euronext LC100 and the SBF 120, in two different years, 2018 and 2019. The methodologies included in the test were selected based on their 1. Availability at present or shortly (road-test stage), 2. Applicability at the level of an investment portfolio; 3. Comparison with trajectory and/or implied temperature rise indicator and 4. Accessibility to all investors on a free-of-charge or paid-basis. The main

focus is on listed equity and corporate bonds. The NEC metric was also included as a comparison as it can be considered as an alignment metric, even if it is not a temperature alignment metric *stricto sensu*, as defined in this report (see p.38).

Little consistency and comparability across methods. Currently available temperature alignment methods show little consistency in terms of results. The results themselves are hard to compare due to different coverage levels and assumptions. This is to be expected as each of these methods are designed to answer different questions. Therefore, it is essential to highlight the specific question answered when disclosing the results of this type of assessment.

The following analysis is performed on the results received:

- Coverage at portfolio-level (table 18);
- Headline results, either expressed through an Implied Temperature Rise metric (ITR) or a percentage deviation from a 2 °C trajectory (p.73);
- The relative ranking between each index (figure p.74);
- Where possible, the relative dispersion of company-level results for each method (p.75);
- Where possible, specific results for companies with science-based targets (p.76);
- Where possible, specific results for the LC100 “green pocket”, i.e. companies with more than 50% of their revenue derived from “green” activities (p.76).
- Where possible, the correlation between company

level results across the different methods is analyzed, in an attempt to determine whether methods that have the highest correlation coefficients between each other share the same methodological attributes, if any (p.81).

- Where possible, the most and least consensual companies across methodologies are highlighted,

where “consensual” is defined as the standard deviation of company-level results across methods. (p.82)

- Finally, where possible, company-level results are correlated with carbon footprint data, to determine to what extent using this type of methodology complements carbon footprinting (p.83).

3.1. FROM CONCEPTUAL TRADE-OFFS TO PRACTICAL DIFFERENCES

Data providers and investors have built temperature alignment methodologies that are based on different choices within each of the four main methodological steps highlighted in Section 2 of this report. Are some of these choices more relevant than others? In this section, these choices are first reviewed in light of the key principles embedded in the definition of assessments that aim to capture compatibility with 1. one or several scenarios, 2. the temperature objective of the Paris Agreement, and 3. the Paris Agreement, as highlighted in Section 1 of this report. Second, how these choices may influence the results is analyzed through a practical test on the Euronext LC100 and the SBF120.

3.1.1. Reconciling effectiveness and applicability

Table 14 translates into tangible methodological choices the principles on which may rely assessments that seek to capture compatibility with one or several temperature trajectory, with the temperature objective of the Paris Agreement and with the Paris Agreement (see p.16). It is possible to derive a number of key conclusions from looking at this table.

First, can temperature alignment assessments, as defined in this report, be used to assess compatibility with the Paris Agreement as a whole? As highlighted on p.16, no temperature alignment assessment method are currently built on the methodological choices that would be appropriate to capture “alignment to the Paris Agreement”. Moreover, **it remains to be shown whether a “trajectory alignment” type of assessment could be used to demonstrate “compatibility with the Paris Agreement”, in a relevant, sound, holistic, and easily-understandable way.** Indeed, this type of assessment would require:

- **Using nationally-determined trajectories** as a starting point: current nationally-determined trajectories to achieve these goals are most often not available, or not ambitious enough. The UNEP Gap report (2019) shows that the sum of today’s NDCs puts us on a 3.2°C trajectory.
- **Using trajectories that incorporate considerations relating to both adaptation and the Sustainable**

Development Goals: on what metrics should these trajectories be based? What is the end objective equivalent to the 1.5°C temperature rise limitation for adaptation and other environmental and especially social themes? These trajectories would also need to take into account both the local, regional, national, and global dimensions.

- Finally, **assessing the performance of companies and portfolios based on a multitude of criteria relating to adaptation and the SDGs** is hard to do. No agreed-upon framework equivalent to the GHG Protocol exists to date to measure most of these aspects. Company reporting is poorer for environmental indicators other than carbon emissions, especially in terms of forward-looking data. This data is often not segmented per geography. Also, this would yield the difficult question of “science-based” aggregation and weighting between different criteria. Finally, how can “adaptation” be captured?

Second, few temperature alignment assessments to date are based on all the appropriate methodological choices to assess “compatibility with the temperature objective of the Paris Agreement”, mainly because of trade-offs in terms of data availability and applicability. These trade-offs often arise when trying to maintain the overarching methodological internal consistency, as reviewed in table 15 below. It may not always be feasible to apply the most relevant, or effective methodological choice, leading providers to manage this trade-off using a range of strategies.

Table 14: Summary of methodological choices and relevance to assessment question (see relevant pages for discussion)

	All temperature alignment assessment methods
Consistency	Any possible methodological choice as long as the climate performance (current and future) or companies and portfolios is expressed consistently with the temperature benchmarks (in terms of scope and perimeter, normalization metrics e.g.)
	Compatible with the Temperature objective of the Paris Agreement
Is it achievable?	Few temperature alignment assessments as done to date capture all the below aspects, mainly because of trade-offs in terms of data availability and applicability, as reviewed in table 15 below.
Step 1: Assessing the current and future climate performance of companies and portfolios	
Metric	Include carbon and other GHGs emissions; technology-based metrics
Perimeter	Relevant value-chain scope, or scope 1,2 3
Sector coverage	As large as possible, with a specific focus on sectors with high-climate stakes (high GHG emissions and/or key to the transition)
Forward-looking	Capture locked-in emissions
Step 2: Choosing one or several scenarios and temperature trajectories	
Scenario(s) and associated temperature pathway(s)	Precautionary scenarios with low or limited overshoot, lower reliance on removal technology, stronger decarbonization rate, and sooner emissions peak, within the most precautionary socio-economic conditions. Declined in geographical – sector-specific trajectories
Step 3: Deriving micro-level temperature benchmarks from macro-level temperature trajectories (step 2)	
Benchmark type	Any, as long as it guarantees the respect of the absolute remaining carbon budget when intensity-based metrics are used.
Allocation	Recognize where possible sector- and company-specific current climate performance, capability, and specific trajectories.
Step 4: Assessing company and portfolio temperature alignment (putting Step 1 and 3 together)	
Time horizon	If possible, different time horizons to (short- 1-2 years), medium- (5-10 years), long- (more than 10 years).
Alignment type	Dynamic assessments that capture cumulatively compatibility over the full assessment time horizon (between T and T+N).
Portfolio-level aggregation	Takes into account portfolio exposition to high-stakes sectors (high GHG emissions and/or key to the transition)

Table 15: Non exhaustive list of the main trade-offs in temperature alignment methodologies

<p>Choice of metric: Technology metrics are “purer” than GHGs metric – it is easier to attribute emissions reduction to corporate actions and plans through these metrics. On the other hand, GHGs metric are applicable across sectors and encompass a larger scope (efficiency e.g.).</p>	
<p>Data providers’ response:</p> <ol style="list-style-type: none"> 1. Use technology metrics only and limit sector coverage; 2. Use a mixture of technology and GHGs metrics, depending on the sector; 3. Use GHG metrics only and attribute change by deriving an intensity metric by production where possible; 4. Use GHG metrics and attribute change by deriving an economic intensity metric; 5. Use absolute GHGs metrics and do not attribute change. 	<p>Data gaps:</p> <ul style="list-style-type: none"> • Technology-type data for a higher number of sectors, granular enough; • Temperature benchmarks expressed in technology share for a higher number of sectors; • Harmonized and comparable corporate reporting on production metric; • Incomplete emissions data and uncertainty of modelled data.
<p>Value chain perspective: Scope 3 emissions can represent the largest share of a company or portfolio emissions. To ensure that the temperature alignment assessment does not lead to a displacement of emissions along the value chain, these may be captured where relevant. However, data availability and quality, although increasing, has historically been very low. It may also lead to double-counting under certain circumstances. Finally, sector-specific temperature benchmarks for scope 3 categories may not be available.</p>	
<p>Data providers’ response:</p> <ol style="list-style-type: none"> 1. Only include scope 1 and 2; 2. Use most relevant scope(s) where benchmark(s) are available ; 3. Use most relevant scope(s) and derive specific benchmark(s); 4. Use most relevant scopes(s) and map them to benchmark(s) using additional data; 5. Use all scopes (1+2+3) and sector-agnostic benchmark(s) ; 6. Use all scopes and recalculate benchmark(s); 7. A mix of the above. 	<p>Data gaps:</p> <ul style="list-style-type: none"> • Comparable and relevant Scope 3 data reporting by corporates; • Temperature benchmarks for all relevant scopes/ sectors at a sufficient level of granularity.
<p>Inclusion of removed and avoided emissions: Nearly all 1.5 °C and 2 °C trajectories require the use of industrial or removal technologies that need to be scaled up significantly. This is not captured by traditional carbon accounting. In addition, traditional accounting that focus on Scope 1, 2 and 3 emissions do not capture entirely “avoided emissions”, i.e. emissions that were avoided by a third party due to the use of greener products and services. However, little comparable and quality data are reported by companies on these two aspects. In addition, decarbonization trajectories do not cover avoided emissions. Finally, removed and avoided emissions should not come at the expense of decarbonization in terms of climate mitigation strategy.</p>	
<p>Data providers’ response:</p> <ol style="list-style-type: none"> 1. Do not include removed or avoided emissions; 2. Consider only removed emissions and net them from induced emissions; 3. Include avoided emissions where relevant; recalculate them to increase comparability and recalculate temperature benchmark to make it comparable; 4. Map “solutions” providers to the relevant scope and temperature benchmarks and assess how they contribute to the decarbonization objective of their clients. 	<p>Data gaps:</p> <ul style="list-style-type: none"> • Comparable and consistent removed and avoided emissions data; • Product & sales mix relating to “greener” products; • Temperature benchmarks for avoided emissions that may be mapped to specific sectors and corporates; • Temperature benchmarks for “solutions” providers; • Temperature benchmarks for removed emissions that can be mapped to specific sectors and companies.

Forecasting future performance and time horizon: There is a disconnect between the time horizon embedded within the climate models of the scientific community, international treaties and national climate plans, the investment horizons for different asset classes and type of investors, and the reporting of businesses. Temporality is therefore a central point of the concept of alignment. Indeed, a portfolio can be aligned with a 2 °C trajectory when a short-term perspective is adopted, but not be in the long term. However, the further the time horizon, the more uncertain the estimation of the future climatic performance of a company or portfolio.

Data providers' response:

1. Do not forecast future climate performance;
2. Use one type of forward-looking metric, e.g. focus on engagements and targets or revealed plans; cut off at most relevant time;
3. Use a mixture of forward-looking metric and cut-off "arbitrarily";
4. Use a mixture of forward-looking metric depending on company reporting and time horizon; cut-off at the end of scenario used (2050);
5. Split the results by time period (short, medium, long);
6. Any of the above and provide an uncertainty measure, e.g. "confidence corridor".

Data gaps:

- Forward looking production/ asset data;
- Better clarity and harmonization of targets;
- Attribution models to attribute past variation and better extrapolate (incl. long enough time series to do that);
- R&D data to estimate transformative change potential.

Choice of scenario and trajectories: Sector-specific trajectories better capture the differentiated role that sectors can and should play in the transition. IEA scenarios are the most disaggregated, comprehensive, useable and up-to-date output data today, although new scenarios are being developed e.g. CLAIM by Beyond Ratings. IEA scenarios are biased towards a specific technological development path and it do not cover all sectors. In addition, the way the remaining carbon budget is split between sectors is often an oversimplification that relies on specific hypothesis (e.g. cost-efficiency). If the assessment question is "alignment with the temperature objective of the Paris Agreement", the scenario must lead to a 1.5C° temperature outcome, be as precautionary as possible, with a high-level of probability, a short-term peak, limited overshoot and low reliance on capture technologies. While IPCC scenarios are best from a conceptual perspective, they are not as easily useable from an output perspective.

Data providers' response:

1. Favor a "pure" sector-based approach based on IEA, in spite of the lower coverage;
2. Use sector-agnostic trajectories and put company-specific constraint;
3. Use mix of scenarios depending on sector (e.g. IEA, IPCC);
4. Derive additional trajectories to cover additional sectors;
5. Build new trajectories on the basis of existing datasets (e.g. SR1.5)
6. Build new scenario(s) with the required criteria;

Data gaps:

- Scenarios that combine both the practical and conceptual requirements for this type of analysis: as sector-country specific as possible, covering a long period of time, following a precautionary approach (no or limited overshoot, low reliance on capture and removal technologies, short term emissions peak, fast decarbonization rate); providing production outputs for each sectors in physical and economic terms.
- Sector-geography data by companies to map these with sector-country trajectories.

Deriving micro-level temperature benchmarks: How to take into account company specificities, without constraining growth in portfolio value, but ensuring that the macro-level remaining carbon budget is respected? Methodologies that rely on benchmarks expressed in absolute terms ensure that the overall remaining carbon budget is respected but may be seen as restrictive as they restrict growth to 0-carbon growth. Methodologies that use relative benchmarks, i.e. expressed per unit of production or revenue, do not guarantee the overall respect of the carbon budget – if the production or revenue growth rate is higher than that embedded in the scenario and used to derive the normalized metric, then the overall budget is overshoot even if all portfolios and/or companies are "2 °C aligned" (see p.53 for a detailed discussion).

Data providers' response:

1. Use only benchmarks expressed in intensity terms and recalculate benchmark when more recent scenarios becomes available;
2. Use benchmarks expressed in intensity terms but adjust the benchmark to reflect sector growth;
3. Use only benchmarks expressed in absolute terms and recalculate company- and portfolio-specific carbon/ technology budgets every year based on new market share information;
4. Use a mixture of both.

Data gaps:

At company-level, attribution methodologies are lacking to attribute year-on-year changes in temperature alignment based on: 1. Scenario change, 2. Market share change (disaggregated between M&A, gain of market share at the expense of competitors, or gain of market share in a growing market), 3. Actual decarbonization.

3.1.2. A tasting session: rationale and description

Testing different temperature assessment methods. To date, different temperature alignment methodologies exhibit a range of methodological choices that can differ widely, mostly because of the range of trade-offs that arise when seeking to maintain internal consistency (table 15). Therefore, it is interesting to compare these methodologies, in order to identify the practical implications of their similarities and divergences. In this section, the objective is to test selected methodologies on actual indices to see what insights can be derived from them and to what extent different methodological choices drive the results.

Testing available methods on investment portfolios.

The following methodologies are included in the practical test. **The Euronext LC100 and the SBF 120 indices were chosen for this test because of their:**

- Diversified sector composition;
- Focus on large cap that ensures, in theory, higher coverage;
- France/ European focus;
- Combination of multiple low-carbon strategies in the Euronext LC100: pocket of “green” companies; fossil fuel exclusions; best in class climate score including Scope 1, 2, 3, avoided emissions and transparency. The construction rules are detailed in the below. The results are calculated for two years, 2018 and 2019.

Figure 24: Summary of data providers participating to the practical test and type of data shared (Alphabetical order). The NEC metric was included for comparative purposes as it can be considered as an alignment metric, even if it is not a temperature alignment metric stricto sensu, as per the definition of this report.

Provider	Data scope	Portfolio/ company results
Arabesque	LC100 2018, 2019, SBF120 2018, 2019	Portfolio-level; company-level
CDP-WWF Temperature Rating	LC100 2018, 2019, SBF120 2018, 2019, CAC40	Portfolio-level; company-level
Carbon4 Finance	LC100 2018, 2019, SBF120 2018, 2019	Portfolio-level; company-level for LC100 2019
EcoAct	CAC 40 2018	Portfolio-level; company-level
Urgentem	LC100 2018, 2019, SBF120 2018, 2019	Portfolio; sector; company-level
I Care & Consult	LC100 2019, SBF120 2019	Portfolio-level; company-level
ISS	LC100 2018, 2019, SBF120 2018, 2019	Portfolio-level; company-level
MSCI - Carbon Delta	Not included – Method is currently being updated	
right. based on science	LC100 2018, 2019, SBF120 2018, 2019	Portfolio-level; company-level
Standard & Poors – Trucost	LC100 2018, 2019, SBF120 2018, 2019	Portfolio-level; company-level
2 ° Investing Initiative – MoreImpact	LC100 2018, 2019, SBF120 2018, 2019	Portfolio; sector/ technology; company-level
2 ° Investing Initiative – Influence Map	LC100 2018, 2019, SBF120 2018, 2019	Portfolio; sector/ technology; company-level
NEC (1.0, calculated by Sycomore AM)	LC100 2018, 2019, SBF120 2018, 2019	Portfolio-level; company-level

Deep-dive: The Euronext LC100 Index ([Euronext, 2019](#))

Description. The Euronext Low-Carbon 100 is designed to reflect price level trends of companies in Europe that have the best climate score. It is the largest ESG ETF on European companies and was awarded two distinctions: Towards Sustainability Label (Febelfin) and French ISR label.

Construction rules. The index Universe is made of the 300 highest Free Float Market Capitalisations of the Euronext® Europe 500 Index minus the (in order of calculations):

- 30 worst performers in term of Social and Governance score;
- Exclusions related to the United Nations Global Compact;
- Exclusion of companies operating in the following ICB Subsectors: Tobacco, Defense, Aerospace and Oil Equipment & Services, fossil fuel activities;
- ESG controversies and controversial weapons;
- and adding Green companies.

Process. First, 300 companies are assigned a Social and Governance score. This score is computed as the average between the Social and Governance scores as defined by Vigeo-Eiris. The 30 worst scores are removed. In case of equal average score, the company with the best Social score will be preferred.

Second, the companies that do not meet or are at risk with the fundamental responsibilities in the areas of human rights, labour, environment and anticorruption as defined by the Ten Principles of the United Nations Global Compact (UNGC) and evaluated by Vigeo-Eiris are excluded.

Third, the companies involved in the following activities are excluded from the index: ▪ Companies with fossil fuel reserves, ▪ Companies searching, collecting, treating, refining or transporting coal, oil or gas, ▪ Utilities that use fossil fuels to produce electricity.

Finally, from the index Universe, 100-‘NG’ companies are selected based of their Climate score (best in class approach). The score is calculated by combining Carbon4 Finance CIA and CDP scores.

Up to 15 green companies with the highest percentage of their turnover (minimum 50%) related to “low carbon technologies” (renewables or energy efficiency) are selected from the 1000 highest European Free Float Market Capitalizations. These companies should be part of the following ICB sectors, as evaluated by Carbon4 Finance: ▪ Alternative Energy (580) ▪ Construction & Materials (2350) ▪ Electricity (7530) ▪ Electronic & Electrical Equipment (2730) ▪ Industrial Engineering (2750) ▪ Industrial Transportation (2770).

Table 16 highlight the overlap between the SBF120 and Euronext LC100 indices, at year end 2018 and 2019, by company count and portfolio weight. Table 17 lists the top 10 companies, their weightings (in parenthesis) and whether they have committed/validated science-based targets.

Table 16: Overlap in composition, by company count and portfolio weight

	LC100 2018	LC100 2019	SBF120 2018	SBF120 2019
Overlap by company count				
LC100 2018	NA	62%	21%	21%
LC100 2019	62%	NA	18%	18%
SBF120 2018	25%	21%	NA	98%
SBF120 2019	25%	21%	98%	NA
Overlap by portfolio exposure				
LC100 2018	NA	66%	24%	24%
LC100 2019	66%	NA	16%	16%
SBF120 2018	29%	20%	NA	83%
SBF120 2019	29%	20%	83%	NA

Table 17: Top 10 constituents per index and science-based targets

LC100 2018	LC100 2019	SBF120 2018	SBF120 2019
Roche (3.5%)	Nestle (7.3%) **	Total (9.2%)	Total (7.8%)
Veolia (3.5%) **	Roche (4.4%)	Sanofi (6.7%) *	LVMH (7.2%)
Unilever (3.2%) **	SAP (4%) **	LVMH (5.6%)	Sanofi (6.3%) *
Sap (2.9%) **	Siemens (3.1%)*	Airbus (3.8%)	Airbus (4.7%)
Airbus (2.6%)	Unilever (2.9%) **	Air Liquide (3.6%) *	L'Oréal (4.2%) **
Reckitt benckiser (2.5%) *	Astrazeneca (2.5%) **	BNP Paribas (3.5%) *	Air Liquide (3.7%) *
Diageo (2.3%) **	L'Oréal (2.5%) **	Danone (3.1%) **	BNP Paribas (3.7%) *
L'oréal (2.2%) **	Allianz (2.4%) *	Axa (2.9%) *	Schneider Electric (3.1%) **
Upm (2%) **	Diageo (2.3%) **	Safran (2.8%)	Vinci (3.1%)
Gsk (2%) **	Sanofi (2.3%) **	Schneider Electric (2.7%) **	Axa (3%)*

“*”: Committed science-based target as of April 2020;

“**”: Validated science-based target as of April 2020

3.2. HEADLINE RESULTS

In this section, the headline results are first disclosed at index-level and at company-level. In particular, a range of analysis is performed on the data received from providers, including but not limited to coverage levels, consistency in headline results, relative ranking between each index, relative dispersion, and influence of company-specific factors on the results (“green share” and presence or not of a validated or committed science-based target).

3.2.1. Portfolio-level results

In this section, the index-level results for each of the two indices over the two chosen years are compared based on the following data points:

- Coverage at portfolio-level;
- Headline results, either expressed through an Implied Temperature Rise metric (ITR) or a percentage deviation from a 2 °C trajectory depending on the methodology;

- Whether each index is considered “2 °C aligned or not” given the headline results;
- The relative ranking between each index.

Variable coverage levels. Coverage levels vary significantly across methodologies. It would be interesting to calculate coverage figures based on total emissions (if possible Scope 1, 2 and 3) as a complementary measure, especially for methodologies with lower coverage that focus on high-emissions sectors.

Table 18: Coverage of datasets used in this test (by weight).

	LC100 - 2018	LC100 - 2019	SBF 120 - 2018	SBF 120 - 2019
Arabesque *	>90%	>90%	>95%	>95%
Carbon4 Finance **	100%	100%	>95%	>95%
CDP-WWF Temperature Rating	>95%	>95%	>90%	>90%
EcoAct***	NA			
I Care & Consult bottom-up (SB2A)	NA	>20%	NA	>30%
I I Care & Consult bottom-up/top-down (Climate SBAM)	NA	>95%	NA	>90%
ISS	>99%	>99%	>95%	>99%
Urgentem	100%	100%	100%	100%
right. based on science*	>99%	>99%	>99%	>99%
S&P Trucost (GEVA & SDA)*	>90%	>90%	>85%	>90%
S&P Trucost (SDA only)*****	>3%	<1%	<5%	<3%
PACTA*****	5%	>5%	>15%	>10%
NEC (1.0, 2018, calculated by Sycomore AM) *****	>99%	>99%	100%	100%

* Calculated by author where granular data available. Methodology details and results presented use Temperature Score V1.1, to be released by Q3 2020.

** By company count

*** EcoAct provided data for the CAC 40 (2018) as part of this test (see p.151 for database coverage).

**** I Care & Consult has devised a top-down approach to “fill the gaps” of the “bottom-up” approach in partnership with Arvella Investments (see p.155). Coverage is increasing for the bottom-up method and should reach >50% in 2020 and >60% in 2021.

***** SDA-based data for the automobile and energy sectors were not included in this analysis but are available within S&P Trucost dataset. Therefore, these coverage levels are likely to be underestimated.

***** Only four sectors out of eight covered by the PACTA methodology are aggregated at portfolio-level as part of these results.

***** The NEC metric is not a temperature alignment metric stricto sensu as per the definition in this report but can be considered as an alignment metric and is included for comparison.

A lower coverage signifies that a proportionally higher weight is put on the results of companies that are covered by the methodology. As a consequence, the results cannot be compared across methods with significantly different coverage levels: for example, the index-level PACTA results are hardly comparable to the results of other methodologies

A lower coverage may arise from:

1. A smaller data provider universe/ mismatch between portfolio composition and covered universe;
2. A lack of company-level data (current or future) when estimated data are not used;
3. A lack of temperature benchmarks for the relevant scope/sector arising from the choice of scenario and methodology. In this case, data providers use a range of strategies:
 - Assessing only companies for which climate performance (or other type of data allowing such as revealed plans or product mix data) and benchmark data is available (thereby leading to a lower coverage): PACTA, I Care & Consult bottom-up method (SB2A).
 - Filling the gaps in company-level reporting by attributing an average temperature/ score: e.g. CDP-WWF Temperature Rating, EcoAct.
 - Using alternative methodologies and benchmarks when the scope/sector-specific one is not available: sector-agnostic benchmarks (CDP-WWF Temperature Rating, S&P Trucost) or further breaking down sector-level benchmarks into additional sectors: ISS, Arabesque, right. based, Urgentem, I Care & Consult / Arvella Investments top-down method.

The extent and way the use of these strategies influence the results at index-level depend on a range of factors, including but not limited to index composition and temperature alignment scores of the stocks covered by the “main method”. Using data gaps filling strategies increases uncertainty: therefore,

there is a trade-off between the use of scope-sector specific benchmarks, coverage and uncertainty.

Table 19 presents the headline index-level results.

It is difficult to compare the headline results of each method directly as presented on table 19 and figure 25. Indeed:

- Data coverage is highly variable from one method to the other;
- Each method has different perimeters, assumptions and indicator(s);
- A number of methods use a range of metrics – not all of them are disclosed in table/figure x;
- It was necessary to perform additional calculations to derive a temperature alignment metrics for a number of methods to express the results in a similar metric.

Methods were grouped and organized according to three criteria: point-in-time vs dynamic analysis; from short to longer-time horizons, and based on the type of metric provided as results. See [Section 3.3](#) for a detailed discussion of the results.

- **Arabesque and ISS** derive the portfolio Implied Temperature Rise (ITR) metric based on gap analysis, at point-in-time T but also disclose dynamic information.
- At portfolio-level, **Urgentem** does not calculate a temperature alignment metric stricto sensu. The author of this report estimated the Implied Temperature Rise of each index based on gap analysis in 2060, after discussion with the data provider.
- **Carbon4 Finance** results are derived based on the relative CIA (Carbon Impact Analytics) score of the portfolio under consideration, the CIA score of a 2°C aligned portfolio and the average CIA score of their entire database, corresponding to a 3.5°C ITR. The CIA score includes forward-looking elements, although the time horizon is not specifically defined.

- **EcoAct & CDP-WWF** Temperature Rating both evaluate the Implied Temperature Rise of companies' emissions reduction targets, over the target time horizon.
- Index-level results of **CDP-WWF** Temperature Rating are available for different weighting approaches, and for Scope 1 & 2, Scope 3, and Scope 1, 2 and 3 aggregated. The weighting approaches are: GHG weighting (or Total emissions weighted temperature score: the temperature scores are allocated based on historical emission weights using total company emissions, included in table 19), index holding weighting (or Weighted average temperature score: the temperature scores are allocated based on portfolio weights, included in table 19), and Enterprise value weighted score (based on enterprise ownership approach).
- **S&P Trucost and I Care & Consult** calculate the index-level ITR Metric based on dynamic, cumulative assessments, although at different time scales (T+5: S&P Trucost, 2050: I Care & Consult).
- **PACTA MoreImpact temperature indicator** is designed to show the relative alignment of a portfolio across a range of IEA scenarios over a 5-year time-horizon. I Care & Consult results are displayed for both the bottom-up method only (SB2A), and the bottom-up/ top-down combination method (Climate SBAM) (see p.155 for more details).
 - Within the **PACTA Influence Map and right.** based methodologies, results are expressed relative to a chosen temperature benchmark, in terms of technology exposure and emissions intensity, respectively.
 - In particular, **the right. based** approach show the differential in ITR between the portfolio under consideration and what the ITR would be if the portfolio followed the 2DS and B2DS trajectories (taking into account its composition).
 - The **NEC metric** does not measure “alignment to a temperature trajectory” stricto sensu as defined in this report – but rather whether business models are aligned with the energy and ecological transition. It is expressed between -100% (worst) and 100% (best).

Table 19: index-level temperature alignment scores

	METHOD*	LC100 - 2018	LC100 - 2019	SBF120 - 2018	SBF120 - 2019	CAC 40
Arabesque (near-term, 2030)	S1&2, SS	1.5C	1.5C	>2.7C	>2.7C	NA
Arabesque (far-term, 2050)	S1&2, SS	2.7C	2C	>2.7C	>2.7C	NA
Arabesque** (trend, 0-1, 1=best)	S1&2, SS	0.3	0.5	0.2	0.3	NA
ISS *** (2050)	S1, SS	2-4C	<2C	2-4C	2-4C	NA
ISS (2 °C aligned until...)	S1, SS	Never	2050	2031	2030	NA
Urgentem 2060****	S1,2,3, SA	2-2.7C	2-2.7C	>2.7C	>2.7C	NA
Carbon4 Finance (undefined)	S1,2,3,AE, SA*****	2C	2C	3.2C	3C	NA
CDP-WWF (target time horizon) – GHG weighting	S1,2,3 SS/SA	2.7C	2.7C	2.7C	2.7C	2.7C
CDP-WWF (target time horizon) – index holding weighting	S1, 2, 3, SS/SA	2.7C	2.7C	2.8C	2.8C	2.7C
EcoAct (target time horizon)	S1,2,3, SS/SA	NA	NA	NA	NA	3.2C*****
PACTA – MoreImpact (2018-2023)	S1,2,3, SS	2.01-2.75C	2.01-2.75C	2.76-3.5C	2.76-3.5C	NA
S&P Trucost (2012-2025)	S1,2 SS/SA	>2.7/3C	>2.7/3C	>2.7/3C	>2.7/3C	NA
S&P Trucost (2012-2025 – tGHGs over 2 °C benchmark, apportioned, rounded)		135,000	35,000	95,000	217,000	NA
I Care & Consult, bottom-up only-SB2A (2010-2050)	RS, SS	NA	2.4C	NA	2.5C	NA
I Care & Consult, bottom-up/ top-down - Climate SBAM (2010-2050)	RS,SS	NA	2.7C	NA	2.8C	NA
PACTA – Influence Map (2018-2023)	RS,SS	-26%	-1%	-6%	0%	NA
right. based B2DS***** (2018 – 2050)	RS,SS	-21%	-13%	-18%	-16%	NA
right. based 2DS***** (2018 – 2050)	RS,SS	-12%	-4%	-8%	-6%	NA
NEC (1.0, 2018, calculated by Sycomore AM) -100% = best, -100% = worst	RS, SS	3%	2%	-3%	-3%	NA

* RS: relevant scope, S1: scope 1, S2: scope 2, S3: scope 3, AE: avoided emissions, SS: sector-specific, SA: sector-agnostic.

** Calculated by author based on a binary score, with 1 = company decarbonization trend is in line with a 1.5 °C trajectory on weighted average

*** Read on graph provided by data provider

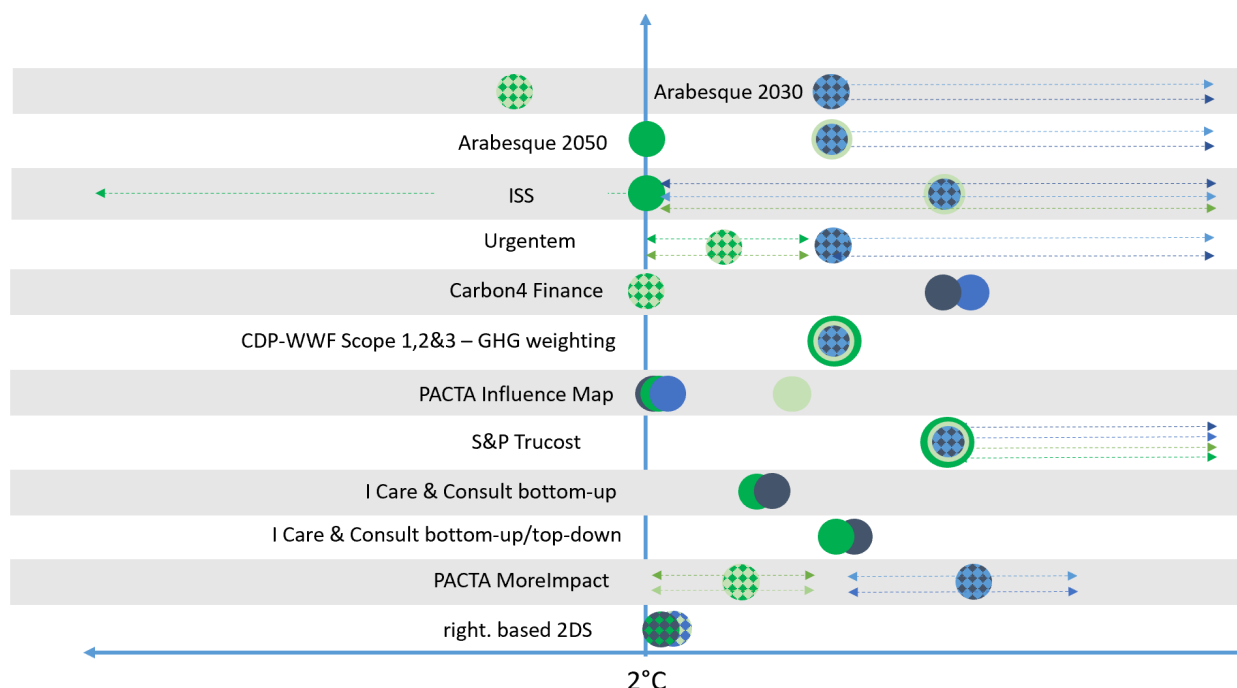
**** Inferred by author based on portfolio-level temperature benchmarks, assuming constant intensity to 2060 (based on market cap).

***** Portfolio-level temperature benchmark is sector-agnostic (sector-specific for company-level analysis)

***** Index-holding weighting

***** Calculated by author (negative = not aligned)

Figure 25: Relative dispersion to 2 °C trajectory, as depicted by the blue line (Light Green: LC100 2018, Dark Green: LC100 2019; Light blue: SBF120 2018; Dark blue: SBF120 2019). Round: central value, dashed arrows: range. Calculated by author.



Binary results and relative ranking.

- All of the methods included in this review find that the SBF120 is not aligned with a 2 °C trajectory. Results are more variable for the LC100 2018 and 2019, although most methods find that these indices are not aligned with a 2 °C trajectory.

- Results are much more variable in terms of relative ranking. Most methods finds that the “best” index in terms of alignment is the LC100 2019. However, the relative ranking of the other indices vary significantly from one method to another.

Table 20: Relative ranking (1: best, 4: worst)

	LC100 - 2018	LC100 - 2019	SBF120 - 2018	SBF120 - 2019
NEC (1.0. 2018, calculated by Sycomore AM)	1	2	3	3
Arabesque (near-term, 2030)	2	1	4	3
Arabesque (far-term, 2050)	2	1	4	3
ISS (2050)	4	1	2	3
Urgentem (2060)*	2	1	4	3
Carbon4 Finance	1	1	3	2
CDP-WWF – GHG weighting**	2	1	3	3
CDP-WWF – Index holding weighting**	1	2	3	4
PACTA – MoreImpact (2018-2023)	1	1	2	2
S&P Trucost (2012-2025)	3	1	2	4
I Care & Consult, bottom-up only-SB2A (2010-2050)	NA	1	NA	2
I Care & Consult, bottom-up/ top-down (2010-2050)	NA	1	NA	2
PACTA – influence map (2018-2023)	4	2	3	1
right. based 2DS & B2DS (2018 – 2050)	4	1	3	2

* Inferred by author, based on Scope 1, 2, 3 intensity, market value.

** Results may not be significant as based on 2 numbers after the coma.

3.2.2. Company-level results

Exploring company-specific results. Where possible based on the data shared by providers, results at company-level are compared based on different criteria, namely:

- The relative dispersion of company-level results for each method;
- Specific results for companies with science-based targets;
- Specific results for the LC100 “green pocket”, i.e. companies with more than 50% of their revenue derived from “green” activities.

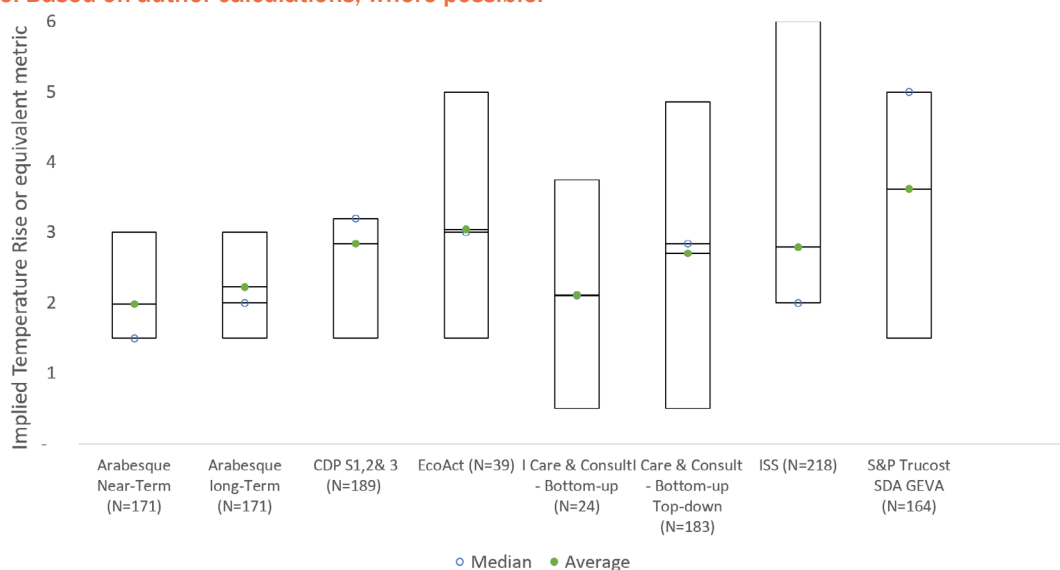
This has required additional manipulations from the author of this report based on the data received.

Relative dispersion. In order to explore the relative dispersion of company-level results for each method, the maximum, minimum, average and median ITR metric is computed where possible for all latest year

available data. These results are illustrative only as they rely on additional data manipulation from the author and are representative of a sample rather than entire data provider’s datasets. In particular, where results are disclosed as a range (e.g. 2-3 °C), the central value is taken. Where the results are disclosed as an upper or lower bound (<2 or >5 °C), the bounding value is taken. Some providers disclosed data based on company disclosure for the two years (2018 and 2019) – in that case, only the latest year is taken.

Although the results need to be interpreted with care for the reasons listed above, it is possible to distinguish some key differences between methods. Arabesque and CDP-WWF Temperature Rating have the lowest range in results while I Care & Consult top-down/bottom-up method (Climate SBAM) and ISS have the largest. In addition, the median company-level score is lower for ISS South-Pole and Arabesque methodologies. Finally, S&P Trucost has the highest company-level median score, >5 °C.

Figure 26: Upper & lower bound of company-level ITR metric within the indices under consideration (box plot), median and average value. Based on author calculations, where possible.



Specific results for companies with science-based targets. Based on SBTi data from April 2020, over 35% of companies by count in the LC2019 have set a science-based target (c.65% vs c. 55% for the SBF120 2019 by weight).

This data point is compared, where possible and available, to the percentage of companies (by count) that have a 2 °C or less score according to the different assessment methods. Most methods find a higher number of companies that have at least a 2 °C score than the number of companies with a validated science-based target as of April 2020. The overlap between companies with a science-based target and

considered 2 °C-aligned in each method varies.

This can be explained by:

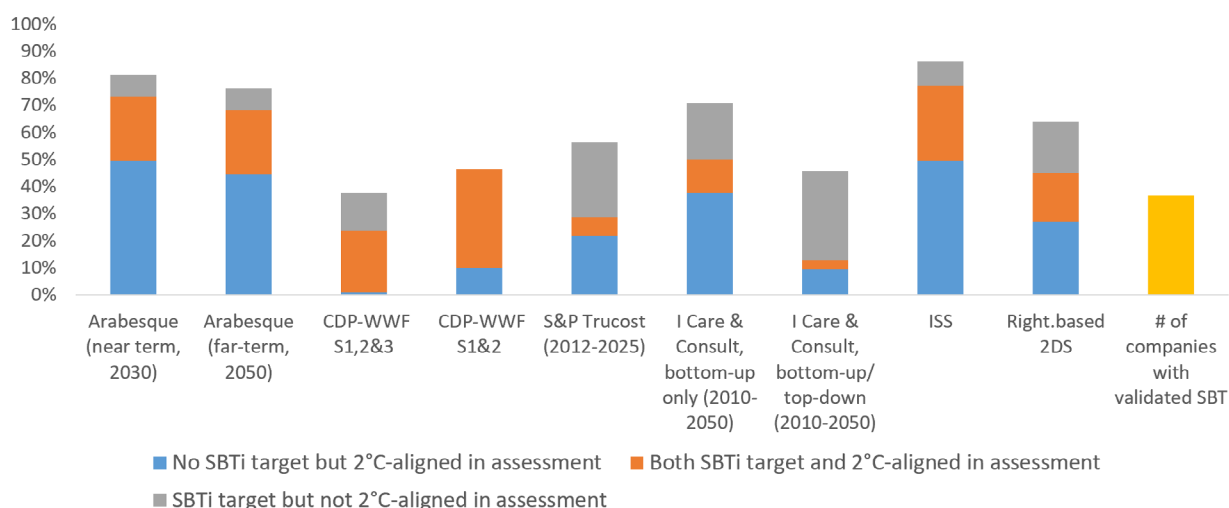
- Some methods assume a fixed or slightly evolving (sector-agnostic) carbon intensity in the future. As the LC100 2019 has been constructed in such a way that companies with lower emissions intensity are selected, this currently lower or decreasing carbon intensity may be sufficient to achieve a 2 °C score in the future (Arabesque, right. based).
- Some methods attribute automatically a 2 °C or less score to companies with a validated science-based target (Arabesque, CDP-WWF). However, it is expected that there is a short lag between target validation and

input of this information in a data providers' database, thereby leading to a small discrepancy in some cases. In addition, some companies have a validated science-based target but are not considered aligned when taking into account Scope 3 in the CDP-WWF Temperature Rating method, as this method is more

precise to evaluate Scope 3 target alignment.

- Some methods use a range of forward-looking data and do not attribute systematically a 2°C score to companies with a science-based target and take into account the company's historical performance (I Care & Consult SB2A, S&P Trucost, ISS).

Figure 27: Percentage of companies in the LC100 2019 index with a validated SBTi (yellow) relative to the number of companies that are 2°C or below aligned in each method (authors' calculations).

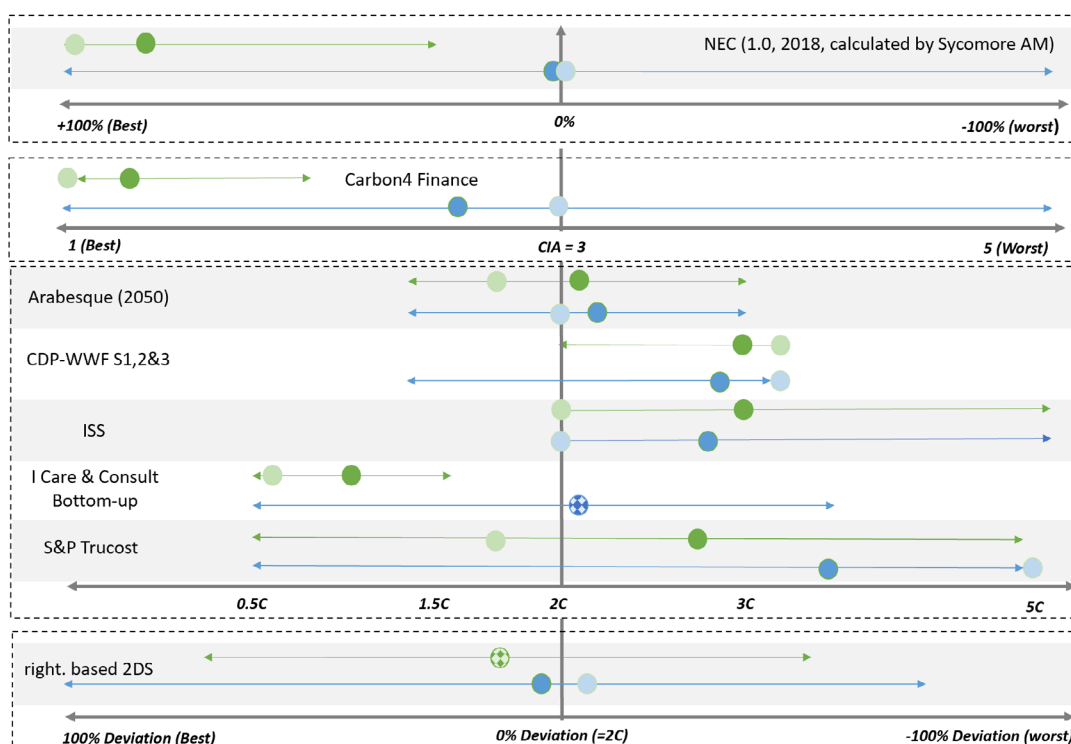


Note: S&P Trucost has recently decreased its requirements to integrate targets. Therefore, it is possible that in future assessments, the proportion of companies with a SBTi and rated 2°C or less increases.

Specific results for companies included in the “green pocket” of the LC100. Descriptive statistics (average, median, high, low) are disclosed for the whole dataset and the “green” companies only (as per Euronext criteria, i.e. companies with more than 50% of their revenue derived from the sales of green products and

services). The results should be interpreted with care due to the small sample size (N green companies = 10, lower for some providers). “Green” companies have a better NEC score on average, and a lower temperature score within the I Care & Consult, Carbon4 Finance and to a certain extent S&P Trucost methodologies.

Figure 28: Descriptive statistics for the green pocket (in green) and all dataset (in blue). Line: spread, dark round: average, light round: median. Calculated by author.



3.3. INTERPRETING THE RESULTS

In this section, the results for each method are first described in turn. Then, we comment on the insights that can be derived from comparing the results of each method. In particular, correlation analysis is performed, where possible, to identify whether some methods are better correlated with each other. In addition, correlation analysis with carbon footprint data is done, in order to determine whether temperature alignment assessments are complementary to carbon footprints.

3.3.1. What does each method teach us?

As highlighted throughout this report, each method is based on its own recipe. No two methods are 100% similar in terms of the methodological choices taken. As a consequence, each method helps answer slightly different questions, highlighted below and within the detailed appendix, and can therefore be seen as complementary (starting p.143).

Arabesque: How does the current Scope 1 and 2 GHGs emission intensity (per revenue) of the companies in my portfolio compare with what it should be in 2030 and 2050 under different sector-scope specific temperature trajectories?

- The LC100 2019 has the highest score in all four cases and is considered 1.5°C aligned in 2030, 2°C aligned in 2050. The LC100 2018 is considered 1.5°C aligned in 2030 too, but has a lower long-term alignment score in 2050 (2.7°C). Indeed, a lower number of companies are considered 1.5 or 2°C aligned in the LC100 2018 compared to the LC100 2019. In particular, Veolia was rated >2.7°C prior to having its science-based target validated in 2019 and represents 3% of the LC100 2018, while the top 20% of the LC100 2019 is invested in companies with 1.5 or 2°C scores.
- The SBF120 has a temperature score of over 2.7°C in 2030 and 2050, in particular driven by Total that has a score of over 2.7°C.
- Finally, the LC100 2019 is performing best from a trend perspective. It is more exposed to companies whose year-on-year emission reductions over the past three years are in line with those required to reach net zero emissions by mid-2060s and limit global temperature rise to below 1.5°C.

ISS: Is the Scope 1 emission intensity of my portfolio sufficiently low and/or decarbonization trends as observed over the past 5 years, and the reduction targets set by companies, sufficiently high for my portfolio to be considered 2°C aligned to 2050, compared to its sector-specific temperature

benchmark?

- The LC100 2019 is aligned with a 2°C trajectory for the whole time period, between 2018 and 2050. Both the SBF 120 2018 and 2019 are aligned with a 2°C trajectory until around 2030 and thereafter 2-4°C. Finally, the LC100 2018 is aligned with a 2-4°C trajectory.
- The LC100 2019, SBF120 2018 and 2019 emissions intensity change between 2018 and 2050, as forecasted using past emissions trend, is relatively flat in the aggregate. Their ITR score is therefore mostly attributable to their current emissions intensity. The LC100 2018 emissions intensity is decreasing but not sufficiently fast to achieve a 2°C score, given its starting high carbon intensity, mostly attributable to its 3% position in Veolia.

Urgentem: Is the Scope 1, 2 and 3 emission intensity of my portfolio sufficiently low to be considered 2°C aligned in different points in time, compared to its sector-agnostic benchmark? What is the required decarbonization trend for a portfolio to be aligned with a 2°C or 1.5°C trajectory?

- At portfolio-level, Urgentem does not calculate a temperature alignment metric stricto sensu. Based on the portfolio current carbon footprint, compared to the world's average, its "target-setting module" highlights the emission trajectories that a portfolio may follow in order to be considered aligned with different user-defined temperature scenarios, to 2060. Urgentem also provides emissions (over)undershoot at sector-level, for different years and scenarios, and company-specific trajectories.
- When calculated per unit of market cap, the LC100 2019 and 2018 have the lowest current carbon intensity. Assuming constant emissions intensity through time (authors' assumption), these indices would therefore be rated 2-2.7°C. The SBF 120 would be rated >2.7°C. These two indices have a carbon intensity higher than the global average.

Carbon4 Finance: What is the temperature trajectory of a portfolio based on its constituents' current and

future climate performance (scope 1, 2 and 3, avoided emissions and forward-looking qualitative data), as measured by a score?

- Carbon4 Finance results are expected to be less sensitive to emissions' intensity than other methods, as they include avoided emissions and a qualitative metric as part of the overall score.
- The LC100 2019 and 2018 have the best temperature alignment score (2°C). This is expected as the LC100 is used as the 2°C benchmark in Carbon4 Finance methodology. Both have a higher carbon impact ratio (avoided emissions/ induced emissions) than the SBF120 as well as a higher share of companies with an A rating, especially the LC100 2019.
- Carbon4 Finance method captures the “positive” side of the story – therefore, companies within the Euronext LC100 “green” pocket are better rated, on average.

CDP-WWF Temperature Rating: Have the companies in my portfolio set ambitious-enough Scope 1, 2 and 3 targets and to what degree do they translate, based on sector and scope-specific precautionary temperature benchmarks derived from IPCC?

- CDP can apply a range of aggregation methods at index-level and provides the results disaggregated between Scope 1 & 2, Scope 3 and Scope 1, 2 & 3.
- Based on the two aggregation methods used in this report, the LC100 has a slightly better ITR score than the SBF120. The aggregated metric hides significant dispersion differences though. In particular, the LC100 is more exposed to companies with Scope 1, 2 and 3 emissions reduction targets than the SBF120 (55% vs 35% on average), based on CDP-WWF Temperature Rating target evaluation process.
- When a company has not target, or when its target is considered of insufficient coverage, an average score of 3.2°C is given. This hypothesis will be refined in the new versions of the method.
- CDP-WWF Temperature Rating can be considered an extension and refinement of the portfolio coverage approach, tested in the context of the SBTi that measures the exposure of portfolio to companies with science-based targets.

EcoAct: Have the companies in my portfolio set ambitious-enough Scope 1, 2 and 3 targets, leading to absolute emission reductions in line with a 2°C trajectory, based on sector-agnostic temperature benchmarks?

• EcoAct can apply a range of temperature alignment methods. As part of this report, EcoAct provided results that reflect the implied temperature rise score of companies' emissions reduction targets. EcoAct provided results for the CAC40 only, based on 2018 data.

• In 2018, the CAC40 is on a 3.2°C trajectory based on company-level data provided by EcoAct and using the weighted average aggregation protocol.

S&P Trucost: Is my portfolio invested in companies that decarbonize at a sufficiently fast rate, over 2012 and 2025 (T+5), based on companies' targets, assets' investment and retirement plans and sub-industry historical trend extrapolation?

• No index is 2°C aligned. The best performing index is the LC 100 2019, which is close to achieving a score of 2°C (emissions overshoot of 21 tonnes per m€ invested). Its score is lowered by Maersk, Panalpina, and Veolia. The SBF 120 2019 has the higher emissions overshoot per m€ invested (205 tonnes), nearly double that of the SBF 120 2018, in particular attributable to Air Liquide, Veolia and Arcelor Mittal.

• Across the sample used in this study, a large proportion of the forward-looking data used is based on an extrapolation of sub-industry trend; followed by company-specific targets and asset-level data. Therefore, the results are expected to be mostly correlated to Scope 1 and 2 past industry trends, due to a lack of company reporting and targets.

I Care & Consult: Is my portfolio invested in companies with a low Scope 1, 2 or 3 intensity per unit of production, that have historically decarbonized at a fast-enough rate, and that have set ambitious-enough targets sufficient to be considered 2°C aligned, cumulatively, over 2010-2050, compared to its company-scope specific benchmarks?

• I Care & Consult provided results for the LC100 and SBF120 2019. The bottom-up approach, most specific, can only be applied to a subset of sectors in 2019. Coverage of the bottom-up method is increasing and is expected to reach >50% in 2020 and >60% in 2021. To fill the gaps, I Care & Consult uses a top-down approach, when requested by its client, based on sector-level estimates, resulting in Climate SBAM database

• Neither the LC100 nor the SBF120 2019 are considered 2°C aligned. The LC100 2019 has a better Implied Temperature Rise score than the SBF 120 2019 (2.4 vs 2.7°C). The order of performance is maintained when using the top-down approach, but the

results are slightly higher as the top-down approach does not capture the dynamics of alignment of each company.

- The bottom-up approach captures the “positive” side of the story. Indeed, the Implied Temperature Rise score of the companies that form part of the Euronext LC100 2019 green pocket have a better score, on average, than other companies in the assessment sample.

right. based on science: Is the Scope 1, 2 and 3 emission intensity of my portfolio sufficiently low to be considered 2°C aligned, cumulatively, over 2018-2050, compared to its sector-scope specific benchmark, when assuming that portfolio emissions grow at the same rate as the IPCC SSP2 scenario ?

- The results are expected to be highly correlated with emissions intensity per economic unit (here, value-added): all companies are expected to have their emissions intensity decrease at the same rate to 2050 regardless of their sector. Targets are not taken into account as part of this test but right. based has done so for other reports ([2019](#))

- All indices are aligned with its sector-specific IEA 2DS trajectories to 2050 when taking Scope 1 only; no indices is aligned when taking Scope 2 only, or Scope 1, 2 and 3.

- The LC100 2019 index generally comes out better. The LC100 2018 appears worst, however, when considering Scope 1, 2 and 3. This is mostly driven by Veolia, Saint Gobain and Linde. Nestle on the other hand, is considered 2DS aligned, contributing positively to the results of LC100 2019.

PACTA MoreImpact and Influence Map: Are the revealed plans of the companies in my portfolio sufficiently ambitious for my portfolio brown and green technology exposure to be aligned with a 2°C trajectory over 2018-2023 (T+5), compared to its company-technology-specific temperature benchmarks?

- The 2° Investing Initiative PACTA methodology covers eight sectors. However, the two aggregation protocols at portfolio-level used in this report (Influence Map and MoreImpact) were only applied to sectors analyzed on technology exposure (oil & gas, coal, auto and power). The coverage is lower for the LC100 than for the SBF.

- Any sector, even coal production, can be considered 2°C-aligned if a company reduces its extraction of fossil-fuels and/or carbon-intensive production at

a rate consistent with a 2°C scenario. A portfolio need not be exposed to all “brown” and “green” technologies as represented in the scenario used as temperature benchmark. However, if it is exposed to a technology, even in small amounts, then this exposure needs to be “2°C aligned”. For example, if a portfolio is not exposed to ICE vehicles, this will not impact its temperature alignment score. If it is exposed through one holding to ICE technology, this is counted in the score.

- Under the Influence Map aggregation methodology, the LC100 2018 is the least aligned, and the SBF120 2019 and LC100 2019 the most. This aggregation method captures the deviation from the 2°C benchmark but does not take into account the non-linearity between different temperature benchmarks.

- The MoreImpact aggregation methodology takes multiple temperature benchmarks into account. The LC100 2018 and 2019 are preferred, mostly driven by EDP Renovaveis and Siemens Gamesa.

NEC score: What is my portfolio’s alignment with the ecological and energy transition (on a unique scale from -100%, for dark brown, to +100%, for dark green, and where average scores and benchmarks are in the grey zone around 0%)?

- As highlighted throughout this report, the NEC is a metric that measures the alignment of companies and portfolios, not with temperature trajectories, but with an holistic, impact-based, scale going beyond carbon. It was included in this report as a reference point as the metric captures and aggregates the brown and green shares of companies and portfolios.

- The LC100 2018 and 2019 have a slightly better NEC score than the SBF120. However, the results are not extremely different (around -3% for the SBF120, in line with most market indices and around +3% for the LC100) and are positioned in the grey zone of the NEC scale around 0%.

- The LC100 green pocket (companies selected based on a higher than 50% share in “green” revenue) achieves very high NEC scores, confirming the current revenue exposure of these companies to activities in line with the Energy and Ecological transition. A number of companies have a relatively high NEC (over 50%) but do not form part of the green pocket, suggesting that the NEC could bring a complementary data point.

3.3.2. What does the comparison of results across methods tell us?

Comparison of the portfolio-level results. The most important difference that arises at portfolio-level is whether the LC100 2018 is considered better or worse than the SBF120. A number of methods lead to a higher ITR metric/ deviation from a 2°C benchmark for the LC100 2018 than the LC100 2019. In many cases, the LC100 2018 is considered the worst of the four indices analyzed. Deeper analysis suggests that the results are primarily driven by one company, Veolia, in which 3% of portfolio value is invested in 2018.

Veolia has a high carbon intensity per unit of revenue. As it is split in three business lines (Energy, Water and Waste), it is not possible to normalize its corporate-level carbon footprint per unit of production, unless analyzing separately each business units. In addition,

there is not sector-specific benchmarks for its waste and water business. Besides, 31% of its scope 1 emissions in 2018, often compared to IEA scenario capturing only carbon, comes from methane. Finally, Veolia had its science-based target set in October 2019, which may explain some data providers have not yet embedded this in their forward-looking data (when they rely on this type of data).

Therefore, Veolia is often mapped to “utilities” and compared to the utilities sector benchmark per unit of revenue often expressed in carbon terms or assessed based on sector-agnostic benchmarks, thereby leading to a higher Implied Temperature Rise score. Besides, most methods do not capture Veolia’s activities that could contribute positively to the energy and ecological transition: its NEC score is 44%, one of the highest of the sample (1.0, 2018, calculated by Sycomore AM). In a nutshell, Veolia is particularly hard to assess based on current methodologies, especially prior to setting a science-based target.

Table 21: Analyzing Veolia

	Implied temperature score (ITR)
Arabesque	ITR: 2C (both 2030 and 2050). Veolia is attributed a 2C score because it has a validated science-based target. Prior to this, it was attributed >2.7C.
ISS	Veolia is attributed a >6°C score in 2018 and 2019. Scope 1 Emissions Intensity per unit of revenue; Multiutilities (excl. electricity). Going forward, Veolia results are likely to receive a positive tilt because it has a validated science-based target.
CDP-WWF Temperature Rating	Veolia has an ITR score of 2°C (Scope 1 & 2, Scope 1, 2,& 3), in line with its validated science-based target.
right. based	Mapped to the NACE code 36 (Water collection, treatment and supply) and IEA sector “other transformation”; 63% overshoot relative to 2DS scenario for Scope 1, 2 and 3; 77% overshoot for Scope 1.
S&P Trucost	Veolia has a score of >5°C and the largest apportioned overshoot in the LC1002018 (GEVA approach). This is based on Veolia’s emissions before the announcement of its science-based target, as the most recent annual report (FY2018) was used at the time of the analysis.
I Care & Consult	Not included in bottom-up analysis for lack of waste & water benchmark; high ITR score when using the top-down method (4.9°C).
Carbon4 Finance	Veolia is rated as A, even prior to setting its science-based target.

How do results at company-level compare? Three types of tests are applied.

- First, the correlation between company-level results across the different methods is analyzed, in an attempt to determine whether methods that share the highest correlation coefficients share the same methodological attributes.

- Second, the most and least consensual companies across methodologies are highlighted.
- Finally, company-level results are correlated with carbon footprint data, to determine the extent to which temperature alignment assessments complement carbon footprinting.

Table 22: Linear correlation coefficient between each method, where possible.

	Arabesque (near-term, 2030)	Arabesque (far-term, 2050)	ISS	Carbon4 Finance	CDP-WWF (S1,2&3, including companies with no targets)	CDP-WWF (S1,2&3, excluding companies with no targets)	EcoAct	S&P Trucost	I Care & Consult bottom- up (SB2A)	I Care & Consult, bottom-up/ top-down (Climate SBAM)	right. based B2DS	right. based 2DS	NEC metric
Arabesque (near-term)		87%	38%	-31%	5%	-2%	23%	9%	9%	4%	6%	16%	3%
Arabesque (far-term)	87%		33%	-19%	11%	-9%	28%	9%	15%	3%	1%	16%	5%
ISS	38%	33%		-27%	-4%	10%	36%	24%	15%	6%	6%	3%	-12%
Carbon4 Finance	-31%	-19%	-27%		21%	-15%	-9%	-2%	62%	38%	-11%	19%	55%
CDP-WWF (all)	5%	11%	-4%	21%		100%	59%	0%	-5%	-4%	7%	4%	5%
CDP-WWF (targets only)	-2%	-9%	10%	-15%	100%		-57%	10%	42%	14%	-4%	0%	-2%
EcoAct	23%	28%	36%	-9%	59%	-57%		18%	-34%	14%	15%	2%	35%
S&P Trucost	9%	9%	24%	-2%	0%	10%	18%		60%	19%	16%	-3%	21%
I Care & Consult, BU (SB2A)	9%	15%	15%	62%	-5%	42%	-34%	60%		100%	-5%	23%	88%
I Care & Consult, all (Climate SBAM)	4%	3%	6%	38%	-4%	14%	14%	19%	100%		-10%	10%	56%
right. based B2DS	6%	1%	6%	-11%	7%	-4%	15%	16%	-5%	-10%		58%	-16%
right. based 2DS	16%	16%	3%	19%	4%	0%	2%	-3%	23%	10%	58%		-6%
NEC	3%	5%	-12%	55%	5%	-2%	35%	21%	88%	56%	-16%	-6%	
N (sample size)	171	171	161	84	214	48	35	127	24	183	222	222	227

Correlation analysis. It is important to bear in mind that these results are only applicable to the sample used. As expected, there is little, or even negative correlation between most of the methods. Yet, the following points can be highlighted:

- The highest correlation can be found between “associated methodologies”, as expected: I care & Consult Bottom-up (SB2A) and Climate SBAM bottom-up/top down ($r=1$), CDP-WWF when considering companies with targets or all companies ($r=1$) Arabesque near- and long-term ($r=0.87$) and right. based 2DS and B2DS scores ($r= 0.58$).

- The NEC score, Carbon4 Finance and I Care & Consult have a correlation coefficient of over 50%. These three methods take scope 1, 2, and 3 (or the relevant scope) into account and include a procedure to take positive impact into account. In particular, the NEC score is strongly correlated with the I Care & Consult bottom-up approach SB2A ($r=0.88$). This is not surprising as I Care & Consult is one of the methodology partners of the NEC Initiative: both approaches share similar methodological underpinnings.

- The I Care & Consult bottom-up and S&P Trucost approaches are highly correlated ($r=0.6$). One potential explanation is that part of the S&P Trucost method relies on the SDA approach, so does the I Care & Consult bottom-up approach (SB2A), although with notable differences (in time horizon e.g.).

- The Arabesque and ISS approaches are relatively well correlated ($r>0.3$), which is not surprising as they share a number of common features (value chain perimeter, point-in-time analysis).

- When excluding companies that have no targets, CDP-WWF Temperature Rating results are well correlated with the I Care & Consult results ($r>0.4$). CDP-WWF results are not well correlated with EcoAct, even if both methods assess the implied temperature rise score of targets. This could be due to the fact that service providers/method developers use different data bases or, and datasets / data samples based on different time periods.

Most and least consensual companies. The standard

deviation in alignment scores between each method for each company is computed to determine how consensual each company is. Companies with the lowest standard deviation (i.e. most methods agree on the alignment performance) are considered “most consensual”. Amongst the companies in the sample under consideration that are covered by at least five different methods for which company-level data was provided:

- The most consensual companies are UPM, Peugeot, Covivio, Renault and Faurecia.

- The least consensual companies are Veolia, Deutsche Post, Ferrovial, Red Electrica and Rockwool. Low correlation was generally found between level of consensus across methods and different company characteristics tested (targets, green share). It appears that companies with the highest proportion of their total emissions coming from Scope 3 (based on Urgentem data) are generally the least consensual ($r=-0.15$).

- In addition, consensus is highest in the insurance ($n=9$), automobiles & parts ($n=6$), health care ($N=8$) real estate sectors ($n=5$). It is lowest in utilities, including multi-utilities ($N=6$), food and beverage ($N=4$), oil & gas ($N= 3$) and construction & material ($N=10$) sectors.

The low sample sizes do not allow to make generalization on these results and the correlation coefficients generally very low.

Correlation with company-level carbon footprint.

To what extent can each of these method provide additional information compared to company-level carbon footprint? To answer this question, the company-level correlation between temperature alignment results and carbon footprint is analyzed. Carbon footprint data is based on Urgentem dataset of reported and estimated data.

Correlation coefficients are not very high in most cases, thereby pointing to the complementarity of temperature alignment approaches with carbon footprinting.

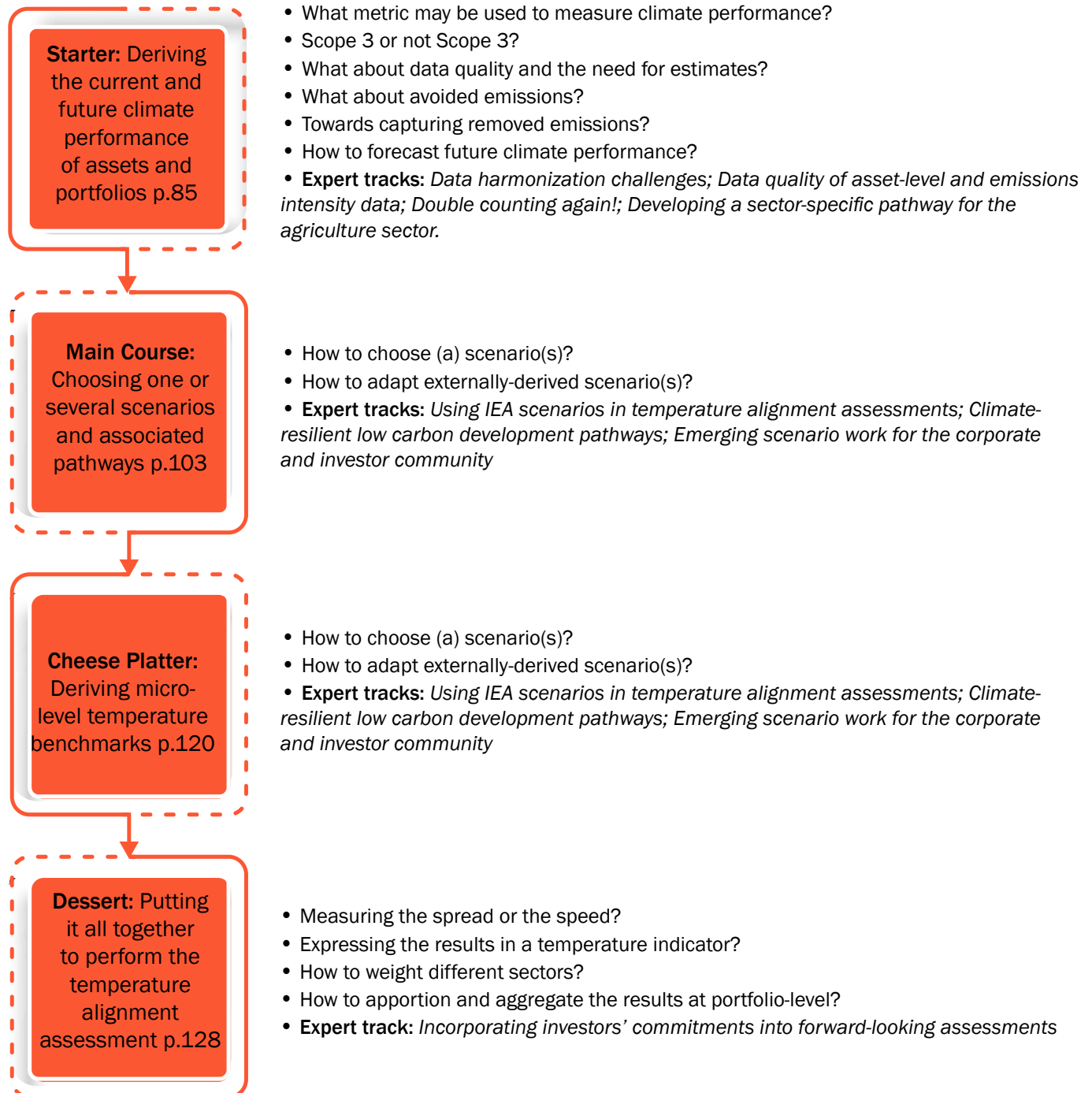
Table 23: Correlation coefficient (r) between company-level Temperature alignment score and 2017 actual carbon intensity per \$m revenue, based on Urgentem data. Correlation between Scope 1 & 2, and Scope 3 intensity = 0.36.

	Scope 1 & 2 intensity	Scope 3 intensity	Scope 1, 2 and 3 intensity
Arabesque (near-term, 2030)	28%	28%	32%
Arabesque (far-term, 2050)	28%	18%	23%
ISS	28%	28%	32%
Carbon4 Finance	-41%	-21%	-28%
CDP-WWF S1,2&3, targets only	-8%	14%	11%
CDP-WWF S1,2, all (targets & no targets)	17%	8%	12%
EcoAct	25%	22%	26%
S&P Trucost	8%	11%	12%
I Care & Consult bottom-up (SB2A)	-50%	38%	23%
I Care & Consult, bottom-up/ top-down (SBAM)	-14%	-12%	-14%
right. based B2DS	22%	49%	48%
right. based 2DS	18%	45%	43%
NEC	1%	-5%	-4%

4. TECHNICAL DEEP-DIVE

This section aims at providing additional details to practitioners that wish to go further than Section 2 of this report (p.30). The figure below lists the four different assessment steps and the associated methodological questions that are reviewed in detail in this section.

Figure 29: The menu - Assessment steps and methodological questions



STARTER: ASSESSING THE CLIMATE PERFORMANCE OF A PORTFOLIO

This section reviews the different ways to capture the current or future climate performance of a company or portfolio. This climate performance will then be compared to the temperature benchmarks derived as part of Step 2 and 3 to produce the portfolio temperature alignment metric in Step 4.

KEY TAKEAWAYS

This step involves several methodological choices:

What metric may be used? Two types of metrics have been used in the context of temperature alignment methodologies: technology (kWh, number of electric vehicles e.g.) and GHGs. Using the former is considered less complex to interpret than carbon or GHG emissions metrics, as it directly relates to the share of “green” or “brown” activities of an underlying company or investment portfolio, and are better suited to capture locked-in emissions.

However, technology metrics are sometimes considered too prescriptive when used to measure temperature alignment. Indeed, if the ultimate objective is to reduce GHG emissions, how this objective is attained is not as relevant as the attainment of the final objective itself. Using carbon or GHG metrics allows to capture overall changes, including efficiency improvements, but is prone to uncertainty and reported data is often incomplete.

Scope 3 or not scope 3? In the context of portfolio temperature alignment assessments, a value-chain view is necessary. For certain sectors, most of their carbon emissions, negative or positive, lies within value chains. Methods that focus on scope 1 and 2 may penalize “green” companies, under certain circumstances.

It is necessary to change our point of view, from “scopes” to “stakes”, to map companies to their relevant pathway, thereby allowing us to evaluate entire value chains based on the main decarbonization stake. This may not always be possible, however, when sector-specific temperature benchmarks are not (yet) available and reporting is (still) limited. Providers have used a range of methods, from excluding these sectors to deriving their own benchmarks (see Step 3).

Including avoided emissions? Avoided emissions are not captured by temperature alignment methodologies that rely on GHGs emissions and

technology exposure, even when Scope 3 emissions are included. Investors might want to include avoided emissions, to build a more complete picture. This raises, however, many methodological questions.

The difficulty lies in the fact that 2°C benchmarks are built on induced emissions and therefore do not capture avoided emissions. Therefore, it would be incorrect to compare the decarbonization rate or performance of a company or portfolio that includes avoided emissions with its sector-specific pathway. To overcome this challenge, data providers have rebuilt temperature benchmarks at the company or portfolio-level to maintain the internal consistency of their methodology.

What about removed emissions? Emissions reductions only are not sufficient to limit temperature rise well below 2°C. For example, in the context of 1.5°C trajectories, carbon removals play two roles: 1. They compensate for emissions that accumulate in the atmosphere and 2. They can create the net negative emissions required post-2050. As a result, only 4 of the 42 trajectories that limit global warming to 1.5°C with limited or no overshoot avoid the use of carbon removal at scale.

Focusing on emissions reduction only in temperature alignment methodologies therefore “takes for granted” the other side of the equation on carbon removals that are embedded in temperature trajectories. Carbon removal technologies can be controversial though, especially in light of potential social and environmental trade-offs that may arise, as highlighted in the IPCC SR1.5 report. Therefore, removed emissions can be included in the assessment to build a more complete view, but with great care.

How to forecast the climate performance of a company or portfolio? Simple climate performance metrics are static, and often backward-looking as there is a lag between carbon emissions, company reporting, inclusion in a database, and application

at portfolio-level. Most temperature alignment assessments rely on estimates of the future climate performance of companies and portfolios. A small number of methods, however, do not attempt to forecast future climate performance because of the difficulties in doing so – and compare today's climate performance with a future desired state as given by one or several scenarios.

Forward-looking data may capture the commitment gap between companies' targets and its temperature benchmark(s), the short-term action plan through revealed CAPEX, or seek to forecast the future performance using a range of data as a proxy, including targets, Capex plans, R&D & green patents, and qualitative scores. Each of these types of forward-looking data has pros and cons, and in practice are often combined over different time scales.

Choice 1: What metric may be used to measure climate performance?

Definition, pros, and cons. Several metrics can and have been used in the context of temperature alignment assessments: carbon or GHG emissions, energy mix, and technology mix.

- **Carbon or GHG metrics are most often used in temperature alignment methods.** On the negative side, they are inherently backward-looking (unless forward-looking data can be estimated, see p.98) and it is hard to attribute changes in carbon footprints to company-specific decarbonization strategies and actions. This can hide a risk of emission lock-in as it does not give visibility if emission reductions are due only to easy-to-reach quick wins or real transformation allowing to reach the net zero carbon goal. On the positive, carbon or GHG metrics are applicable to all sectors and allow for greater flexibility in reaching the temperature rise limitation objective, i.e. do not constrain emission reduction trajectories to specific technology combinations.

- **Technology mix metrics** can include kWh of renewable energy generated, number of electric vehicles sold and the like; **energy mix metrics** are a subset of the former, that focus only on energy, as the name indicates. **Using technology metrics is**

considered less complex to interpret than carbon or GHG emissions metrics, as it directly relates to the share of “green” or “brown” activities of an underlying company or investment portfolio. Indeed, changes in carbon footprints can be attributable to reasons unrelated to specific actions put in place by companies to decarbonize. Energy mix metrics are even simpler than technology mix metrics, but hide a significant part of the story by focusing only on the energy mix.

- **Contrarily to carbon or GHG metrics, technology metrics are sometimes considered too prescriptive when used to measure alignment.** Indeed, if the ultimate objective is to reduce GHG emissions, how this objective is attained is not as relevant as the attainment of the final objective itself – even if it can be used to assess the credibility and feasibility of the end objective. Several combinations of technologies can lead to the same result. There is no consensus today on the optimal technology mix needed to limit the rise of temperature under a specific threshold. Finally, **it is harder to grasp continuous efficiency improvements with a technology metric**, which are also needed in the context of the energy transition. **Using carbon or GHG metrics allows us to capture overall changes, including efficiency improvements.**

- Both types of metrics suffer from significant data quality issues (see p91).

Figure 30: Conceptual and practical pros and cons of each type of metrics

	Carbon/GHG	Technology mix
Use case		
Flexibility to reach climate objective	High, potentially lowering credibility	Low (prescriptive technology mix)
Attribution of change to decarbonization efforts	Lower, potential risk of lock-in	High
Differentiation between green/brown technology, activity, companies	No – carbon/GHG metrics are by definition aggregated	Yes
Captures efficiency efforts	Yes – but changes cannot be attributed directly (aggregated)	Not currently
Data availability		
Applicability to a large range of sectors	High (all sectors) in theory but in practice incomplete (e.g. Scope 3)	Low (emission intensive sectors only: oil & gas, electricity generation, transport)
Scenarios choice to maintain internal methodological consistency	All types of scenarios, including IPCC, that all provide carbon/GHG data as output	Limited to IEA or scenarios that provide technology data as output
Financial asset-level data availability	Higher	Depends on the sector/ type of financial asset
Availability of aggregated datasets	Companies: data providers, CDP, Bloomberg/ Thomson Reuters, etc.	Companies: data providers, sectoral datasets (Global Data...), Bloomberg/ Thomson Reuters, etc.
Asset-class suitability	Listed equity, corporate bonds, sovereign bonds, infrastructure, real estate	Listed equity, corporate bonds, infrastructure. Less suitable for real estate and sovereign

Conceptually, both types of metrics are suited to measure compatibility with one or several temperature trajectories and with the temperature objective of the Paris Agreement, as long as the internal methodological consistency is maintained. Mixing the two types of metrics is a possible approach.

Practical considerations: what about data availability?

To perform temperature alignment assessments, the chosen metric is used to compare the climate performance of a company or portfolio with one or several temperature benchmarks derived from one or several scenarios. Therefore, data availability may be evaluated on these two elements.

- **Scenario data availability.** The IEA provides scenario output data expressed in both technology and GHGs metrics. For example, the carbon intensity of the utility sector in a specific scenario corresponds to a specific energy and technology mix. All these variables

result from the calculation model of the scenario and are therefore consistent with each other. This type of metric is only available for a limited set of homogeneous sectors, however. Besides, most other scenarios and trajectories output, including IPCC's, are mostly expressed in a GHGs metric. Finally, technology metrics do include efficiency assumptions, embedded as exogenous variables – that are therefore implicit but not captured directly when only using a technology mix metric.

- **Climate performance data availability.** An increasing number of companies disclose their GHG emissions, although this varies based on the scope, geography, sector, and size. Technology exposure data availability also varies and applies only to certain sectors. In both cases, aggregated datasets exist that compile the data in a single place and make it more easily accessible. It is best to favor datasets that have been double-checked and harmonized, to increase data comparability and quality.

Expert track: Harmonization challenges

- **GHGs or carbon?** IEA reports provide the budget in carbon, rather than GHGs. The precautionary approach still recommends using GHGs, rather than carbon, as the climate performance metric, as non-carbon GHG emissions can be quite significant for some sectors. These include methane for Oil & Gas, solvent, waste management, or agricultural non-carbon emissions.
- **Ownership boundary?** How to account for subsidiaries and partially-owned assets' emissions or technology mix? Let's take the example of a company A that owns 60% of another company B. Within the equity stake approach, 60% of the emissions or technology mix of company B is allocated to company A vs 100% in the management control approach. In practice, assessments based on reported data are reliant on the ownership boundary used by the reporting entity, unless asset-level datasets are used and harmonized to use the same ownership boundary.
- **Calculation of scope 2 emissions?** Scope 2 emissions arise from the use of electricity by companies. The GHG Protocol highlights two ways to calculate scope 2 emissions. The market-based approach takes into account a companies' purchasing decision. The location-based approach applies the emissions from the local power grid.

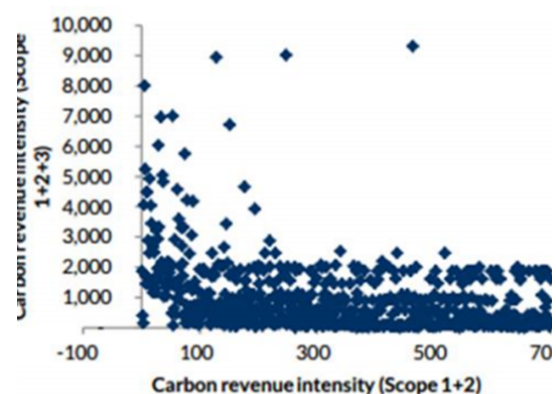
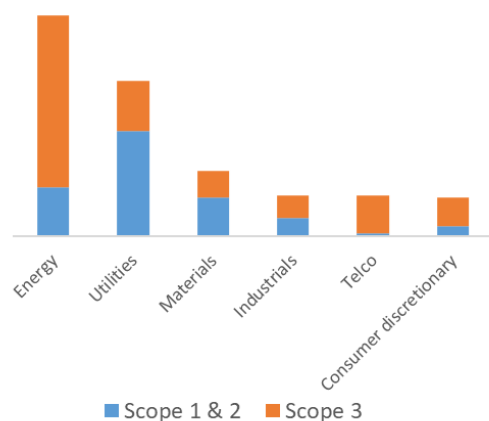
Choice 2: Scope 3 or not Scope 3?

The importance of value chain emissions. When using GHG emissions as the main climate performance metric, the question of perimeter arises. The GHG Protocol "Corporate Accounting and reporting Standard" differentiates between three 'scopes':

- Scope 1 refers to the direct emissions of a company, from direct energy use such as natural gas.
- Scope 2 relates to the emissions from the purchase of electricity, heating, and cooling.
- Scope 3 relates to other upstream and downstream value-chain emissions.

At the company-level, there is an increasing consensus that **Scope 3 emissions need to be included, especially for sectors for which it is particularly relevant, such as oil & gas producers and auto manufacturers.** For example, the TEG report on Climate Benchmarks recommends to include Scope 3 for every sector within 4 years of implementation in climate benchmarks, which is quite ambitious given corporate reporting ([TEG, 2019](#)). The SBTi requires companies to fix scope 3 reduction targets when its scope 3 emissions represent more than 40% of its total emissions ([SBTi, 2017](#)).

Figure 31: (Left panel) The relative importance of Scope 1, 2 and 3 emissions for selected sectors (based on [SBTi, 2017](#)); (right panel) Scope 1 and 2 as an imperfect (uncorrelated) proxy for total emissions ([Kepler Cheuvreux, 2017](#))



Demystifying value-chain accounting for temperature alignment assessments. A value-chain view is therefore necessary when relevant and feasible, especially when assessing “compatibility with the temperature objective of the Paris Agreement”.

- For certain sectors, most of the GHGs emissions, negative or positive, lies within their value chain.
- Methods that assess alignment based on Scope 1 and 2 emissions reduction requirements may penalize companies that offer “greener” products, e.g. a wind turbine manufacturer that increases its production, therefore leading to an increase of its absolute scope 1 and 2 emissions, even if its product is essential in producing wind energy and enables utilities to decarbonize along their own temperature trajectories.
- Methods that rely only on Scope 1 and 2 emissions implicitly give the full decarbonization responsibility to the user of the low-carbon product & service, and not the producer – i.e. to the wind utility rather than the turbine manufacturer, the real estate developer rather than the insulation manufacturer.

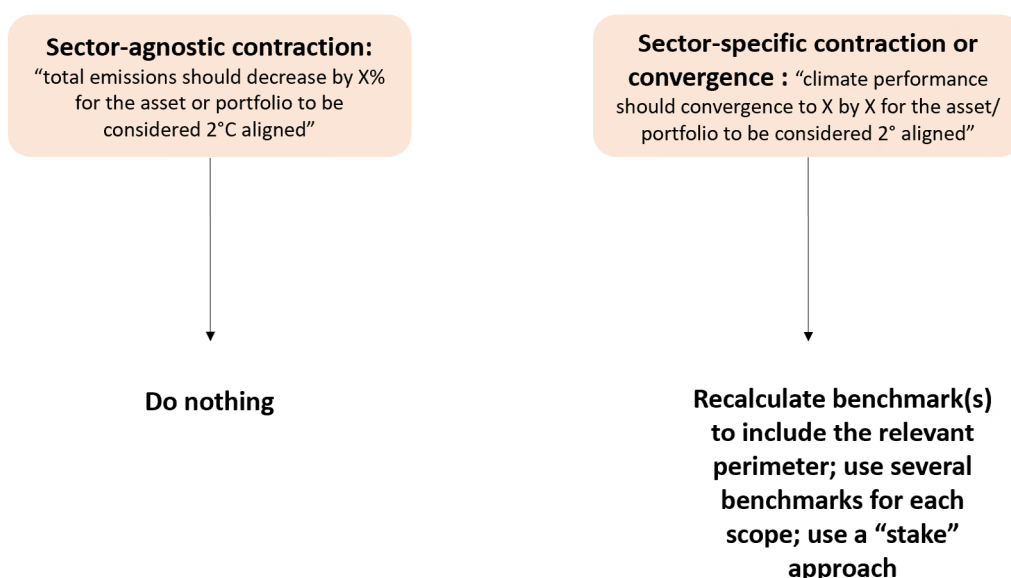
When Scope 1, 2 and 3 emissions are aggregated at portfolio-level, this may lead to double counting however, which occurs when the same tonne of GHGs

is counted multiple times. For example, a construction company scope 3 emissions include the emissions embedded in the manufacturing of building products that correspond to the scope 1 and 2 emissions of a cement company.

There are several (imperfect) methods to get rid of double-counting at the portfolio-level. They range from simple divisions to the identification of the extent of double-counting within a portfolio using input-output models. These methods all introduce additional uncertainties and can be, for some, time-consuming and complex to implement over large portfolios ([Kepler et al., 2015](#)).

Therefore, how to manage the trade-off between using a full value-chain view and limiting double counting? Is it even a trade-off? The comparison between the climate performance of a company or portfolio with a temperature benchmark, for example a 2°C benchmark, is a relative exercise. Therefore, depending on the type of alignment approach used, double-counting may not even be an issue to maintain methodological internal consistency.

Figure 32: Is double counting an issue and what can be done (authors' view)?



Mapping companies to the relevant trajectories.

When the temperature alignment assessment is done at asset-level using a convergence approach (e.g. SDA-like), the **“relevant” trajectories need to be chosen for each company, based on its sector and material scope**. This requires selecting the appropriate trajectories for each scope and sector.

The decarbonization scope depends on the level of influence (understood as responsibility and actionnability) a company has on a specific activity

and the associated emissions’ magnitude. For example, an auto manufacturer has influence on its Scope 1 and 2 emissions, as these are directly linked to its operations. However, it also has influence on the energy consumption of the vehicles it manufactures which constitutes the largest proportion of its total emissions. Therefore, the main stake for an automobile manufacturer is the emissions during the use of its products, and it may be compared to the transport sector trajectory as given by scenarios.

Except from the SDA methodology manual ([SBTi, 2017](#)).

“For example, a truck manufacturer can achieve a scope 3 target by making more efficient trucks. A transportation company can achieve a scope 1 target by using these more efficient trucks. When both companies claim these emission reductions, it results in double-counting. This shouldn’t be a problem since [...] the fact that the two companies reduce emissions in the same activity will only create a stronger impetus to achieve this target [...]. By achieving this target, both companies contribute to achieving the global 2 °C decarbonization pathway”.

Expert track: What to do when a trajectory for the relevant scope & sector is not available?

The SDA approach relies on sector-scope specific benchmarks (e.g. automobiles mapped to Transport – light road vehicles” sector). However, in certain cases, “its application might not be possible given a misalignment in the ways emissions are aggregated in the accounting rules and the existent scenarios, as well as poor availability of data in complex supply chains” ([Faria & Labutong, 2019](#)).

When no specific trajectory is available for the relevant scope, the SDA Guidance requires to use a “contraction approach” while the trajectory is being developed to ensure absolute emissions are reduced.

Using a “stake” approach to avoid “green products and services” myopia. Specific benchmarks have not (yet?) been derived for transition enabling sectors, e.g. EV batteries manufacturers. The emission reductions they allow are, however, embedded in the specific trajectories of the users of their products and services. For example, the residential and commercial real estate sector trajectories have an energy efficiency hypothesis embedded within them that can be achieved by using more insulation material. An insulation provider material does not have a sector-specific trajectory in most scenarios; its product mix can be mapped to the residential and commercial real estate sector.

Existing methodologies have approached this in different ways:

- Exclude these sectors from the perimeter, thereby providing an incomplete view;
- Limit the assessment to Scope 1 and 2, mapping these sectors to general manufacturing, thereby providing an incomplete view;
- Using the contraction approach as recommended by the SDA, with all the bias it introduces;
- Use a stake approach.

Choice 3: What about data quality and the need for estimates where reporting is lacking?

Reporting levels and data quality vary depending on the type of data, perimeter, country, sector, and size of

companies, amongst other things. There are two areas where reporting levels have historically been low and/or data quality and comparability may be an issue.

• **Data quality of reported data and mitigation strategies.** Depending on data type, a range of quality issues can arise that can be mitigated using more or less stringent strategies.

Table 24: Reported data quality issues and mitigation strategies (SBTi, 2017, Kepler et al., 2015)

Data type	Data quality issues	Mitigation strategies (less to more sophisticated)
Scope 1 & 2 GHGs reported data	<ul style="list-style-type: none"> • Incomplete reporting (GHGs, business units, geography); • Attention errors: misplaced commas, unit issues; • Use of outdated or inappropriate emission factors; • Uncertainty embedded in emissions factors used, from 5% (oil, gas, and coal) to 10-15% (electricity). 	<ol style="list-style-type: none"> 1. Rely on checks performed by data providers when compiling data in databases; 2. Perform additional data checks; 3. Only use emissions that have been verified or assured externally e.g. AA1000.
Scope 3 reported GHGs	<ul style="list-style-type: none"> • Incomplete reporting (Scope 3 categories); • Companies that report on scope 3 emissions rely on estimation models and assumptions that exhibit high variability; • When companies that report scope 3 emissions rely on actual data collected from their own value chain, reliance on value chain partners to provide comparable and data of good quality. 	<ol style="list-style-type: none"> 1. Rely on checks performed by data providers when compiling data in databases; 2. Perform additional data checks e.g. outliers analysis; 3. Recalculate scope 3 emissions for all companies (even if disclosed) to ensure data comparability and consistency.
Activity metric (technology)	<ul style="list-style-type: none"> • Incomplete reporting (business units, geography); • Calculated based on different ownership rules. 	<ol style="list-style-type: none"> 1. Rely on checks performed by data providers when compiling data in databases; 2. Perform additional data checks e.g. outliers analysis; 3. Use asset-level databases directly for the compilation (see expert track below).
Emissions intensity per activity metric	<ul style="list-style-type: none"> • Incomplete reporting (business units, geography); • Calculated based on different ownership rules. 	<ol style="list-style-type: none"> 1. Rely on checks performed by data providers when compiling data in databases; 2. Perform additional data checks e.g. outliers analysis; 3. Recalculate (see expert track below).

Missing data and estimation. When data is missing, incomplete, or of insufficient quality, data providers may choose to resort to estimation techniques to fill the gaps.

This is particularly relevant for Scope 3 emissions that are less often reported. Several estimation techniques exist, including sector-level averages and regression,

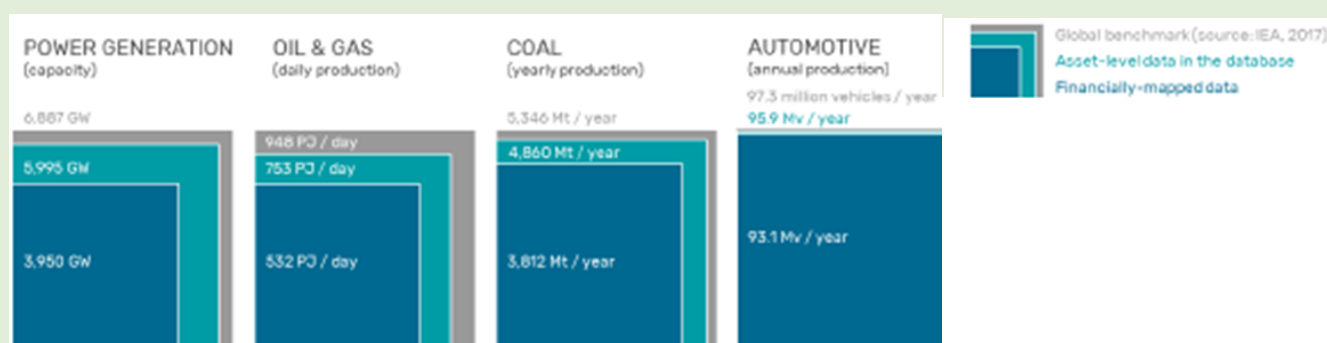
life-cycle analysis, and environmentally input-output analysis. It is outside of the scope of this report to discuss the pros and cons of each of these approaches (see Kepler et al., 2015), however, depending on the method used, there can be large discrepancies in the results. **Therefore, there is a trade-off between the willingness to cover as large a proportion of emissions as possible, data availability, and comparability.**

Expert track: Data quality of asset-level data and emissions intensity

Use of asset-level datasets. A number of methodologies make use of third-party derived asset-level datasets in 1. Computing a company's current and future technology exposure and 2. Computing a company's current and future emissions efficiency (emissions per activity unit). Providers gather data from a wide variety of sources, including desk research, web scraping, analyst's expertise, and direct engagement.

For example, the PACTA method developed by the 2° Investing Initiative compiles asset-level databases from third-parties, covering more than 230,000 physical assets (power plants, oil fields) and representing more than 75% of global emissions. Using these physical-level assets databases require an extensive mapping effort to allocate and aggregate production to specific companies ([2° Investing Initiative, 2019](#)).

Figure 33: Coverage of PACTA asset-level database ([2° Investing Initiative, 2019](#))



On the one hand, using third-party derived asset-level datasets to derive activity metrics allows for greater comparability. Indeed, activity metrics, or emissions efficiency, as reported by companies are often not reported consistently. In addition, it can prove useful in deriving forward-looking data (p.98). On the other hand, these datasets are sometimes incomplete and suffer from lags, as GHG data.

Recalculating emissions intensity per unit of production. When using emissions intensity per unit of production, inconsistencies in calculation protocols used by companies may require data providers and methodology developers to do their own recalculations to ensure consistency and comparability. This is the case of the Transition Pathway initiative e.g.

Table 25: Adjustment calculations to ensure consistency of emissions efficiency data (non-exhaustive)

Sector	Adjustment calculations
Automobile manufacturers (TPI, 2019)	<p>Metric used is average tank-to-wheel CO2 emissions per kilometer of newly registered passenger cars globally, measured in terms of the New European Driving Cycle (NEDC).</p> <p>Different regulatory regimes covering vehicle performance in different jurisdictions.</p> <p>Variations in vehicle type variations (light-duty vehicles, passenger cars).</p> <p>Disclosure across different geographies.</p>
Oil & gas producers (TPI, 2019)	<p>Energy products into five product categories: unrefined; refined; finished; physically traded, other.</p> <p>Different reporting units to be converted in energy measures: volumes, weights, energy</p> <p>Different reporting boundaries for emissions and activities.</p>

In the context of portfolio temperature alignment assessments, should missing GHGs data be estimated? It depends on the alignment approach chosen.

In most cases, estimated data are likely to be based on sector averages. **If the assessment is done using sector- and company-specific benchmarks to support stock selection**, one might attempt to estimate missing data with more specific and robust methods. In most cases, however, this is hard to do, therefore climate performance data may not be estimated for non-disclosing companies, as:

- Doing so could make the interpretation of the results more difficult;
- It is questionable whether a company that does not meet disclosure requirements can be said to be “aligned”;
- The extent of estimation error may be larger than the difference between temperature benchmarks used in the temperature alignment assessment.

On the other hand, if the assessment relies on sector-agnostic benchmarks, it may be useful to estimate missing data, as it mainly reflects sector allocation. Adjusting sector allocation based on incomplete data could bias the results and interpretation.

Choice 4: What about avoided emissions?

The need to understand what “avoided emissions” really are. Avoided emissions include the sales of «low carbon» solutions /services or the financing of third parties «low carbon» projects, outside the scope of activity (ADEME, 2020). Scope 1 and 2 emission reductions due to energy-saving and energy-mix process, do not qualify as “avoided emissions” according to this definition. Emissions avoided by a company through the sale of low-carbon products/services lead to the reduction of the direct (scope 1 and 2) emissions of the user or client. **Therefore,**

avoided emissions contribute to the overall objective of reducing total emissions at the macroeconomic level.

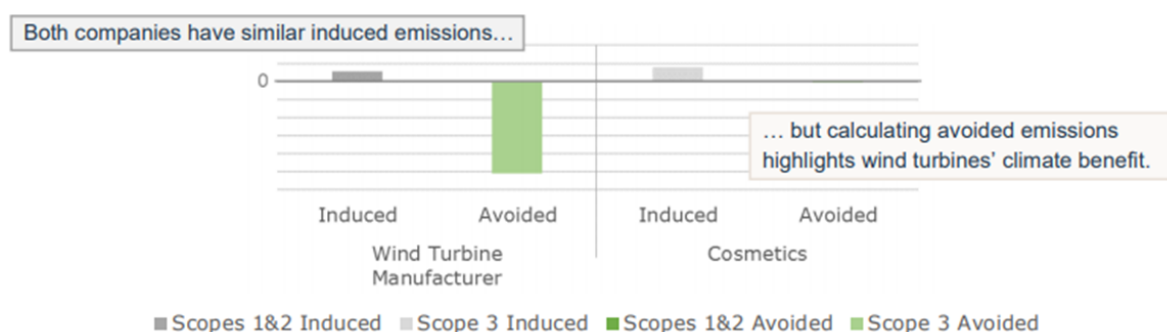
Avoided emissions are not captured by temperature alignment methodologies that rely on GHGs emissions and technology exposure, even when Scope 3 emissions are included.

- **The use of carbon footprinting metrics, even when including downstream scope 3 emissions, hides the share of “green” and “brown” products/services offered by a company.** Two companies with the same carbon footprint and on the same alignment trajectory may have a different relative exposure to green and brown activities – and therefore contribute differently to the low-carbon transition at the macro-level. While technology metrics capture this to a certain extent, **they still do not allow to capture the full range of “green” products or services as they usually focus only on a limited set of technologies.**

- In addition, **two companies may have the same “green” activity exposure in terms of revenue or EBIT percentage, but this may lead to different avoided emission profiles based on the baseline chosen.** For example, replacing grid electricity with renewable energy in China is likely to lead to higher macro emission reductions than doing so in France (avoided emissions, due to the higher carbon intensity per kWh in China (baseline)).

- **Temperature alignment methodologies that include scope 3 emissions do not capture the full range of emission reductions that occur at the macro-level through the sales of “greener” products or services.** Scope 3 emissions (“use of sold product emissions”) are calculated in absolute terms while avoided emissions arise in comparison to a baseline. A wind turbine manufacturer has no “Scope 3, use of sold product” emissions, as the functioning of the turbine does not require fossil energy. The turbine does allow, though, the production of energy that displaces “brown” grid electricity.

Figure 34: Comparison for a cosmetics company and wind turbine manufacturer (Mirova 2019, based on Carbone 4)



Data and methodological issues with avoided emissions. Calculating avoided emissions requires an additional assessment step for providers that wish to integrate this part of the story in alignment methodologies. Indeed, **while an increasing number of companies report their avoided emissions in the CDP Carbon Questionnaire, the data is not easily comparable due to different methodological choices and the lack of standards across sectors.** Calculating company-level avoided emissions is fraught with difficulties and can be time-consuming ([Kepler et al., 2015](#)).

One key question relates to the choice of baseline: should avoided emissions be attributed to “green” technologies that meet increased demand, rather than replacing “brown” technologies? Should avoided

emissions be attributed based on the average baseline (as of today) or its marginal effect? For example, in the case of Saint-Gobain sales of insulation material (table 26), should the baseline be, as in its CDP reporting, “absence of insulation”, the relative performance versus competitors’ products or the minimum insulation standards in force in a country?

One provider includes avoided emissions in alignment assessment to build a more complete view. To overcome some of the methodological challenges, avoided emissions are recalculated, even when companies disclose them. The key rule when including avoided emissions is **not** to net them with induced emissions, as they are conceptually and mathematically different.

Table 26 : Differences in the choice of baseline for avoided emissions ([CDP database](#), [company reporting](#))

	Category	Avoided emissions reported for FY2018	Baseline
Saint Gobain (CDP reporting, 2018)	Insulation products for building exterior walls (glass wool, stone wool, and expanded polystyrene)	1 251 million tons CO ₂ eq over the useful lifetime (30 years, i.e. 40 mt) (Scope 1, 2 and 3 Purchased goods & services = 20 mt)	Absence of insulation (non-insulated wall or simple/double glazing without coating)
Enel (Sustainability report, 2019)	Renewable energy (hydro, solar, wind, geothermal)	77 million tons of CO ₂ eq from energy generation	Calculated as the sum of the emissions avoided in the different countries where Enel is present. The resulting value is the product of the generation of electricity obtained from renewable or nuclear sources and the specific CO ₂ emissions from the thermoelectric generation of the country in which Enel is present.

What benchmark(s)? An additional difficulty arises when using avoided emissions in temperature alignment assessments: temperature benchmarks are built on induced emissions and therefore do not capture avoided emissions. As a consequence, it would be incorrect to compare the decarbonization rate or performance of a company or portfolio that includes avoided emissions with its sector-specific trajectories taken directly from scenarios.

Data providers have used two complementary approaches:

- Rebuilding temperature benchmarks at the portfolio-level to capture avoided emissions, which necessitates

additional manipulation and assumptions.

- Integrating the concept or actual calculations of avoided emissions within an overall score and recalculate the benchmarks for it to be expressed through a comparable score.

The main difficulty lies in the number and types of hypotheses that need to be done in recalculating temperature benchmarks. For example, should “average” avoided emissions be calculated for each green solution sub-sectors represented in the original benchmark? Or should an average “avoided emissions factor” for green solutions in general be used? How to integrate the geographic component? Is there enough

data to do so? What are the sources of emission factors? How should avoided emissions be attributed to the different actors along the same value chain (see expert track below)?

An alternative consists in building Scope 3 benchmarks specific to each solution, organized around the main

value chain stake, as highlighted p.88. For example, the main stake of the wind turbine supply chain lies in wind energy generation. Therefore, wind turbine manufacturers' revenue or activity growth can be evaluated in light of the required expansion rate of wind energy under a given scenario.

Expert track: Double counting, again!

The issue of double-counting arises again when aggregating avoided emissions at the portfolio-level. For example, the sales of wind turbines lead to the reduction of Scope 1 emissions of wind energy production and Scope 2 emissions of the consumer of wind energy. Double counting arises if both the wind turbine manufacturer and the wind energy producers are invested in the same portfolio.

The main question is: to whom should the decarbonization responsibility be attributed? The producer, the user, the financier, the distributor etc.? Within a temperature alignment assessment, as long as the benchmark is calculated using the same rules, double-counting may not be so much of an issue. One may still want to attribute avoided emissions, to 1. Identify and compare the impact of single companies within individual value chains and 2. Avoid over- or under-estimation that may arise from the different relative composition of the benchmark and portfolio.

Figure 35: Pros and cons of attributing avoided emissions along value chains ([WRI, 2019](#) ; [ADEME, 2020](#))

Option	Pros	Cons
Do not attribute	<ul style="list-style-type: none"> Emphasizes that impacts result from the collective efforts of entire value chains 	<ul style="list-style-type: none"> Multiple partners along a given value-chain may double count impacts
Attribute	<ul style="list-style-type: none"> Helps enable assessment, comparison, and communication of the impacts of single companies within individual value chains; Enables a better understanding of potential opportunities to increase positive impacts; Helps prevent the double-counting of impacts within individual value chains (as long as partners use a consistent attribution approach). 	<ul style="list-style-type: none"> May undermine the understanding that impacts result from the collective efforts of entire value chains; Multiple attribution approaches exist and none is likely to truly reflect the contribution of each value-chain partner Challenging to implement for complex product systems; Incomplete knowledge or awareness often exists regarding what activities result in or are required for materializing the impact.

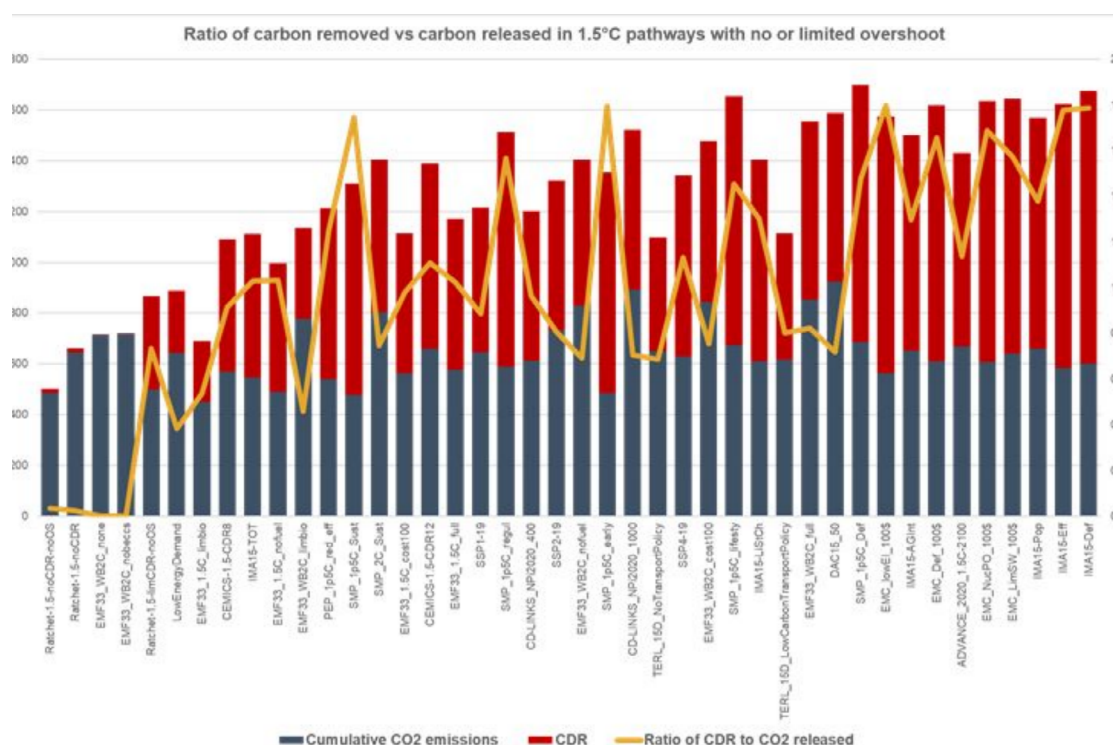
Because there is no guidance as to how to perform the attribution, ADEME recommends to companies not to do it when reporting them to ensure better comparability (ADEME, 2020). Investors, however, can use their own attribution key, such as Carbon4 Finance that uses value-added to allocate induced and avoided emissions between multiple components and an end-product, whose use avoids emissions.

Choice 5: Towards capturing removed emissions?

Emissions reductions only are not sufficient to limit temperature rise well below 2°C. Within the IPCC 1.5 trajectories with no or limited overshoot, **global carbon emissions reach net 0 by 2050 and become net negative thereafter**. This involves the **removal of carbon already emitted into the atmosphere**, for example through industrial (e.g. CCS) or natural carbon absorption and sequestration (e.g. reforestation) technologies, each with different “maturity, potentials, risks, co-benefits and trade-offs” (IPCC, 2018).

When carbon removals equal emissions, it amounts to “zero net emissions”. It is impossible to reduce the totality of carbon emissions to 0, hence the need to absorb the residual to reach net zero. If removal exceeds induced emissions, this is called negative net emissions. Therefore, in the context of 1.5°C trajectories, carbon removals play two roles: 1. They compensate for emissions that accumulate in the atmosphere and 2. They can create the net negative emissions needed post-2050.

Figure 36: Key characteristics of 1.5°C trajectories (CDP, 2019)



There are, however, several concerns reported in the IPCC SR15 report about the reliance on carbon removals at scale in 1.5°C trajectories (IPCC, 2018): uncertainties about the feasibility, potential and sustainability of deploying carbon removal technologies at scale, as well as regarding how the earth system may respond to net negative emissions after a peak;

Focusing on emissions reduction only in alignment methodologies therefore “takes for granted” the other side of the equation on carbon removals that are embedded in temperature trajectories. Only 4 of the 42 trajectories that limit global warming to 1.5°C with limited or no overshoot avoid the use of carbon removal at scale. These rely on a significant reduction in energy and food demand that appear unlikely.

For all other trajectories, approximately 1 ton of carbon should be removed for 1 ton of carbon emitted throughout the century. The topic is likely to grow in importance as we overspend our carbon budget: trajectories with emissions that peak higher and later rely more on removed emissions. Temperature alignment methodologies that solely focus on emission reductions without considering the necessary trajectory of carbon removal technologies development implicitly assume that the responsibility for developing these technologies lie outside of the scope of the companies within an investment portfolio – if the underlying scenario relies itself on carbon removals to achieve the temperature limitation goal.

risk of delaying near-term mitigation because of building expectations on carbon removal technologies deployment in the future; and potential negative trade-offs with other social and environmental impacts, for example in terms of afforestation and bioenergy supply that could, if poorly managed, compete with food production.

Conceptual implications.

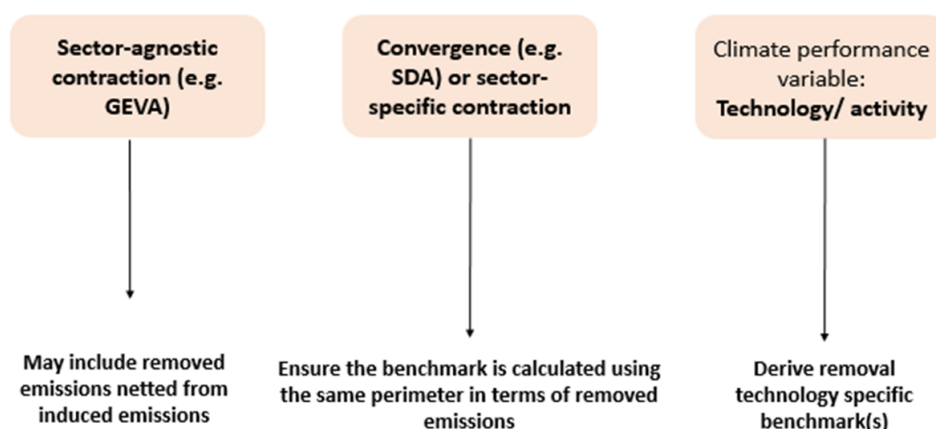
- A temperature alignment methodology may focus, at minimum, on reduced emissions. This is in line with the “compatibility” assessment question. Removed emissions by companies within an investment portfolio may be stated separately.
- Assessments that seek to capture compatibility with the temperature objective of the Paris Agreement may seek to integrate removed emissions in the assessment, if and only if these do not lead to unintended trade-offs and are permanent.

Practical implications. In practice, however, temperature alignment assessments are often performed on the reduction of carbon emissions, because of the methodological difficulties in including removed emissions. Besides, not including removed emissions yields a more conservative alignment estimate. However, as it becomes necessary to develop removal technologies to limit temperature rise, including them may signal to companies the need and expectations that they develop them.

- Sector-agnostic contraction approaches, either at portfolio or asset-level, often rely on trajectories that include the buildup of removal technologies (e.g. IPCC). In that specific case, mathematically, it is possible to net induced and removed emissions to calculate the climate performance of the company or portfolio and compare it to the temperature benchmark. It is however important to ensure that removed emissions are calculated accurately and following the same standards and rules. For greater transparency, it may be better to disaggregate mitigation and removal trajectories – however, this is not available yet (see p.119 on emerging scenario work).

- When using convergence approaches, it depends on whether the benchmark used includes removed emissions if one wants to net company or portfolio removed emissions from induced emissions. This raises the question of what sector is responsible for different removal technologies (e.g. CCS for oil & gas, reforestation for agriculture). IEA trajectories include the build-up of CCS technology e.g. See next page for an example on the land sector.

Figure 37: How to include removed emissions within temperature alignment assessments (authors' view)?

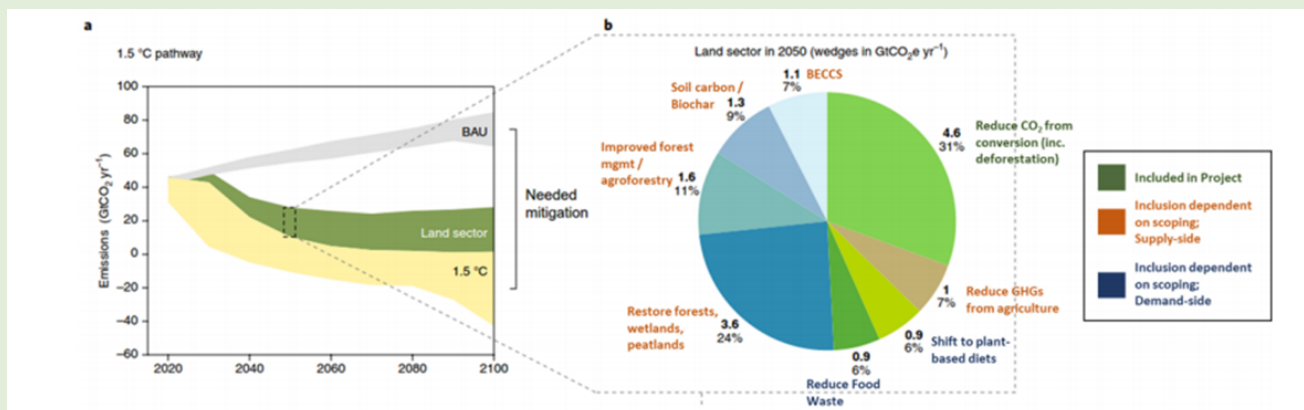


Expert track: Developing a sector-specific trajectory for the agriculture sector

The Food and Beverage sector has been the largest in terms of science-based targets adoption to date. The Science-Based Target Initiative is currently developing a 2°C benchmark for the forest, land, and agricultural sector (publication planned in summer 2021), building on Ecofys/PBL previous work. While the priority is to include deforestation (=induced emissions) that represent 31% of the land sector CO₂ effort in 2050 under 1.5°C trajectories, the feasibility of including other supply-side impacts such as forest restoration and improved management (=removed emissions) is being investigated.

Within the current Science-Based Target boundary settings, companies from all sectors are required to include GHG removals associated with bioenergy feedstock in their inventory and target boundary. However, in the absence of standardized guidance on calculating land-use change emissions (including afforestation), these should not be included. The WRI is currently updating the GHG Protocol with three new standards: carbon removals & sequestration; land sector emissions and removals; and bioenergy.

Figure 38: Land use sector “roadmap” for the development of the SBTi (SBTi, 2020)



Choice 6: How to forecast future climate performance?

Why do we care? Simple portfolio climate performance metrics are static, and often backward-looking as there is a lag between carbon emissions, company reporting, inclusion in providers' or industry database, and application at portfolio-level. Therefore, most temperature alignment analyses rely on estimates of the future climate performance of companies and

portfolios. A small number of methods do not attempt to forecast future climate performance because of the difficulties in doing so – and compare today's climate performance with a future desired state as given by the scenario.

Choices and implications around the temporality of the assessment are reviewed on p.25. In this section, the different ways to derive and use forward-looking data are detailed.

Figure 39: Schematic representation of the different types of forward-looking data (not based on real data)

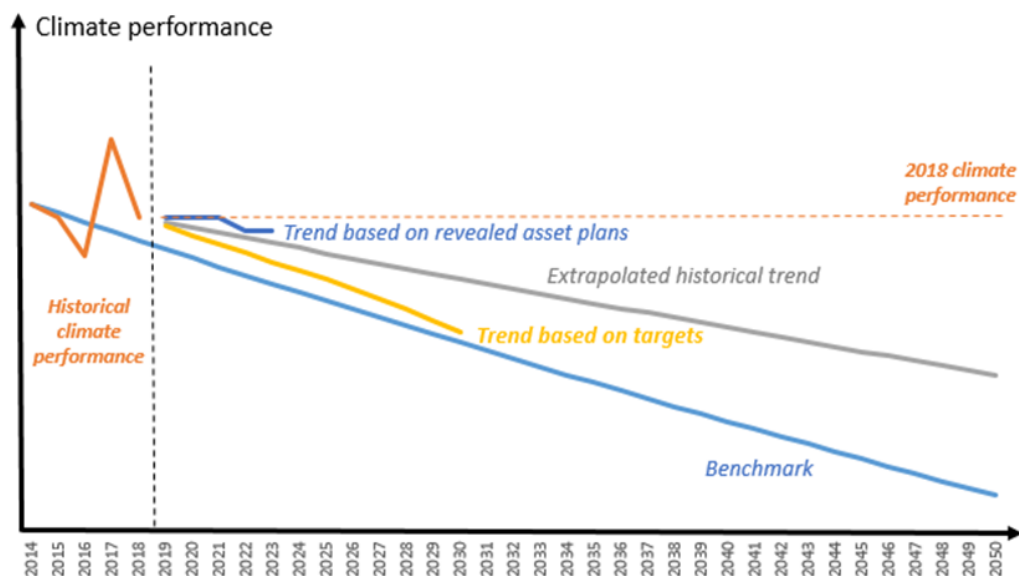


Table 27: Review of forward-looking data types used by providers

Measurement of the intention/ commitment gap, action gap, and forecasted performance gap.	
<ul style="list-style-type: none"> • Assess the alignment of corporate targets: commitment gap (CDP-WWF Temperature Rating, EcoAct, parts of right. based assessment). • Assess the alignment of revealed Capex plans: short-term gap (PACTA of 2° Investing Initiative). • Forecast future performance using a range of forward-looking data as a proxy, including targets (potentially discounted based on their assessed credibility), Capex plans, R&D and green patents, and qualitative scores. 	
Examples (non-exhaustive)	
ACT	Several “alignment with a temperature trajectory” elements as inputs to the score: commitment gap based on targets; action gap based on the extrapolation of past trends; revealed plans to 5 years using asset-level datasets and lock-in ratio.
Carbon4 Finance	Score based on a company’s strategy and Capex plans.
I Care & Consult	Targets discounted based on credibility and historical data.
S&P Trucost	Targets, historical data, and proprietary asset-level databases.
right. based	Calculates different sets of temperatures using different forecasting methods. The base-line scenario assumes that all companies, regardless of sector, geography or size, grow and decouple their emissions from value-added in line with the IPCC SSP2 scenario, which represents a “middle of the road scenario”. The climate target scenario forecasts absolute emissions reductions based on declared targets (and value-add based on SSP2).

Table 28: Summary table on forward-looking data ([2° Investing Initiative, 2018](#); [2° Investing Initiative, 2019](#); [CDP & ADEME, 2017](#); [TPI, 2020](#))

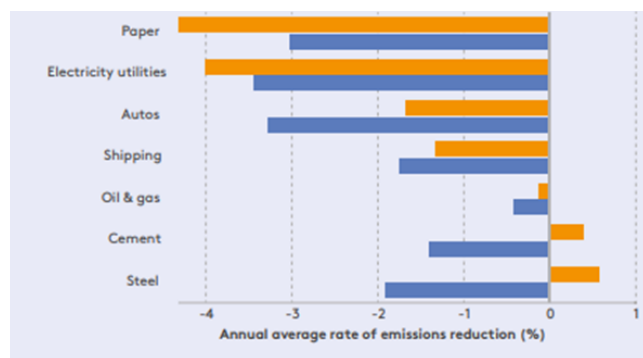
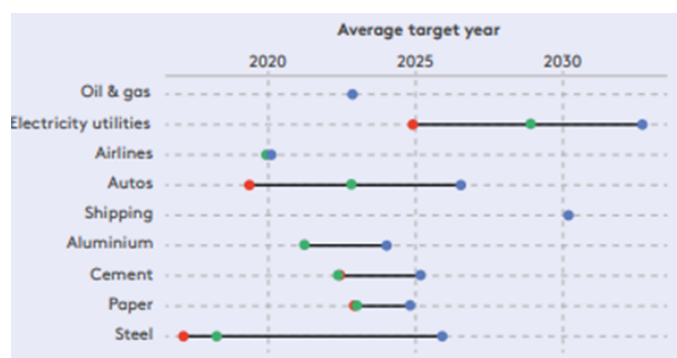
	Pros	Cons	Assessment question(s)	Applicability	Data sources	Extra assumptions/ judgement
Extrapolation based on historical performance	Easier, applicable across all sectors/ companies/ metrics)/ time horizon	Does not capture potential non-linearity, no predictive power, reliance on disclosure	Can the company or portfolio be considered aligned if it continues on its current trend?	Metric: all Asset class: all	Historical reported data (company report, CDP, data providers, national reporting, UNFCC)	<ul style="list-style-type: none"> • How far back? • What metric to extrapolate: absolute or relative? • What to do in the absence of historical reported data?
Macro-economic trend	Easier, applicable across all sectors/ companies/ metric/time horizon	Does not capture potential non-linearity, no predictive power, not sector or company specific in current assessments.	Can the company or portfolio be considered aligned if it decouples its emissions at the same rate as the economy under different future scenarios?	Metric: mostly GHGs and carbon Asset class: listed equity, corporate bonds and sovereign	IPCC SSP scenarios	<ul style="list-style-type: none"> • What metric? • Sector-specific?
Reliance on stated objectives/ targets	Applicable across sectors (creates a system of equivalency).	Implementation difficulties and extra (subjective) hypothesis in terms of harmonization, reliance on disclosure; medium term.	<p>If the company/ portfolio achieves its stated objectives, can it be considered aligned?</p> <p>Targets can also, in certain cases, be considered a proxy of future performance.</p>	<p>Metric: mostly GHGs and carbon</p> <p>Asset class: listed equity, corporate bonds and sovereign</p>	Stated targets and objectives as reported in CSR/ annual/ integrated reports and CDP, NDCs	<ul style="list-style-type: none"> • Harmonization of perimeter, objectives and timeframes • What to do in the absence of targets? • If targets are used as a proxy for future performance, how to judge how realistic they are?
Asset-level databases & Capex	Consistent boundaries, can cover non-reporters, aggregation and usability	Incomplete data, hard to consolidate subsidiaries, do not cover all sectors, differing time horizons, potential time lag, may come at an extra cost (proprietary)	Can the company or portfolio be considered aligned if the underlying companies follow their announced or revealed development plans?	<p>Metrics: technology/ energy mix, some GHGs and carbon</p> <p>Asset class: listed equity, corporate bonds and sovereign</p>	Proprietary and publicly-available datasets.	<ul style="list-style-type: none"> • Matching and mapping subsidiaries? • Harmonizing time horizons?
Green patents and R&D	Forward-looking, gives an indication of a company's strategy	Lack of data; variation in results may not be linked to actual future climate performance (marketing, secrecy, culture, sector bias).	<p>If the companies' patents and R&D efforts are successful and/ or based on past R&D activity, can the company and portfolio be considered aligned?</p> <p>Is the portfolio/ companies financing sufficient innovation and R&D to support the transition?</p>	<p>Metric: technology mix, GHGs and carbon with additional assumptions and calculations.</p> <p>Asset class: listed equity, corporate bonds and sovereign, private equity</p>	OECD, innovation raking of some consultancies, public announcements and plans of companies (e.g. Toyota), earmarked debt issuance, I3 database.	<ul style="list-style-type: none"> • Mapping of R&D efforts and patents to specific techno and emissions reduction • Attributing R&D efforts to different value chain levels (e.g. PV innovation unlikely to come from utilities)

1. Extrapolation. The easiest way to estimate a company's future climate performance is to extrapolate past trends (Thomä et al., [2018](#)). This method is also the most imperfect, as the past is not a good predictor of the future. It also raises several questions, such as how far back in the past one should go to compute the trend provided data availability and whether to use absolute or relative metrics to mitigate price variation and M&A effects. In addition, past trends can be based on efficiency gains that could potentially reach a ceiling and that cannot be sustained over the medium to long-run.

2. Reliance on targets reported by companies,

including science-based targets. This approach is used by several data providers to measure the potential gap between what is committed and what should be committed under a certain scenario. It is sometimes difficult, however, to harmonize corporate targets with different scopes, starting points, time horizon, and metric. CDP-WWF Temperature Rating methodology includes a detailed protocol to assess target coverage e.g. (see p.149). This approach has also been used as a proxy for future performance but one of the limitations is that companies can miss targets. One provider discounts targets based on their credibility, for example their participation in initiatives such as ACT or the SBTi.

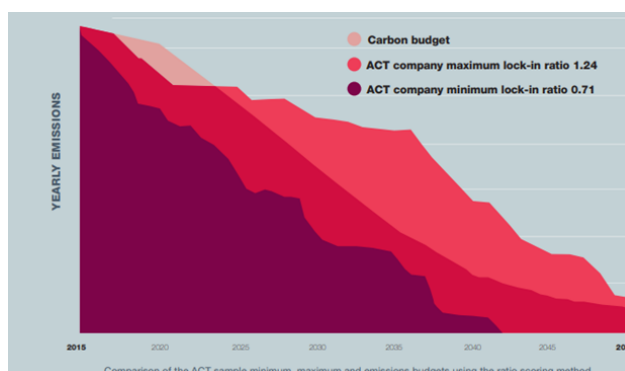
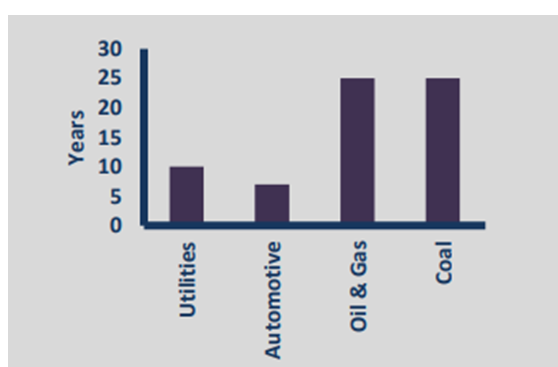
Figure 40: (left panel) Average year of company targets by sector over the last three TPI assessment cycles (red: 2017, green: 2018, blue: 2019); (right panel) Historical rates of reduction of emissions intensity (orange) compared to the required rates of reduction to meet their target extended to 2025 (blue) ([TPI, 2020](#)).



3. Reliance on asset-level databases on Capex announcements. To estimate future performance, some data providers rely on proprietary external asset-level databases, such as Global Data (PACTA), or proprietary internally-developed datasets such as S&P World Electric Power Plants. On the plus side, these databases aggregate and harmonize company plans and announcements, and make them readily available to the user. The use of these datasets also allows methodology developers such as 2° Investing

Initiative to avoid using corporate reporting and capture changes in activities, rather than emissions that could be attributed to other factors. On the limitations side, there is necessarily a time lag between announcements, data treatment, and aggregation in the database. Also, this approach is only possible for some sectors at varying time scales, usually short, and needs further data treatment to take into account subsidiaries.

Figure 41: Varying time horizon of asset-level database (left panel) ([2° Investing Initiative, 2018](#)); lock-in ratio calculated based on CAPEX (assuming no retrofits) (right panel) ([CDP & ADEME, 2017](#))



4. Green patents & R&D. This type of data can be used directly or as part of a score (see below). For example, Carbon Delta/ MSCI uses green patent databases to estimate the future green share of companies' revenue and derive a future carbon intensity. Carbon4 Finance and ACT integrate this type of data within a larger score. This approach requires users to either 1. Derive specific regression-based models, therefore necessitating additional assumptions or 2. Be limited to data disclosed.

R&D holds a special place in alignment assessment. As highlighted by 2° Investing Initiative ([2° Investing Initiative, 2019](#)), “largely missing in the debate has been the role of investors in financing and scaling new zero-carbon technologies”. **Deployment and innovation of low-carbon technologies are embedded in IEA trajectories.** On the one hand, the negative emissions required under the IEA 2°C scenario after 2070 requires technology not yet commercialized today. On the other, R&D can reduce deployment costs of already existing technology that are needed between 2020 and 2050 such as electric vehicle packs. Therefore, if these low-carbon technologies are not developed and deployed at the required rate, supposing R&D today, trajectories may radically shift across sectors, and become much steeper and harder to reach (if the technology concerns carbon removal).

Using R&D data ideally requires several analytical steps: 1. Defining what “mitigation R&D” means and what technologies it covers (e.g. using the OECD Patents Statistics Database taxonomy), 2. Defining the level of maturity of the different types of mitigation technologies and 3. Compare it to R&D roadmaps in different trajectories. As explained in the ACT methodology, this is very hard to achieve given available data, even when engaging with companies themselves ([CDP & ADEME, 2017](#)). In addition, the share of green patents and R&D may vary depending on the type of sectors; a company may acquire a “green division” rather than develop it; patents can be deposited for communication or eliminating a technology, or not be published.

5. Qualitative data/scores. Green patents, R&D, and other more qualitative criteria can be aggregated into a score to form a judgment on the strategy of the underlying company and its adequacy in the context of the energy and low-carbon transition. While these metrics can give a more complete and rounded view, it requires a subjective judgment as to how to weight the different criteria to form a score. Finally, it requires either translating the score in a GHGs, carbon or technology share metric, or translating the benchmark in a score metric in order to perform the alignment and temperature assessment, therefore necessitating additional assumptions.

MAIN COURSE: CHOOSING ONE OR SEVERAL SCENARIOS AND ASSOCIATED TRAJECTORIES

In this section, how to choose one or several scenarios and associated trajectories is reviewed. Micro-level temperature benchmarks are then built based on these macro-level trajectories (Step 3) against which the climate performance of a portfolio or a company (as calculated in step 1) is assessed (step 4).

KEY TAKEAWAYS

This step involves several methodological choices:

What are the main conceptual and practical considerations? A number of scenarios have been developed by different institutions, with macro-level decarbonization trajectories leading to different temperature outcomes. A scenario is a plausible representation of an uncertain future and a story on how to reach it. Associated trajectories depend on a wide range of parameters and hypotheses. Therefore, two 1.5°C trajectories from two different scenarios may be different in terms of the sectoral and time allocation of the remaining global carbon budget and embedded mitigation levers.

The choice of one or several scenarios and associated trajectories depends on a range of conceptual and practical considerations. Most of the time, data providers and investors use the most “practical” scenarios rather than the best-suited to the assessment question, conceptually. In particular,

the adequacy of using IEA ETP and WEO scenarios and trajectories is reviewed.

Adapting externally-derived scenarios to better suit assessment needs? A data provider or investor can decide to either 1. Use externally-derived scenario(s) and trajectories as such, 2. Adjust the trajectories provided as outputs of externally-derived scenario(s) for it to be better suited to their practical needs and/or combine existing scenario(s) to fill data gaps in any one of them, or 3. Develop their own scenario(s). Examples of each option are provided in turns, as well as their pros and cons.

Most portfolio temperature alignment methodologies rely on IEA scenarios and trajectories. Some methodologies use the IPCC trajectories, in particular for 1.5°C trajectories and sectors not covered by the IEA. Some providers build their own scenarios and/or leave the choice to the user.

Choice 1: What are the conceptual and practical considerations?

Different types of climate-related scenarios. As described in detail by I4CE ([I4CE, 2019](#)), it is possible to differentiate between three families of climate-related scenarios.

- **“Transition scenarios”** derive plausible socio-economic and technological trajectories that lead to different carbon emissions and concentration levels.
- **“Climate change scenarios”** model the impact of these different levels of carbon emissions and concentrations on the climate, for example in terms of temperature rise. These are useful when translating

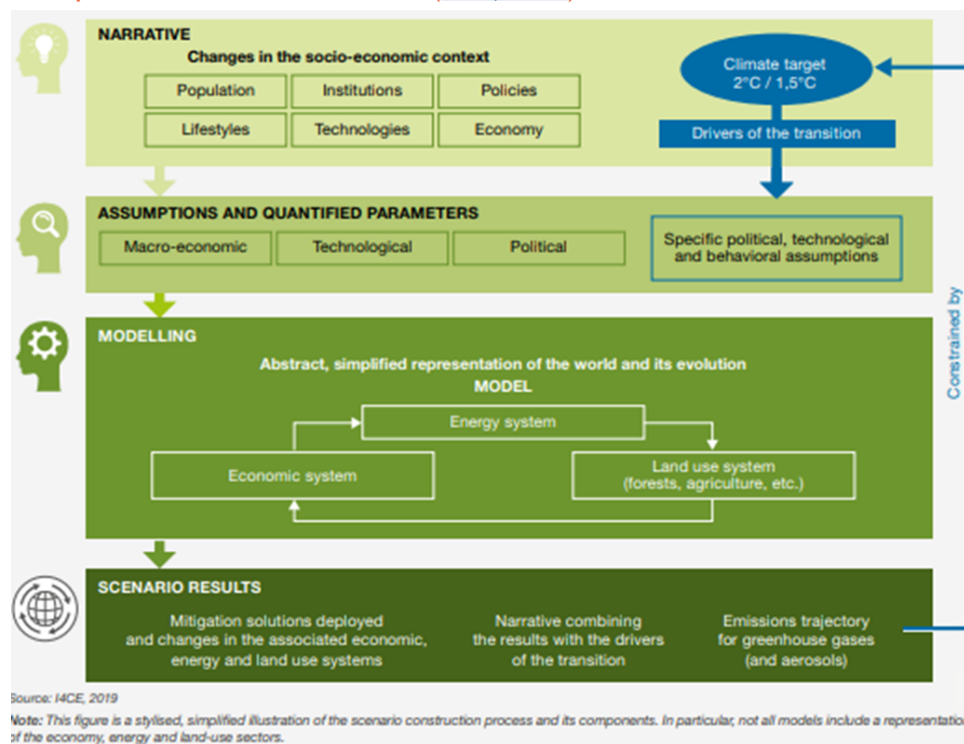
the assessment results into an Implied Temperature Rise (ITR) metric.

- **“Climate impact scenarios”** explore the potential impacts of climate change on socio-economic systems, for example in terms of the financial and human costs attributable to the increase in occurrences and magnitude of extreme weather events in a 3°C world.

Temperature alignment assessments rely on transition scenarios most of the time. One method relies on both transition and climate change scenarios.

How are transition scenarios and trajectories derived? In order to choose the most appropriate scenario(s), it is essential to understand how they are derived.

Figure 42: Construction process of transition scenarios (I4CE, 2019)



The starting point to build a transition scenario is **to set up a climatic constraint**.

- Some scenario developers rely on the overall “remaining carbon budget” - that is, the maximum quantity of carbon, as calculated by the scientific community, that can be emitted to limit its concentration in the atmosphere over a specified period. Using climate change scenarios, this increased concentration can be translated to a temperature level with a certain level of certainty. For example, the carbon budget that keeps warming below 2 ° C with a 66% chance is 1,170 GtCO₂ (1,500 GtCO₂ for a 50% chance) for the period 2018-2050 (IPCC, 2018).
- Some scenario developers directly use carbon emission pathways developed by international institutions such as the IPCC rather than the remaining overall carbon budget as the GHG constraint. In particular, the IPCC has developed a series of global representative pathways (RCPs) limiting temperature under different levels that are not attached to any single one scenario but are rather representative of many pathways in the literature. As such, these pathways are “agnostic”: they do not represent a specific world view or transition story (see p.110).

At this stage, scenario developers also need to define and quantify through time the **macro-economic characteristics** that describe the current and future state of the world. While there is a range of such characteristics, the two structuring ones are population growth and GDP. According to the IPCC 1.5 Special Report “baseline projections for energy-

related GHG emissions are sensitive to economic growth assumptions while baseline projections for land-use emissions are more directly affected by population growth” (IPCC, 2018). These macro-economic variables are often defined outside of the scenario itself.

The carbon constraint may be distributed through time, sectors, and geographical units.

- The simplest distribution key is to allocate the same intensity of carbon reduction to all sectors/ countries (“grandfathering”), but this does not meet the principle of equity as embedded in the Principle of Common but Differentiated Responsibilities and Capabilities in the Paris Agreement.
- A range of more sophisticated distribution keys has been used. These include but are not limited to historical responsibility, population growth, technological availability and mitigation costs or per capita growth projections.

Finally, a scenario relies on hypotheses relating to the type of levers and specific solutions that can be put in place to stay within the carbon constraint, including their availability, scalability, and costs. This will determine the relative shape of the associated emissions pathways through time and between sectors/ geographies. For example:

- Hypothesis around the use of carbon capture and removal technologies, such as CCS or natural sinks: trajectories derived from scenarios that assume that these technologies will be deployed and scaled usually

peak at a later stage and depict lower decarbonization rate over the short-term.

- Some levers, such as bioenergy or hydropower, if not managed properly, can lead to trade-offs with the Sustainable Development Goals and/or maladaptation, in terms of food security for example (see Expert Track p.108).

Assumptions around 1. future macroeconomic conditions and population growth, 2. the distribution key and 3. mitigation levers are directly linked to a certain vision of the future, necessarily normative, and directly determine the shape of the associated trajectories.

It is therefore essential to understand the world that a scenario models as it will drive the shape of the pathway(s) used to derive micro-level temperature benchmarks against which the current and future climate performance of companies and portfolios is compared. A scenario «operationalizes» a given carbon budget or global trajectory and answers the question: how can a temperature objective be reached, under different constraints and assumptions, by distributing the remaining budget on a temporal, geographic and/or sectoral basis? It is a story that describes a hypothetical future amongst a range of others that

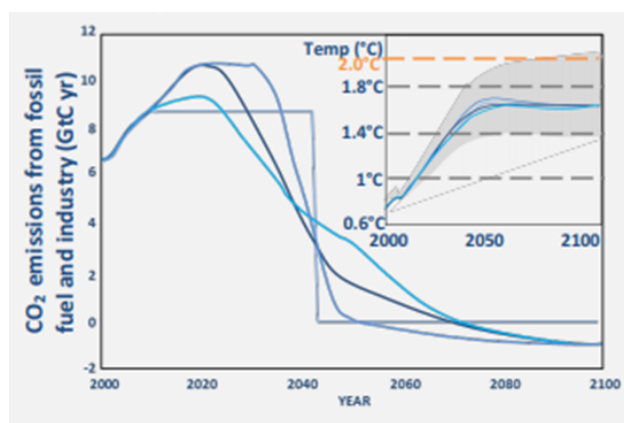
lead to the same temperature objective.

Several trajectories can lead to the same temperature rise in 2100, each embedding different hypotheses.

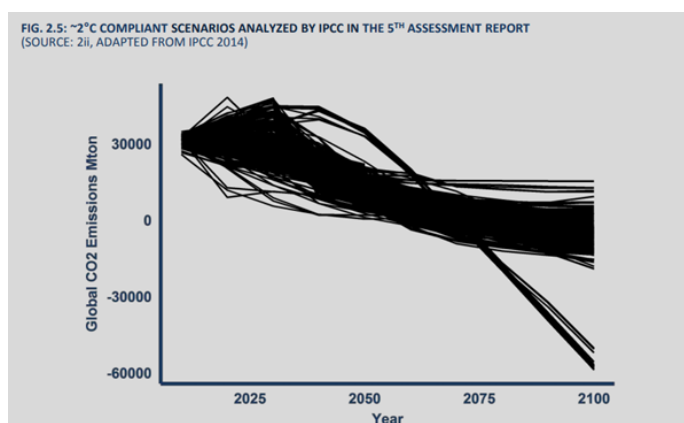
In practice, therefore, there is a range of trajectories leading to the same temperature outcome, and these may overlap with each other – for example, trajectories in the upper range that lead to a 2°C rise can overlap with trajectories in the lower range leading to a 3°C rise. **These trajectories resulting from different scenarios differ on several elements:** the speed and decarbonization rate required, the year and the amount of the carbon peak, the time horizon at which the trajectory must be net-zero, and the reliance on removed emissions. The shape of the pathway is a function of the underlying assumptions, and therefore worldview, that the scenario represents. For example, scenarios that represent a disordered transition to 2°C usually have the following characteristics:

- The carbon peak is reached later rather than sooner,
- A larger proportion of the carbon budget is «spent» in the short term,
- Leading to a higher carbon overshoot and a higher quantity of emissions that must be removed,
- Coupled with a faster decarbonization rate once the peak is reached.

Figure 43: A range of trajectories are compatible with the same temperature limitation objective. The four trajectories on the left panel all limit temperature rise under 2°C by 2100. These trajectories differ in terms of temporality and carbon peak. The later and higher the carbon peak, the faster need decarbonization be after the peak, and the higher the reliance on removed emissions (2° Investing Initiative, 2017).



It is therefore important to note that a portfolio may be aligned with one 2°C trajectory but not with another. Therefore, the choice of scenario(s) and trajectories directly determines the result and is an essential choice in this type of assessment. Therefore, it would be more robust to use a range of trajectories leading to the same temperature outcome. However, as put by CDP & WWF International (2020): “while valuable



to describe the range of uncertainty and variability between scenarios, such an approach has several main drawbacks for the intended use here:

- 1 In order to apply a ‘score’ to targets, a method must return a single unambiguous score, which is not possible using descriptive binning approaches;
- 2 [...] Results [calculated based on a range of trajectories leading to the same temperature outcome]

can be difficult to understand for non-experts since bins tend to have overlapping ranges”.

Therefore, all the temperature alignment methods reviewed in this report rely on choosing one trajectory per temperature outcome. It would be more scientifically-sound to use several trajectories for the same temperature outcome and express the results as a range.

In theory, the choice of scenario(s) and pathway(s) depend on the assessment question. As highlighted by the IIGCC, « understanding the assumptions behind scenarios and the methodologies used to apply them to investments is critical. These assumptions drive the results. Without knowing how they work, the outputs of assessment will be challenging to rely on for investment purposes” ([IIGCC, 2018](#)).

Table 29: Conceptual criteria to choose (a) scenario(s) ([CDP, Global Compact, WRI & WWF, 2020](#); [IPCC, 2018](#); [TCFD, 2017](#))

	Choice of scenario(s)
Compatibility with one or several temperature trajectories	Any, as long as internal methodological consistency is maintained.
Compatibility with the temperature objective of the Paris Agreement	<p>According to the Paris Agreement, it is necessary to “reach global peaking of greenhouse gas emissions as soon as possible, recognizing that peaking will take longer for developing country Parties, and to undertake rapid reductions thereafter in accordance with best available science, so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century.”</p> <p>According to the IPCC, « the longer the delay in reducing CO2 emissions towards zero, the larger the likelihood of exceeding 1.5 °C, and the heavier the implied reliance on net negative emissions after mid-century to return warming to 1.5 °C (high confidence) (2018).”</p> <p>Therefore, it is best to use the most ambitious trajectories that peak sooner than later.</p> <p>The SBT Initiative recommends using scenario(s) that are the most likely and precautionary in attaining the less than 2 °C temperature objective.</p> <p>It is also the perspective of the TEG that uses the 1.5 °C IPCC scenario with no or limited overshoot.</p>
The special case of compatibility with the Paris Agreement	<p>In addition to the above, this supposes to take into account national-determined climate-resilient low-carbon development pathways, adaptation and the wider sustainable development objectives.</p> <p>The IPCC calls for the use of scenarios that rely on low-carbon socio-economic trajectories that take into account the 17 sustainable development objectives adopted by the UN in 2015 as well as adaptation challenges. These scenarios are still emerging and are called “climate-resilient low carbon development trajectories” in IPCC reports (See Expert Track).</p>

However, scenario users are often limited by practical considerations. Trajectories are expressed at different levels of temporal, geographical, and sectoral granularity. Therefore, **in practice, most data providers and investors use scenario(s) that have the relevant level of data granularity for the perimeter**

chosen, rather than scenario(s) most suited to their assessment question. For these reasons, most temperature alignment assessments rely on the IEA ETP scenarios that provide regularly-updated data on the most granular basis available on the market at sector-level.

Table 30: Practical considerations in choosing scenarios (authors' view).

Type of assessment	Relevant issues/ questions
All	<ul style="list-style-type: none"> • Are the scenarios published by an independent organization and properly referenced? • Are the results easily useable (format)?
Ex-ante/ ex-post	<ul style="list-style-type: none"> • Are the scenarios updated frequently?
Sector-agnostic approach	<ul style="list-style-type: none"> • The level of sectoral disaggregation is not that important. • Is there a need to use geography-specific scenarios?
Sector-specific	<ul style="list-style-type: none"> • Highest level of disaggregation possible, especially for high-carbon sectors and/or sectors most represented in the portfolio. • What variables are necessary for the assessment (economic and/or physical variables)? • Are the results also available per geography? At what level of granularity?

Putting it all together. In light of the above conceptual and practical criteria, I4CE put together a step-by-step framework that investors can use to evaluate transition scenarios (I4CE, 2019). The usability of outputs comes

very early in the decision process, highlighting that this is often the limiting factor in portfolio temperature alignment assessments as performed today.

Figure 44: Step-by-step framework investors can use to evaluate the usability of transition scenarios (I4CE, 2019).



The special case of assessments expressed through an Implied Temperature Rise metric. When the temperature alignment assessment has for end objective to translate portfolio alignment into an Implied Temperature Rise metric (ITR), an additional practical consideration comes into play, namely: **How many internally-consistent trajectories are available in each scenario family?**

- As part of a simple 2 °C alignment assessment, only

one trajectory is required, at a minimum.

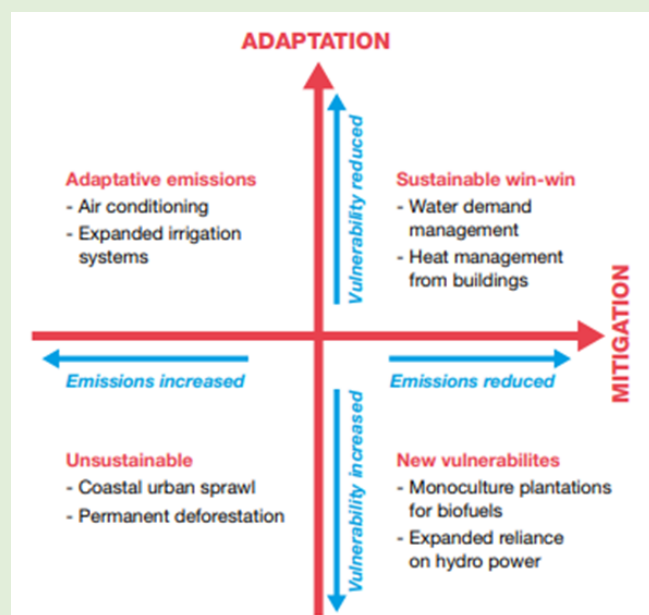
- If the result of the assessment is translated into an ITR metric, several trajectories corresponding to different temperature objectives are necessary. In order to maintain internal consistency, it is desirable that these trajectories come from the same model so that differences are only attributable to mitigation patterns, rather than exogenous hypothesis such as GDP growth.

Expert track: Climate-resilient low carbon development pathways

The importance of the mitigation portfolio. The IPCC SR1.5 report introduced the concept of “Climate-resilient low-carbon development pathways”, in line with the inclusion of considerations relating to the sustainable development goals and adaptation in the Paris Agreement. Indeed, the mitigation portfolio of each scenario, i.e. the types of measures considered and hypothesis around their scale and costs, can lead to a range of trade-offs and synergies between decarbonization, adaptation, and the SDGs.

Most 1.5 °C trajectories have robust synergies for SDG 3 (health), 7 (clean energy), 11 (cities and communities), 12 (responsible consumption and production), and 14 (oceans). Some 1.5 °C trajectories show potential tradeoffs with mitigation for SDGs 1 (poverty), 2 (hunger), 6 (water), and 7 (energy access). In particular, 1.5 °C and 2 °C trajectories often rely on the deployment of large-scale land measures like afforestation and bioenergy supply, which if poorly managed, can compete with food and hence raise food security concerns. This largely depends on local conditions as well.

Figure 45: Examples of adaptation and mitigation trade-offs and synergies (I4CE, 2019)



Therefore, it is possible to identify “contentious” mitigation technologies that might, under certain conditions, lead to tradeoffs with other sustainable development issues. As trajectories hardly integrate local effects and management quality, an investor can choose to avoid trajectories that rely on the deployment of these technologies to build their benchmark.

The logic is the same for potential trade-offs with adaptation: some technologies, such as expanded reliance on hydropower, may lead to increased vulnerability to climate change.

Multi-themes scenario? While an increasing body of work is extending climate-related integrated modeling to include a wider range of sustainability goals, this is an emerging field of research and few scenarios have been built to minimize holistically impacts on sustainable development that is taking climate but also other factors as the starting constraint. As put by the IPCC, full integration of mitigation, adaptation, and sustainable development is challenging given the “need for a high temporal, spatial, and social resolution to address local

The IMAGE Model of PBL Environment can be used to explore trajectories that lead to sustainable development outcomes across multiple themes ([Van Vuuren et al, 2015](#)). However, this is targeted at policy-makers and has not been translated into an investor-user friendly format. To our knowledge, the only scenario that can easily be used by investors is the IEA WEO SDS scenarios that starts with selected SDGs constraints (although limited) then assesses the combination of actions that could deliver them: universal access to affordable, reliable and modern energy services by 2030 (SDG 7.1); a substantial reduction in air pollution (SDG 3.9); and effective action to combat climate change (SDG 13). This scenario is far from capturing all the necessary aspects to be considered “a climate-resilient low carbon development pathway” but it is a first step.

Choice 2: Are existing scenarios adapted to temperature alignment assessments?

Three categories of scenarios. The different types of scenarios and trajectories available to investors in the context of portfolio temperature alignment assessment are classified into three categories: agnostic trajectories as provided by the IPCC RCPs; technology and economy scenarios; and political

scenarios based on countries’ nationally determined contribution. Each of these types of scenarios has pros and cons. It is beyond the scope of this report to review in detail the specific hypothesis and worldviews upon which different scenarios are built. The reader that wishes to know more about this can refer to IIGCC, I4CE, TCFD, SBTi and Shift Project reports amongst others publications ([CDP, Global Compact, WRI & WWF, 2020](#); [IIGCC, 2018](#); [I4CE, 2019](#); [TCFD, 2017](#); [The Shift Project, 2019](#)).

Table 31: Summary of the pros and cons of different scenarios (non-exhaustive). Greenpeace, Irena, and DDPP scenarios are grouped in the “other” category. Political scenarios based on a country’s NDCs are excluded as they are conceptually different (see the relevant section for an explanation of why).

Criteria	IPCC RCPs & SSPs	IEA ETP & WEO	Other
Update frequency			Apart from Remap that is yearly
Geographic disaggregation	Regional only	Relatively more granular	
Sector disaggregation	Energy & industry, land use		Varies but generally limited
Sector coverage			Varies, but generally energy production focus
Include non-energy emissions		Limited to energy demand and use. Assumes 0 emissions from land use and land-use change	Varies but generally not
Include non-carbon emissions			Varies but generally not
Different macro-economic futures in same scenario family			
Available for a range of temperatures	Yes but not 100% consistent		Varies but generally not
Reliance on CCS and bioenergy	Depends on the scenario	Yes, though scale depends on the scenario	Depends

1. Agnostic trajectories (RCPs). The « Representative Concentration Pathways (RCPs) » were derived by the IPCC to increase comparability across different lines of scientific work. The RCPs are averages of scenarios already-developed by the scientific community, of which certain parameters of the underlying models (land use, pollutants) have been harmonized to ensure consistency.

The RCPs offer a trajectory compatible with a given temperature objective - and are "representative" of the scenarios available in the literature. For example,

the RCP 2.6 is representative of a certain number of scenarios that limit the rise in temperatures below 2°C, and calculated based on the IMAGE model from PBL Environment.

The RCPs have been built originally to be a bridge between the work of transition and climatic scenario developers. Each RCP is not associated with a unique socio-economic scenario – it can be the result of different socio-economic, technological, political, and institutional combinations. This is why we label them “agnostic trajectories”.

Table 32: RCPs to 2100 ([I4CE, 2019](#))

	Radiative forcing	GHGs concentration	Temperature increase in °C	Evolution of GHGs concentration
RCP 8.5	8.5 Wm ²	1 350 ppm	4.3 (3.2 – 5.4)	Increased emissions until 2100
RCP 6	6 Wm ²	850 ppm	2.8 (2 – 3.7)	Increased emissions then stabilization in 2100
RCP 4.5	4.5 Wm ²	650 ppm	2.4 (1.7 – 3.2)	Slight increase, decrease from 2050, stabilization from 2100
RCP 2.6	2.6 Wm ²	450 ppm	2 (0.9 – 2.3)	Peak in 2020 then constant decrease
RCP 1.9	1.9 Wm ²	< 450 ppm	1.5	Fast and continuous decrease until 2100

The potential combinations of different socio-economic factors and their compatibility with different temperature trajectories have been explored by the IPCC through the concept of “shared socio-economic pathways”, which “provide narratives and quantifications of different world futures across which

scenario dimensions are varied to explore differential challenges to adaptation and mitigation ([IPCC, 2018](#)).” SSPs characteristics are then used as inputs into integrated assessment models that derive trajectories compatible with each RCPs, where possible.

Advantages and limitations in the context of portfolio temperature alignment assessments.

- Data can be retrieved on the IIASA website ([link](#), [link](#) and [link](#)) and representative pathways can be recalculated based on users' requirements (e.g. exclude pathways with high reliance on CCS).
- In particular, the IPCC 1.5 SR report provides a 1.5 °C trajectory with no or limited overshoot, most suitable for capturing compatibility with the temperature objective of the Paris Alignment, especially the P1 illustrative pathway that does not rely as much on carbon removal technologies.
- Easier to use in sector-agnostic assessments as emissions data is not systematically well-disaggregated. For example, emissions data can be disaggregated between energy and industrial processes, industry, electricity supply, and transportation ([CDP & WWF international, 2020](#)).
- Sector-specific physical and economic data (e.g. number of vehicles sold, revenue and value-add per sector) cannot be retrieved systematically for each solvable SSPs and RCP combination.
- Might be used for temperature alignment assessments as multiple trajectories correspond to different temperature levels. Results should be interpreted with care, as “differences between the RCPs, cannot be directly interpreted as a result of climate policy or particular socio-economic developments. Differences may very well result from differences between models ([Van Vuuren et al, 2011](#)).”

2. IEA scenarios and other developers. The International Energy Agency publishes each year two sets of scenarios in the World Economic Outlook (WEO) and the Energy Transition Perspectives (ETP) reports. Both sets are developed by different teams, use a different model, and have different objectives (energy policy and investment vs technological developments).

These have been widely used in the context of temperature alignment assessments given the output

data availability and granularity. Other institutions have developed their own scenarios, such as Greenpeace, the Deep Decarbonization Pathways Project and Irena Remap.

Contrarily to IPCC's scenarios, these models often artificially cut the timeframe before 2100. Therefore, the implied temperature and associated chance statistics partly rely on assumptions around what happens between the scenario end date and 2100.

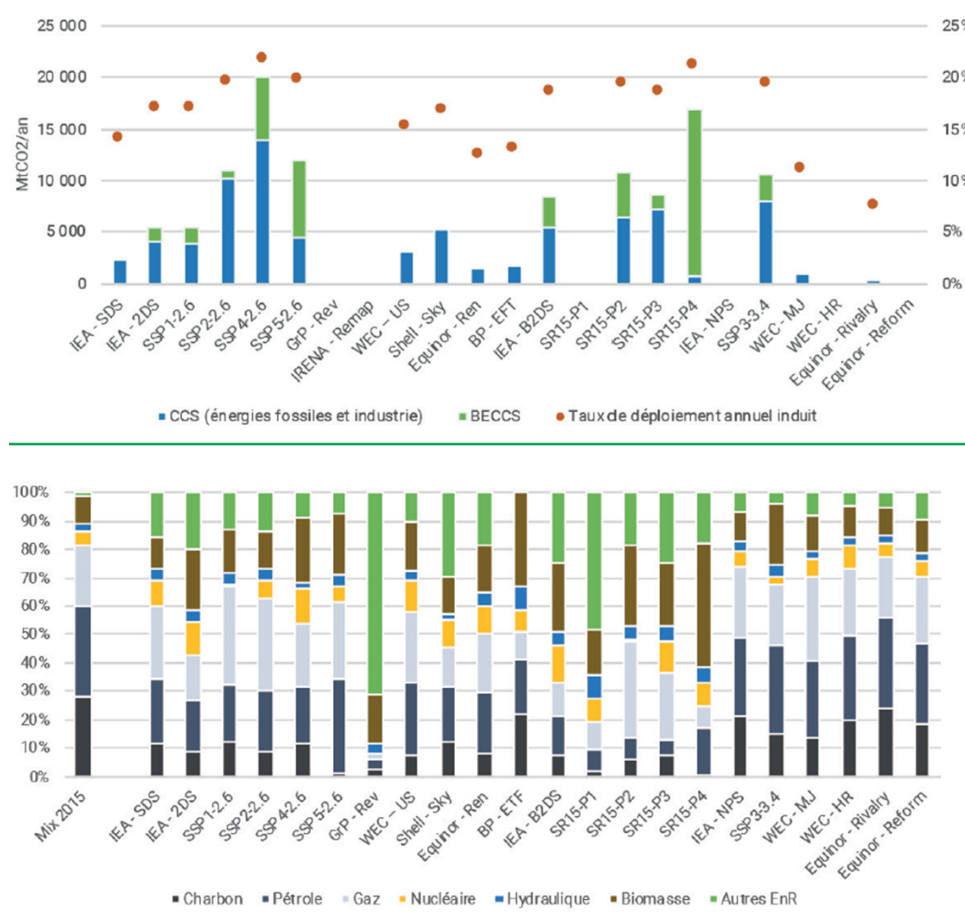
Table 33: Review of economic and technology scenarios ([IEA WEO](#), [IEA ETP](#), [IRENA REmap](#), [Greenpeace Energy Revolution](#), [Deep Decarbonization Pathways Project](#))

Scenarios	Description
IEA WEO family (latest WEO 2019, next publication in Nov. 2020, projections from 2010 to 2040 – 2050 for SDS)	
Current policies scenario	No new policies beyond those already in force; no peak emissions. Projected to generate 6 °C warming.
Stated policies scenario (SPS)	Previously the new policy scenario; government implement (most of) the policies they have already announced; world emissions slow but no peak before 2040. Projected to generate between 3 °C to 4 °C.
SDS (replaces 450s) Available since WEO 2017.	Governments implement policies sufficient to achieve the Sustainable Development goals on climate, energy access and air pollution; and on a path fully aligned with the temperature objective of the Paris Agreement. “1.8 °C with a 66% chance or 1.65 °C with 50% chance if emissions reach 0 by 2070 and remain at 0 thereafter. Reaching 1.5 °C based on this trajectory with a 50% chance would require carbon removals post 2050 (still lower than most IPCC 1.5 scenarios according to IEA).” Emissions peak before 2030 and decrease by 3.3% annually between 2018 and 2040. Emissions in 2040 at the lower range of 1.7 – 1.8 °C IPCC scenarios (with 66% chance) only if large amount of negative emissions later in the century.
IEA ETP family (latest ETP 2017, next publication in June 2020 on clean energy, projections from 2014 to 2060)	
Reference technology scenario (RTS)	Current commitments; average temperature increase of 2.7 °C by 2100 and temperature increase thereafter (no stabilization).
2 °C scenario (2DS)	Policies are introduced with a 50% chance to lead towards a 2 °C world. Annual energy-related CO ₂ emissions are reduced by 70% by 2060 (i.e. 1.5% annual decrease on average, calculated by the author of this report), with cumulative emissions of around 1 170 GGTCo ₂ between 2015 and 2100.
Beyond 2 °C scenario (B2DS)	Improvements and deployment of technologies that are already available or in the innovation pipeline are pushed to their maximum practicable limits across the energy-system to achieve net-zero emissions by 2060 and stay net zero or below thereafter, without requiring unforeseen technology breakthrough or limiting economic growth. Cumulative emissions of 750 GTCO ₂ consistent with a 50% chance of 1.75 °C. Available since 2017.
Greenpeace advanced energy (r)evolution (2012-2050)	Trajectory towards a fully decarbonized energy system by 2050: energy efficiency, large-scale integration of renewables, biofuels and hydrogen into the energy mix. Includes all final energy demand. No CCS technologies. Uses WEO Current Policy Scenario 2014 as the baseline. Aim to hold temperature increase to under 2 °C (peak 2020 then reduction). Latest 2015, 5 published since 2005.
Deep decarbonization pathways project (2010 to 2050)	Blueprints for change, sector by sector and overtime for each 16 countries to inform decision-makers of the technological and cost requirements of different options for meeting their country's emissions reduction goal. Some country analyses include non-energy carbon sources. Consistent with warming to less than 2 °C with a “better than even” chance. Latest report in 2015.
Irena REmap (2010 to 2050)	First published in 2016, latest in 2019 (yearly). Outlines a plan to double the share of renewables in the world's energy mix by 2030, starting with separate country analysis to determine their realistic potential. Focusses on energy generation only. Leads to 2 °C if the lower end of emissions reductions are achieved.

Advantages and limitations in the context of portfolio temperature alignment assessments.

- The higher level of sector-region disaggregation, sector-coverage (beyond energy production), availability of physical data, and frequent updates make IEA scenarios particularly popular for sector-based alignment assessment. In addition, the IEA publishes several scenarios based on the same models (either WEO or ETP family) leading to different temperatures, which therefore provides a consistent set of trajectories when expressing the results through an Implied Temperature Rise metric (ITR).
- Apart from Irena Remap, Greenpeace revolution (and the IPCC RC1.5 P1), all scenarios rely on a high deployment rate of carbon removal and storage and technology and lower renewable growth. While this makes these three scenario families particularly interesting for capturing compatibility with the temperature objective of the Paris Agreement, their outputs are less granular, cover fewer sectors, are updated less frequently, and may not provide several temperature trajectories from the same scenario.

Figure 46: Co2 captured and stored & energy mix in 2050 in different scenarios (The Shift Project, 2019). IEA scenarios all rely on the significant deployment rate of carbon capture and storage. Note that this is also the case for RCP2.6 pathways and three of the SR1.5 pathways. Only the Greenpeace, Irena and SR1.5P1 pathways do not rely on carbon capture and storage (graph 1). These three scenarios forecast a higher share of renewables in the world's energy mix in 2050 (graph 2).



3. Political scenarios. The Paris Agreement reversed the logic of anterior agreements, by allowing parties to determine their own national contributions in achieving the global temperature goal, rather than attempting to allocate the remaining budget using a top-down perspective. Countries have thus to publish short-term climate objectives (the nationally determined contributions of NDCs) that aim to be reviewed with increased ambition every five years, as well as long-term low greenhouse gas emission development

strategies.

Some data providers have therefore attempted to build scenarios and associated trajectories based on the currently-available climate objectives declared by each country in their NDC. While this allows scenario developers and users not to rely on the hypotheses and narratives of top-down scenarios as constructed and published by third parties, NDCs are very diverse and it is currently difficult to relate them to a given temperature objective as they have a short-term time

horizon and aim to be frequently reviewed ([WRI, 2015](#)).

Several studies, including the famous «Emissions Gap Report» from UNEP ([UNEP, 2019](#)), have attempted to estimate the level of temperature increase implied by the sum of all the NDCs as of now. Each of these studies concludes that the NDCs are not sufficient to keep the temperature increase below 2°C, but they differ on the estimate of the level of temperature increase the NDCs lead to - between 2.7 and 3.7°C. (3.2°C with a 66% chance according to the UNEP 2019 Emissions Gap report). Differences arise from the hypotheses that need to be taken in translating NDCs to a temperature level, including:

- Each NDCs have different time horizons. The 2°C temperature goal is to 2100. Therefore, how to extrapolate a country's emission trajectory after the NDC horizon up to 2100?
- Should conditional pledges be included? Pledges may be expressed in relative terms, such as per unit of GDP. It is necessary to make extra assumptions, around GDP growth e.g.

- How to project emissions for sectors and gases not covered by NDCs? How are land use and land-use change emissions accounted for?

Until the sum of all NDCs puts the world on a below 2°C trajectory, it is difficult to use these trajectories as 2°C benchmarks, without further assumptions and calculations. These trajectories can be used, with additional manipulations, to derive a “Paris Pledge” trajectories, corresponding to a temperature of 2.7 – 3.7°C, for temperature assessment.

Several organizations have put in place calculators that propose a repartition of efforts based on different interpretations of equity and can be used as 2°C benchmarks. These include the [Climate Equity Reference Calculator](#), [Climate Fair shares](#), [Paris Equity Check](#) or [Climate Change Performance Index](#). Some providers have also developed their own country-level trajectories that are statistically-derived to avoid subjectivity, such as Beyond Ratings (see p.117).

Advantages and limitations in the context of portfolio alignment and temperature assessment.

- NDCs cannot be used as such to derive 2°C benchmarks for temperature alignment assessment as they do not limit temperature rise under 2°C. Using them as inputs require extra manipulation, which creates uncertainty. NDCs are often used as forward-looking data in sovereign bonds temperature alignment assessment, whereby NDCs are used as “climate performance data” and national trajectories as given by different tools are used as pathways.
- Available tools provide a range of methods and criteria to derive “fair” and “ambitious” trajectories for different countries and regions. An alternative is to use the most likely outcome of the negotiations, as statistically derived by providers such as Beyond Ratings ([Beyond Ratings, 2018](#)).

Expert track: using IEA scenarios in temperature alignment assessments

The higher level of sector-region disaggregation, sector-coverage (beyond energy production), availability of physical data, and frequent updates make IEA scenarios particularly popular in the context of alignment assessments that rely on sector-specific trajectories. Besides, the IEA publishes several scenarios based on the same model leading to different temperatures, which therefore provides a consistent set of trajectories for expressing the results with an Implied Temperature Rise (ITR) metric. As a consequence, the IEA ETP and WEO scenarios are the most often used scenarios in temperature alignment assessments.

However these scenarios may not be the best suited from a conceptual perspective when attempting to capture compatibility with the temperature objective of the Paris Agreement.

There is a tension between the need to derive sector- and company-specific benchmarks and the availability of ambitious-enough scenarios. The IEA has been historically criticized for missing the renewable trend and relying too heavily on carbon removal technology. This makes this family of scenarios less suited to capture compatibility with the temperature objective of the Paris Agreement, as the decarbonization curve is less ambitious in the short term compared to scenarios that do not rely on carbon removal and forecast a much

stronger penetration of renewables (see below). Other scenarios, such as the Irena REmap, Greenpeace Revolution, and RCP1.5 P1 are more suited from that perspective but less granular, cover fewer sectors, are updated less frequently, and may not provide internally-consistent several temperature trajectories from the same scenario.

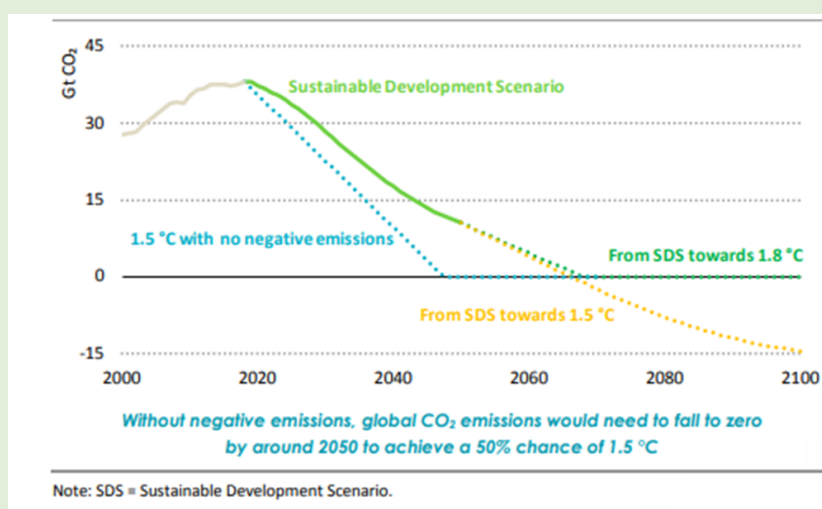
Research has shown that the IEA 2DS only has a 50% chance of limiting temperature under 2 °C. The SDS and B2DS have a 66% chance of limiting temperature under 2 °C – which makes them more suitable to assessment that has for objective compatibility with the Paris Agreement temperature goal (ETP 2017).

However, the B2DS (ETP 2017) scenario rely on carbon removal technologies that can lead to potential trade-offs with the sustainable development objectives (afforestation and bio-energy) and maladaptation challenges (hydro-power) if not well-managed.

The SDS (WEO 2019) takes into account co-benefits such as access-to-energy and air pollution reduction and does not rely on bioenergy with carbon capture and storage. Yet, the SDS assumes that emissions reach net 0 in 2070 (compared to 2050 for 1.5 °C with no negative emissions) and stay at 0 thereafter for the 1.8 °C with 66% chance statement to be true. To reach 1.5 °C, it relies on large negative emissions post-2070. Therefore, the trajectory is less stringent than the IPCC 1.5 °C with no or limited overshoot and no negative emissions.

In addition, production and carbon data is not as disaggregated as within the B2DS, though, making it less easy to use directly or requiring the user to combine multiple datasets (e.g. WEO and ETP), potentially leading to consistency issues.

Figure 47: Emissions trajectories for total Co2 emissions in the Sustainable Development Scenario and to limit warming 1.5 °C (WEO 2019)



Choice 3: Adapting third-party derived scenarios and temperature trajectories?

Third-party derived scenarios were not developed to support portfolio temperature alignment assessments. Therefore, it is normal that the scope, focus, or outputs are not perfectly suited to be used directly as inputs in this type of assessment. **In light of this challenge, data providers and investors use in practice a range of combinations to adjust and/or derive 2 °C and other trajectories.** These combinations

seek to overcome the following challenges: 1. sector granularity; 2. inadequate temperature objective, 3. Integration of national plans, 4. taking into account avoided emissions, and 5. inadequate trajectory shape (table 34).

Adjusting and combining third-party derived trajectories raises consistency questions – and may not guarantee that the overall economy-wide carbon budget is respected.

- Scenarios and trajectories may lead to the same

temperature but have different certainty levels and assumptions built-in, in terms of GDP e.g. Therefore, using a trajectory from scenario A and another trajectory from scenario B to derive the 2°C benchmark for different sectors may not lead to comparable results.

- Even if two trajectories lead to the same cumulated carbon budget between 2020 and 2050, the yearly budget may be allocated differently. Therefore, when portfolio temperature alignment assessment is done over a shorter period (between 2020 and 2030 e.g.), combining trajectories from two different scenarios may not guarantee that the economy-wide budget is respected.

For example, the 2DS (ETP 2017) yearly decarbonization between 2020 and 2030 is c. 0.75% for the industry sector and 2.55% for other sectors (2.33% on average). This compares to 1.7% in RCP2.6. Therefore, using the RCP2.6 decarbonization rate for sectors that fall within the category “other sectors” of the IEA ETP may lead to a budget overshoot (1.7% vs 2.33%).

- Adjusting one trajectory on the basis of another one (e.g. scaling up or down) does not capture temporal and sectoral non-linearity.

Therefore, discussing and ensuring the consistency of trajectories, when not used directly, is key.

Table 34: How data providers and investors use and adapt scenarios to fit better the needs of portfolio temperature alignment assessments

Sector granularity	<p>The issue: Some providers or investors wish to use SDS WEO because it takes into account other environmental themes. At the time of writing, it does not have granular data for as many sectors as ETP. Most providers use the IEA ETP scenarios because of its output data granularity, despite its still incomplete sector coverage. To do so, providers often rely on the trajectories developed by the “Sectoral Decarbonization Approach” (SDA) which build on the IEA ETP. The SDA uses the International Energy Agency (IEA) low carbon scenarios (mainly the IEA ETP 2DS and B2DS) to draw carbon intensity trajectories for different sectors. SDA trajectories are progressively developed for the main climate intensive sectors.</p> <ul style="list-style-type: none"> • Already-existing: power, iron & steel, cement, aluminum, pulp & paper, commercial buildings and transport. • In Development: the oil & gas; financial sector; forest, land & agriculture; apparel and footwear; chemicals and petrochemicals sectors.
Combine trajectories taken from different scenarios	<p>Combine IEA ETP with RCP pathways; IEA ETP and WEO; IEA scenarios with internally-developed trajectories (outside of IEA modeling).</p> <p>This is the simplest way to “fill the gaps” when trajectories have not been developed yet for a specific sector and/or when the scenarios chosen (e.g. SDS) do not provide directly useable outputs for energy-relevant sectors. For example, the ETP 2DS trajectory is used for available sectors; the IPCC 2.6 trajectory (2 °C) can be used for others. It is essential to check the consistency of the used scenarios to ensure the overall carbon budget is respected, especially when the assessment is done over a shorter period.</p>
Various adjustments	<p>The Transition Pathway Initiative (TPI) uses sector-specific trajectories for the following sectors: airlines, autos, cement, electric utilities, oil & gas, paper, shipping and steel. In addition to using IEA trajectories where available and relevant, it makes various adjustments. For example (non-exhaustive):</p> <ul style="list-style-type: none"> • New trajectories: TPI uses ICCT scenarios for road transport rather than the IEA to take into account modal shift effects. • Split: Air transport trajectories relate to passenger transport in the IEA. TPI further splits the trajectory to include freight (c. 10% of sector emissions). • Intensity data: For the shipping sector, the IEA does not provide “activity data”. Therefore, TPI uses data from ITF to calculate intensity. • Adding a GHG: In the Oil and Gas sector, the IEA trajectories are used and complemented with methane emissions data from IPCC and EDGAR.
Sector and temperature coverage	<p>The issue: No IEA scenario has a 66% probability of limiting temperature rise under 1.5 °C.</p> <p>In addition, IEA scenarios only cover energy-related emissions. The land-use sector is not analyzed in itself.</p>
Adjust temperature and add one sector	<p>FMO, the Dutch Development Bank, worked with Navigant (formerly Ecofys) to derive a non-OECD 1.5 °C scenario. Indeed, at the time of assessment, the SR1.5 IPCC report was not available. Therefore, based on “leading 2 °C scenarios and key insights from the literature regarding the difference between 1.5 °C and 2 °C scenario”, FMO and Navigant followed the following analysis steps (FMO, 2019):</p> <ol style="list-style-type: none"> 1. Assess the carbon budget in line with 1.5 °C based on IPCC SR5; 2. Take existing 2 °C scenarios and translate them to a 1.5 °C scenario, based on scientific literature and the carbon budget available under 1.5 °C; 3. Split the 1.5 °C scenario into OECD and non-OECD based on IEA ETP; 4. Add a non-OECD scenario for Agriculture, Forestry, and Land-Use (AFOLU) from IPCC RCP2.6.
Integrating the geographical dimension	<p>The Issue: Most existing scenarios solve the temperature constraint using a least-cost approach, where the largest share of the reduction is allocated to sectors/ countries with the lowest marginal cost. However, other criteria will in reality influence the specific decarbonization trajectories of sectors and countries across the globe.</p>
Use National strategies to 2 °C derive trajectories	<p>The ACT (Assessing Low Carbon Transition) Initiative of CDP and ADEME, together with ClimateCHECK, 2° Investing Initiative, and the EIB, was developed to assess corporates’ climate strategy of various size and activities in the face of the low-carbon transition. Part of the grading process includes computing an action and commitment gap between the company’s performance and the relevant sector-specific decarbonization trajectory.</p> <p>In 2017, 30 small and medium French companies in the electricity generation, retail, automobile manufacturing, transport, and building and food sectors participated in a pilot. Instead of using the IEA ETP scenarios as for the pilot test of multinationals, the working group adapted the French Low Carbon National Strategy (SNBC) to derive the alignment benchmark. This was possible because the French SNBC is granular enough to build sector-specific trajectories. This may not be the case for all countries (ADEME & CDP, 2018).</p>

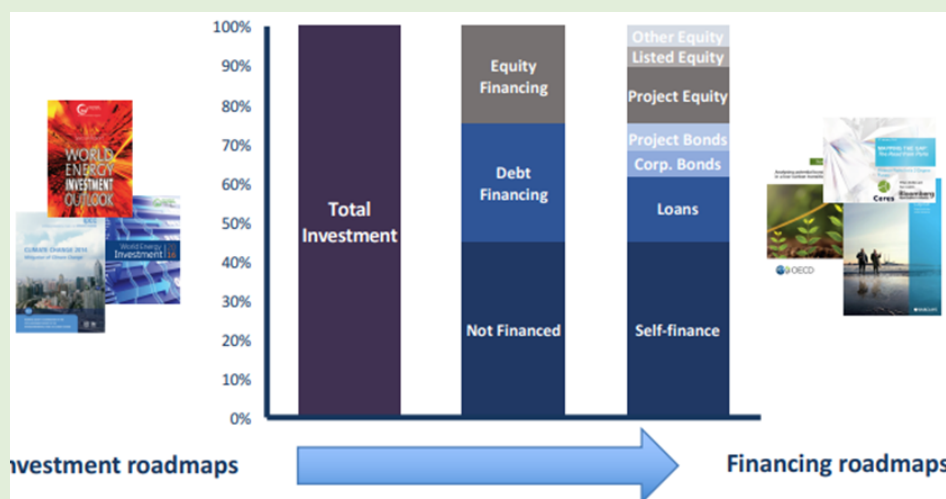
<p>Build new scenarios & trajectories</p>	<p>Beyond Ratings built its own 2°C trajectories at the country level through statistical analysis (CLAIM model) that “do not rely on any normative judgment about the [distribution] criteria”. [...] “It computes the allocation of 2°C compatible national carbon budgets which have a priori the highest probability of emerging from international discussions, whatever being the criteria on which the latter might be based. [...] In particular, it avoids the pitfall of arbitrarily assigning weights according to, for example, “capacity” or “responsibility” criteria, and simultaneously unifies the different methodologies that have been proposed in the literature aiming at setting national GHG budgets (Beyond Ratings. 2018).”</p> <p>The model is also declined at sector-level within the Climate Technology Compass (Beyond Ratings. Climate-Kic & 2° Investing Initiative). It covers eight sectors with a 2030 temporal horizon: power generation, automobile, aviation, shipping, agriculture, and cement, steep, residential, and commercial real estate. This opens the possibility to perform integrated corporate- sovereign alignment assessment using a set of consistent scenarios.</p>
<p>Avoided emissions</p>	<p>The Issue: Macro-level trajectories cannot be used as such to compute micro-level benchmarks that take into account avoided emissions.</p>
<p>Recalculating the temperature benchmark</p>	<p>Mirova takes into account both Scope 1, 2 and 3 emissions as well as avoided emissions in its assessment. As the assessment compares the relative distance between climate performance levels corresponding to different temperatures, the institution needs to adjust the trajectories as given by external scenario developers to make them comparable with the calculated portfolio climate performance (Mirova. 2019).</p> <ol style="list-style-type: none"> 1. First, trajectories are expressed per unit of investment needed, based on the IEA and IPCC. Mirova classifies each sub-sector into “brown” (fossil fuels), “green” (renewable & low-carbon energy, energy efficiency & batteries) and “neutral” (transmission & distribution networks). 2. Based on its analysis of the MSCI World, assumed to be representative of the global economy, Mirova estimates that investments in “brown” categories generate 800 tCo2e/M€ enterprise value; “green” categories lead on average to 130 t/Co2e/M€ in avoided emissions. The ratio of “green”/“brown” investments corresponding to different scenarios and temperature is converted to an avoided/induced ratio. 3. By plotting avoided/induced ratio against the temperature level it leads to, Mirova derives an equation against which portfolio climate performance can be plotted to derive a temperature indicator.
<p>Unsuited trajectories shape for specific use cases</p>	<p>The Issue: As highlighted throughout this chapter, most scenarios rely on the use of carbon capture and storage technology as well as large amounts of carbon removed, thereby allowing an emissions overshoot on the shorter term.</p>
<p>Rebuild trajectories based on a range of scenarios</p>	<p>CDP and WWF International (2020) rebuild temperature trajectories based on the IPCC 1.5 scenarios dataset, to ensure that the derived benchmarks meet their pre-defined criteria:</p> <ul style="list-style-type: none"> • The integrated Assessment Modelling Consortium compiled a database of 400 scenarios produced by models across different experimental frameworks (cover a wide range of temperature outcomes); • Filter scenarios based on their peak emissions year and maximum annual CDR, resulting in 56 unique different scenarios sets; • Remove baseline scenarios; • Develop regression-models for each unique combination of key scenario variables or benchmarks and for six key time horizons.

Expert track: Emerging scenario work for the corporate and investor community

Work on scenarios that holistically maximize mitigation, adaptation and sustainable development considerations was mentioned on p.108. Two additional emerging types of scenario work are highlighted.

Financing roadmaps. As mentioned, most data providers and investors currently use IEA ETP scenarios, which provide technology roadmaps. In order to make the assessment more relevant to investors, the next step would be to consider whether investors contribute to filling the financing gap to make this happen (vs. assessing their exposure as done in most methods today).

Figure 48: From investment to financing roadmaps (2° Investing Initiative, 2017)



2° Investing Initiative explored how financing roadmaps could be derived and used by investors, for example in portfolio alignment assessment. It is important to distinguish between investment roadmaps and financing roadmaps. Indeed, most scenarios, including the IEA's, provide investment roadmaps that define the level of CAPEX needed to follow the selected transition path as well as the expected sources of investments, but not the type of capital needed. Therefore, as put by the 2° Investing Initiative, turning CAPEX roadmaps into financing needs roadmaps requires two further steps:

1. Breaking down CAPEX volumes by type of capital based on the technology development stage;
2. Connecting capital needs to an ownership and financing structure.

A range of challenges need to be solved when doing so, including but not limited to the lack of annually-updated and technology-specific investment roadmaps and financing structures, as well as the additional uncertainty relating to the costs of technology deployment.

Removal trajectories. Carbon removals through natural or industrial technology play an important role in reaching net zero emissions by 2050 or 2070 and potentially compensating for emissions overshoot in the short run. The later and higher the carbon peak, the stronger our reliance on these technologies to limit temperature increase below 2°C.

Given that decarbonization is what is most needed in the short run, alignment methodologies focus on emissions reduction. However, as the topic of removal becomes more important in the future and as trajectories are being developed for sectors that could play an important role (e.g. land use, forestry, and agriculture), the question of developing carbon removals trajectories against which company and portfolio climate performance can be compared arises. The Science Based Targets Initiative is exploring this in its work on Agriculture. The Net Zero Initiative, led by Carbene 4, is also looking at the topic.

CHEESE PLATTER: DERIVING MICRO-LEVEL TEMPERATURE BENCHMARKS

In this section, how to derive micro-level temperature benchmarks from the scenarios and trajectories selected as part of Step 2 is reviewed. In step 4, the climate performance of a portfolio or a company (as calculated in step 1) is compared to its temperature benchmark to derive the temperature alignment results.

KEY TAKEAWAYS

This step involves several methodological choices:

How can temperature benchmarks be expressed?

Once the scenarios are chosen, data providers and investors use the output trajectories to derive sector-agnostic, sector-specific, or company-specific temperature alignment benchmarks. These benchmarks can be expressed in absolute or physical, intensity or economic intensity terms. Each of these has practical and use case limitations.

For example, absolute benchmarks are relatively better suited to capture compatibility with the temperature objective of the Paris agreement, as their use ensures better than other metrics that the overall carbon budget, itself expressed in absolute terms, is not surpassed. Intensity-based benchmarks (by a unit of production) are the best-suited to compare companies operating within the same sector – however, they can only be applied to a limited set of homogenous sectors.

How are macro-level trajectories distributed to micro-level actors? Macro-trajectories, as derived from selected scenarios, need to be translated to micro-benchmarks, either at the level of an investment portfolio or a specific asset. There are two potential ways to do so. The first method assumes

that the intensity and/or efficiency of different portfolios and companies need to converge by a given set date to the same climate performance. The second assumes that all portfolios and companies need to decarbonize, reduce their exposure to brown technologies, or increase their exposure to green technologies by the same rate.

The first approach, by convergence, has been historically used by the main company-level methodology recommended by the SBTi, the Sectoral Decarbonization Approach. It is best applicable to compare companies within the same sector regardless of their size and focusses on efficiency. However, it is only applicable to a limited set of homogeneous sectors and may lead to an overall increase in absolute carbon footprint if adequate checks are not put in place in the calculation protocol.

The second approach, by contraction, is easiest to implement on a large range diversified portfolio. However, if not adapted, it tends to favor laggards by not taking into account prior efforts of companies and portfolios to decarbonize and grow their green exposure. It also does not apply a differentiated rate based on responsibility and capacity. Potential ways to mitigate this methodological flaw are reviewed.

Choice 1: How to express micro-level benchmarks?

Once temperature trajectories as given by the chosen scenario(s) have been selected, they can be used as such or require additional modifications to be translated in the relevant metric, through normalization e.g. There are three main types of benchmarks: absolute, physical or economic intensity.

- **Absolute benchmarks**, depending on the alignment variable chosen, are expressed in absolute units, such as tonnes of GHGs or carbon or technology/ activity (kwh, electric vehicles).

- **Physical intensity benchmarks** express an absolute benchmark in relation to a unit of production, such as GHG per Kwh or Euro invested per kwh.

- **Economic intensity benchmarks** express absolute benchmark in relation to an economic or financial metric, for example revenue or value-added.

Why is it important? The key rule is that the benchmark is expressed in a comparable unit to the climate performance of companies and portfolios, to ensure internal methodological consistency. Therefore, the way the benchmark is expressed drives the results of temperature alignment assessments.

Table 35: Pros and cons of benchmarks types. For the relative pros and cons of the different metrics (carbon vs activity/ technology for example), please refer to p.86. For the relative pros and cons of the different intensity normalization metrics, please refer to p.124.

	Advantages	Limitations	Example metrics for benchmark
Absolute benchmark	<ul style="list-style-type: none"> • Relatively lower data needs; • Ensures that the overall carbon budget is respected, if the assessment horizon goes until the meeting of net zero emissions or if safeguards against carbon lock-in are applied. 	<ul style="list-style-type: none"> • Results driven by the largest company/position in the portfolio; • Benchmarks need to be restated as companies/ portfolio expand; • Improvements may be due to economic variations (e.g. decrease in activity) rather than actual decarbonization. 	<ul style="list-style-type: none"> • Absolute carbon footprint; • Kwh or electric vehicles.
Physical intensity benchmark	<ul style="list-style-type: none"> • Good for intra-sector comparison; • Reflects improvements independent of economic growth (decoupling). 	<ul style="list-style-type: none"> • Not applicable to inter-sector comparisons (necessary in sector-agnostic approach); • Need to be mixed with an absolute approach to ensure the overall budget is met; • Relatively higher data needs; • Harder to apply to diversified companies. 	<ul style="list-style-type: none"> • Carbon emissions per kWh produced, per cars sold, tons of cement, etc.
Economic Intensity benchmark	<ul style="list-style-type: none"> • Applicable to both inter and intra-sector comparisons; • Reflects improvements independent of economic growth (decoupling); • Suitable for companies that generate a diverse product and service mix. 	<ul style="list-style-type: none"> • Sensitive to price or value variations; • Need to be mixed with an absolute approach to ensure the overall budget is met; • High data needs (esp. for the denominator). 	<ul style="list-style-type: none"> • Trajectory is expressed in emissions per GDP; Technology per GDP • Micro-level benchmark is expressed in emissions per an economic unit, each with pros and cons (p.124).

Advantages and limitations of absolute benchmarks.

Using a benchmark expressed in absolute terms ensures that the final environmental objective, i.e. not going over the carbon budget or reaching a specific “green” production level, is achieved. For example, if every company or investment portfolios were aligned with an absolute 2°C benchmark, the carbon budget would not be surpassed, regardless of economic contraction or expansion. Therefore, this type of benchmark is more credible from an environmental point of view. However, this is true only if the assessment horizon goes over the full decarbonization trajectory or if safeguards to ensure the avoidance of carbon lock-in are applied.

The advantage of absolute benchmarks is also one of its main limitations. Indeed, these benchmarks are not sensitive to changes within underlying

companies. Hence, an improvement of the absolute GHG performance of a company could be caused by a decrease in production and not its actual efforts towards the transition. A growing company or “growth” portfolio may find it hard to stay within the absolute benchmark unless additional organic growth is zero-carbon.

Advantages and limitations of intensity benchmarks.

Benchmarks expressed in these terms enable the evaluation of the climate performance of different companies and how it decouples from economic growth. The yearly carbon budget is divided by a coherent economic or production unit to build average intensity under different temperature trajectories, against which companies or portfolio intensity are compared.

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Advantages and limitations of intensity benchmarks.

Benchmarks expressed in these terms enable the **evaluation of the climate performance of different companies and how it decouples from economic growth**. The yearly carbon budget is divided by a coherent economic or production unit to build average intensity under different temperature trajectories, against which companies or portfolio intensity are compared.

This type of benchmark does not necessarily guarantee that the overall absolute carbon budget is respected, or that the overall “green” production

objective is reached. Indeed, this type of benchmarks partly depends on future GDP or production, as used in the denominator. These variables are, in most of scenarios, exogenous variables. Therefore, if future GDP is under-estimated within the scenarios used, the benchmark is likely to be overestimated (higher carbon intensity is sufficient to limit temperature rise under a certain level), leading to a surpassing of the absolute carbon budget.

This is true both for intensity benchmarks per unit of production and per economic unit. However, there is an extra difficulty when using intensity benchmarks per economic unit. Widely-used scenarios, such as the IEA, forecast specific production growth rates for different sectors, in terms of energy produced or tonnes of materials manufactured. However, most scenarios do not provide sector-specific GDP growth data: therefore, sector-specific approaches that use this type of benchmark rely on the assumption that every sector grows at the same rate as the economy.

For example, as put in the SBTi manual, “GEVA only maintains a global emissions budget to the extent that the growth in value-added of individual companies is equal to or smaller than the underlying economic projections. [...] It depends on idealized conditions where all companies are growing at the same rate, equal to that of GDP, and GDP growth is precisely known” ([CDP, Global Compact, WRI & WWF, 2020](#)).

As a consequence, intensity benchmarks do not always guarantee the respect of the overall macro carbon budget or green activity objective unless specific safeguards are built in the methodology.

Expert track: Ensuring that intensity targets lead to absolute reduction – the SDA approach

At the company-level, the SDA method is used by companies to compute a sector-specific benchmark compatible with a 2°C temperature, expressed in production intensity terms. **The calculation protocol includes a safeguard to ensure that the absolute macro-budget is respected if the overall sector production is higher than what is expected in the scenario.** As put by Faria & Labutong (2019), “the mathematical formulation of the SDA ensures the global sector carbon budgets are conserved. Its allocation principle caps company activity levels so they do not exceed activity levels of the scenario.”

The following formula is used to derive a company's physical intensity target in year Y in line with its sector-specific convergence requirement by 2060:

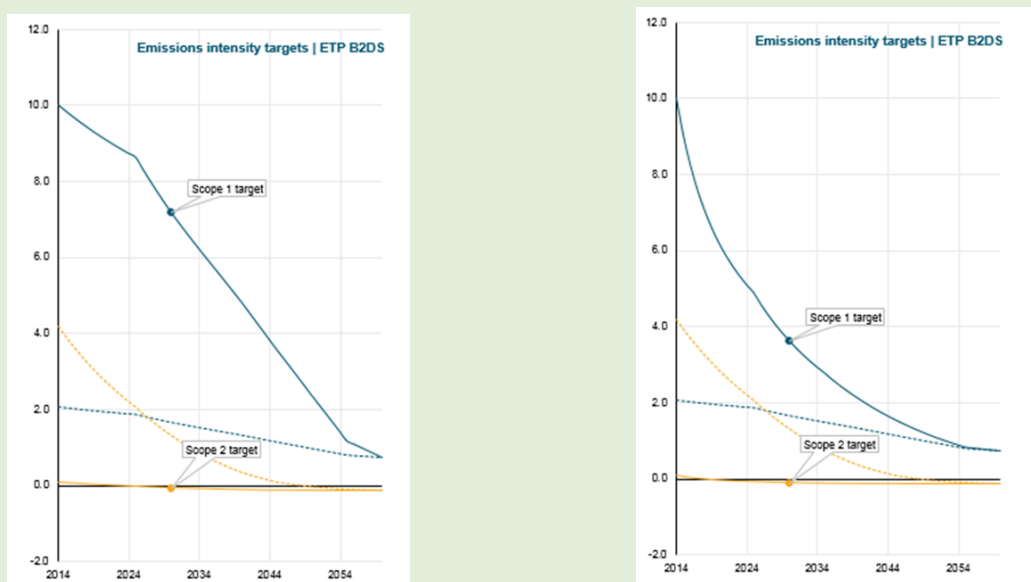
$$Cly = d * Py * My + SI2060$$

Where Cly= company efficiency target (or benchmark) in year y ; d = distance between company efficiency in the base year and sector efficiency in 2060; Py = remaining time until target end year; My = inverse of the change in production market share of the company relative to projected sector activity.

“My” decreases if a company's market share increases. Therefore, if the forecasted market share of a company increases relative to the projected sector activity, its “allowed” intensity target decreases and becomes harder to reach – see figures below.

However, this variable is seldom included, or calculated from a dynamic point of view, in data provider alignment and temperature methodologies that use physical intensity benchmarks. Indeed, it is very hard to collect this type of forward-looking and comparable data for all the companies in which a large investment portfolio is invested.

Figure 49: The effect of adjusting for the future market share. Example from the SBTi tool for a company operating in the aluminum sector. On the left panel, the company maintains a fixed market share to 2030. On the right panel, the company plans to triple production. Therefore, the formula adjusts its target to reflect higher production levels and ensure that the macro-budget is not surpassed (SBTi Tool, accessed in March 2020).





Comparison between physical and economic intensity benchmarks. Physical intensity benchmarks, based on production metrics such as Kwh or tons of cement produced, are considered “purer” –as they are not sensitive to price differentials and variations. Examples of sectors with volatile pricing include ([CDP](#), [Global Compact](#), [WRI & WWF, 2020](#)):

- Pharmaceuticals: the price of drugs can fluctuate based on demand, patents or regulations;

- Luxury brands in the auto or textile sectors e.g.;
- Commodity prices are set by trades on commodity exchanges.

Price variation can introduce noise when using economic intensity benchmarks: a company revenue could increase because of price increases, thereby leading to a reduction in intensity and better alignment, without actual changes in emissions happening.

Figure 50: The noise introduced by the use of economic intensity metric (vs physical intensity) (Sycomore AM, 2019)

Manufacturer			Observations
Model (both gasoline)	Smart FORFOUR 2	Land Cruiser Serie 150	the smallest is...
Consumption in l/100km	4.3	11.0	the most frugal is...
Emissions in g CO ₂ /km	97	248	the least emitting is...
Tare weight in kg	975	2 100	the lightest is...
Sale price in € excl. tax	10 000	50 000	the cheapest is...
Emissions in teq.CO ₂ /€M of annual sales	2 910	1 488	Carbon intensity depends on selling price ...
Emissions in teq.CO ₂ /year/€M invested	5 820	1 984	Carbon footprint depends on stock price ...
Emissions in g eq.CO ₂ /km/passenger	69	177	GHG impact per functional unit

Physical intensity benchmarks can only be derived for homogenous sectors for which a clear production metric exist and can be retrieved. Most alignment and portfolio temperature providers use different strategies to increase the sector coverage of their methodology:

- Certain methods only cover sectors for which a physical intensity trajectory is available. This represents around 20-30% of the market cap of an

average diversified portfolio but around 70-80% of their carbon footprints, for IEA-based trajectories.

- Other methods combine both approaches, using physical intensity benchmarks where possible and economic intensity benchmarks, per unit of revenue, for other sectors.
- Finally, some methods use only economic intensity metrics, even for sectors where physical intensity could be derived, to maintain consistency.

In focus: Deriving economic intensity-based benchmarks – what denominator can be used?

Emissions trajectories as provided by scenarios can be translated into economic intensity benchmarks – by dividing the absolute emissions reduction required to limit temperature rise under a certain level by forecasted GDP under that specific scenario. Therefore, to be comparable, the portfolio or company climate performance needs to be expressed as well as a function of an economic unit. **The question is: which type of economic unit should be chosen?**

The TEG report on Climate Benchmarks (TEG, 2019) highlights different economic metrics that can be used to normalize carbon emissions in the context of carbon footprinting. Each has its pros and cons.

- **Financial flow metrics**, such as revenue, allow for an intra-sector comparison of the emissions decoupling rate. However, cross-sector comparisons are harder because revenue multiples are not comparable and may favor “brown” sectors (e.g. coal sector have high revenue multiples).
- **Stock financial market metrics**, such as enterprise value, that allows for within-sector efficiency comparisons but is biased against companies with high intangible value (e.g. technology sector) and companies that have more cash (equivalents).
- **Stock financial accounting metrics**, such as total capital, that are sufficiently constant to allow for comparison across time but can be negative in certain instances.

Notwithstanding data availability considerations, as the temperature benchmark is expressed per unit of GDP, the most conceptually correct metric to normalize company or portfolio climate performance to make it comparable is value-added or gross-profit, potentially revenue as an imperfect proxy. The use of enterprise value may introduce additional noise, as changes in this metric are not necessarily linked to changes in value-added, but rather a modification of the equity/debt structure and market variables. For example, MSCI calculated that it’s provisional EU-aligned Climate Benchmark products had their carbon intensity per EV increase by around 25% within the recent oil price declines and COVID19 crisis (Responsible Investor, 2020).

Choice 2: How to derive the micro-level benchmarks?

Definition. Transition scenarios distribute the available carbon budget over time and/or sectors along different trajectories that if followed, lead to a given decarbonization and temperature limitation objective. **These macro trajectories need to be distributed to micro-actors to create temperature benchmarks that represent the temperature alignment objective,** for example in the context of target-setting. This step, called allocation, may be done in two ways.

- The approach by convergence is based on the hypothesis that the carbon intensity of companies operating in the same sector, including the financial sector, should converge at a certain time horizon. For example, the SDA uses 2060.

- The approach by contraction (or expansion) is based on the hypothesis that all companies and portfolios should either decarbonize, decouple, decrease their brown production and/or expand their green production at the same rate, regardless of their past efforts.

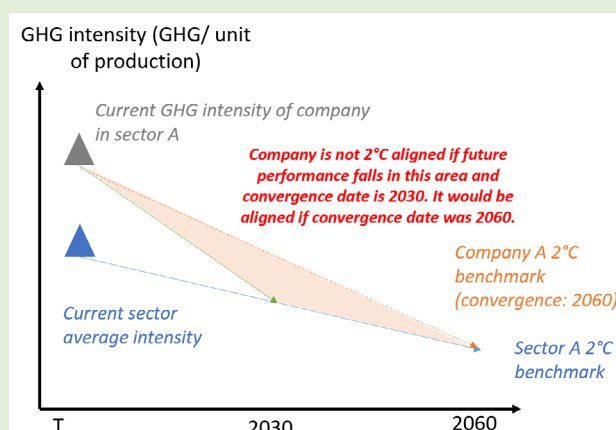
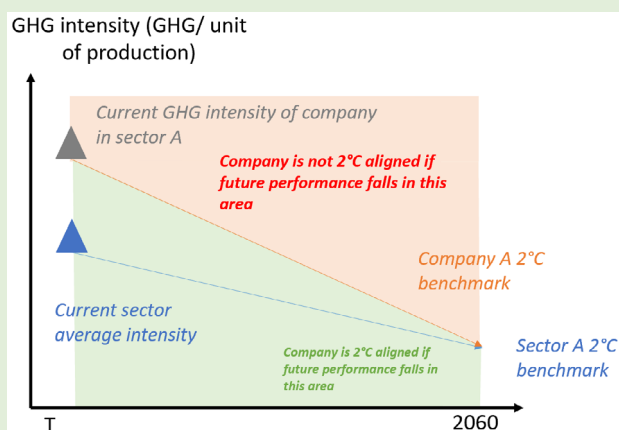
Expert track: The importance of the time horizon for convergence-based methods

Intensity benchmarks are constructed by dividing the absolute carbon budget by a normalization metric, expressed in physical or economic terms. Therefore, the benchmark represents the sector- or economy-wide intensity that needs to be respected to reach different temperature outcomes, on average. In practice, 1. some companies will be better or worse than the average, and 2. it is hard to expect all economic actors to have the same intensity given their idiosyncrasies.

Methods by convergence are based on the hypothesis that all companies within the same sector should converge towards the same carbon intensity in a given year. In the SDA method, the convergence is set in 2060 because this is the time horizon of the IEA ETP trajectories on which the method is based.

Therefore, it is essential to differentiate between sector-level and company-specific carbon intensity benchmarks: the decarbonization speed required for different companies within the same sector to be considered aligned is different depending on the company starting point – before 2060, a company can be considered “aligned 2 °C” even if its intensity is not equal to the benchmark, i.e. the sector average.

Figure 51: (Left panel) A company need not have a performance on, or lower the sector benchmark, to be considered 2 °C aligned; (right panel) The effect of using a shorter convergence time frame (Schematic, authors' view).



Some portfolio alignment and temperature methods use different convergence date hypothesis. For example, the TPI compares the forecasted carbon intensity of a company with the sector benchmark in 2030 – this supposes that all companies of the same

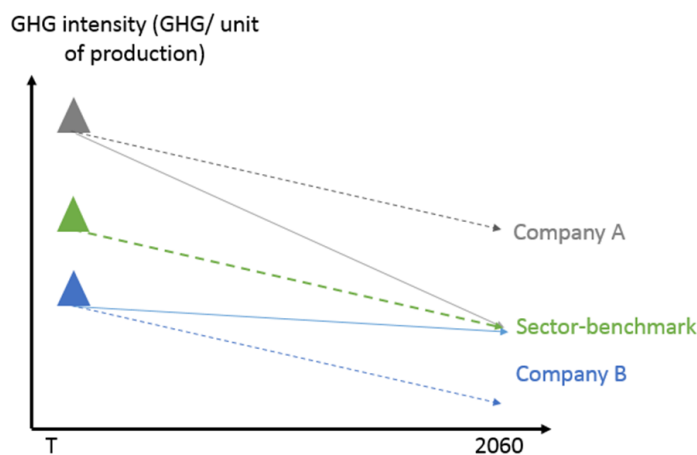
sector should converge in 2030 to be 2 °C aligned. The shorter the convergence time frame, the steeper the company-specific required decarbonization rate and the more weight put on current climate performance.

Advantages and limitations of the contraction and convergence approaches. Methods by convergence take into account the starting climate performance of companies and therefore recognize anterior decarbonization efforts. Hence, a company that already has significantly reduced its carbon footprint relative to its peers will have a lower decarbonization effort to do to reach the sector benchmark. Yet, the choice of the convergence year is subjective and directly drives the results. The convergence

hypothesis itself is disputable. Finally, this approach is harder to implement, in particular on a large range of companies.

On the contrary, a pure contraction method tends to favor companies that have not yet started to decarbonize, as each company needs to decarbonize at the same rate regardless of their past and actual performance. The contraction method is easier and faster to apply though, as it applies to all sectors.

Figure 52: The contraction method favors laggards. The plain line represents two company-specific trajectories for their intensity to converge in 2060 (convergence method). The dashed line represents the two company-specific trajectories when applying the contraction method. Company A that starts with higher GHG intensity, needs to decarbonize at a lower rate within the contraction approach than it would under the convergence approach, and vice versa. (Schematic, authors' view).



Expert track: calculating a “fair” contraction/ expansion rate.

Companies and portfolios of different sizes cannot be evaluated against the same absolute benchmark. Therefore, an approach by “absolute convergence” is conceptually impossible. Contraction is therefore the only possible method to translate macro trajectories to micro-benchmarks in absolute terms. Contraction methods can also be applied to assessments based on carbon intensity per economic unit.

The “pure” contraction or expansion approach imposes the same decarbonization/ brown activity reduction rates or green activity expansion rates to all companies based on their current climate performance, regardless of how good or bad vs peers. This approach favors laggards by not recognizing prior efforts made by specific companies. It can also be considered unfair or inefficient, as the same rate is applied regardless of the different decarbonization capability of companies.

Therefore, some methodologies have adapted the contraction approach to derive specific contraction/ expansion rates that take into account 1. The relative current climate performance of companies and/or 2.

Differentiated responsibility and capability. This involves the following steps:

- Calculate the current portfolio or company climate performance (carbon footprint, green/ brown technology exposure).
- Calculate the budget for each company under given temperature trajectories, based on a given distribution key, for example market share: if a company has 80% market share in a sector today, then it is attributed 80% of the carbon budget.
- Calculate the portfolio-specific or asset-specific contraction or expansion rate, taking as a starting point the current climate performance and its budget attributed as part of b.

Different types of distribution keys. As for the disaggregation of the overall budget to a specific sector, there are several ways to disaggregate sector-geography budgets to specific economic actors.

Table 36: Pros and cons of different distribution key of macro budget to micro actors (adapted from 2 ° Investing Initiative, 2019)

Distribution key	Pros	Cons
Fair share: Sectoral budget apportioned proportionally to market share (by revenue or production).	<ul style="list-style-type: none"> • Can be applied to a large universe with relatively low costs; • Can also be applied at the portfolio-level, where the global budget is allocated to a specific portfolio based on their relative contribution to value-added. 	<ul style="list-style-type: none"> • Quite crude: Does not take into account capacity, economic efficiency, or other criteria. • A higher market share by revenue may be due to higher prices and not higher production levels: following this approach, a luxury car manufacturer will have a higher budget than a conventional car manufacturer.
Economic efficiency/ least-cost approach: Sectoral budget apportioned based on relative cost/ efficiency. The better the efficiency/ lower the cost, the lower the budget.	<ul style="list-style-type: none"> • Conceptually close to the IEA ETP distribution key from global to technology budget; • Used for example by Carbon Tracker Initiative in its Stranded Assets thesis, using company-specific production costs. 	<ul style="list-style-type: none"> • Relies on more data and analysis; • More time-consuming to implement; • Not applicable at portfolio-level; • Does not take into account “responsibility”.
Historic responsibility approach: Sectoral budget based on ‘historic contributions’.	<ul style="list-style-type: none"> • Relevant in the context of climate litigation analysis in terms of liabilities for climate damage. 	<ul style="list-style-type: none"> • Does not take capacity and efficiency into account.
Bottom-up approach: Sectoral budget apportioned based on the individual positioning of each asset, taking into account physical assets, market position and other parameters.	<ul style="list-style-type: none"> • In depth asset by asset assessment. 	<ul style="list-style-type: none"> • More difficult, data-intensive and time-consuming to implement.

When the benchmark is expressed in technology/ production metric (see px), it is necessary to build several benchmarks that correspond to the different technologies. The PACTA method uses the “fair share approach” but adapts it depending on whether the technology needs to expand or contract.

- For example, the “**brown**” electrical capacity withdrawals required in the 2°C scenario are distributed based on **market share in the technology** considered. This ensures that companies with

higher “brown” technology share should retire these assets faster than a company with a higher “green” technology share, regardless of their overall market share.

- Targets for adding “**green**” electrical capacity are allocated based on the **overall market share**. This avoids laggards with a small or zero “green” market share not having to build out renewable power capacity and all of the responsibility falling on “green” market leaders.

DESSERT: PORTFOLIO TEMPERATURE ALIGNMENT ASSESSMENT

In this section, approaches are reviewed to combine the climate performance of a portfolio or company as measured in Step 1 and the benchmark(s) derived as part of step 3 to measure temperature alignment, potentially expressed through an Implied Temperature Rise (ITR) metric.

KEY TAKEAWAYS

This step involves several methodological choices:

How to measure temperature alignment? The climate performance of a company or portfolio can be compared with its benchmarks in two ways: static and dynamic.

Static alignment methods measure the performance gap between a company or portfolio climate performance and its temperature benchmarks at a specific point in time (2025 or 2030 e.g.). It helps answer the following question: how does the performance of a company or portfolio compare with what is expected to limit temperature rise under a certain level, in year t?

Dynamic alignment methods compare the evolution of a company or portfolio climate performance with the evolution that is expected under its temperature benchmarks, over a defined period (between 2020 and 2025 e.g.). Temperature alignment can be measured based on the relative trends or the cumulated over(under)performance, or over(under)shoot. Both will give the same results but complement each other. However, as they provide the cumulated performance in light of the carbon budget, dynamic alignment methods are most suited for an assessment that seeks to capture compatibility with the temperature objective of the Paris Agreement.

With what metric to express the results? The results can be expressed qualitatively, through a percentage difference or a score, and/or an Implied Temperature Rise (ITS) metric. The latter has been gaining

momentum in the last few years.

Most methods use interpolation to derive the ITR metric – i.e. compare the static or cumulated gap and/or trend of the portfolio or company under consideration with its derived benchmarks that, if met, limit temperature rise under a certain level. While different methods vary slightly depending on the type of temperature alignment approach, the philosophical underpinnings are similar.

How to reflect the different roles of sectors, companies, and portfolios in the low-carbon transition? Temperature alignment metrics are calculated relative to temperature benchmarks. Therefore, any company or investment may be aligned with a below 2°C trajectory regardless of whether it operates/ it is invested in a high stake or low stake sector.

This raises the questions: **is the 2.3°C of a media company equivalent to the 2.3°C of an oil & gas company in terms of their relative importance to the low-carbon transition? Is the 3°C of a portfolio only invested in media equivalent to the 3°C of a portfolio invested in the power sector?**

Some data providers and investors have therefore adjusted their methodology to reflect the relative importance of different sectors to the energy and low-carbon transition, by bounding the lower achievable temperature by sector, applying weightings, recalculating portfolio ITR to reflect sector allocation or imposing sectoral constraints.

Choice 1: Measuring the spread or speed?

Definition and assessment questions. The climate performance of a company or portfolio can be compared with its temperature benchmarks in two ways: static and dynamic.

- **Static alignment methods** measure the performance gap between a company or portfolio climate performance and what is expected under its

benchmarks at a specific point in time (2025 or 2030 e.g.). It helps answer the following question: how does the performance of a company or portfolio compare with what is expected in year t to limit temperature rise under a certain level? It does not judge the performance neither of the preceding nor of the following years.

- **Dynamic alignment methods** compare the evolution

of a company or portfolio climate performance with the evolution that is expected under its benchmarks, over a defined period (between 2020 and 2025 e.g.).

-The degree of alignment of a company or portfolio can be measured through trend metrics, reflecting the percentage reduction or increase of the climate performance between year t and $t + n$,

in comparison with the target percentage in a given trajectory.

- It can also be measured by absolute, budget terms, by comparing the cumulated absolute climate performance of a company or portfolio between t and $t + n$ with the target budget as required in a given trajectory.

Table 37: Examples of metrics to measure alignment under a static and dynamic approach (observed)

Approach	Example of metrics
Static	<ul style="list-style-type: none"> • 20% of GHG emissions above the carbon budget determined by a 2 °C trajectory, in 2025; • 1000 t GHGs per thousand euros invested vs 500 t in the 2 °C trajectory, in 2025; • 30% of renewable energies vs 35% expected as part of the 2 °C trajectory, in 2025; • 100 MW of renewable capacity vs 300 MW in the 2 °C trajectory, in 2025; • This difference results is equivalent to a portfolio temperature of 3 °C, in 2025.
Dynamic	<p>Trend (relative)</p> <ul style="list-style-type: none"> • 5% annual reduction of the portfolio's carbon footprint between 2020 and 2025 vs 7% expected; • 15% reduction in the cumulative carbon footprint between 2020 and 2025 vs 20% expected; • 5% reduction in the carbon footprint per million euros invested between 2020 and 2025 vs 10%; • 20% increase in renewable energy capacities funded vs 30% expected between 2020 and 2025; • This trend is reflected in a portfolio temperature of 3 °C between 2020 and 2025. <p>Cumulated yearly budget (absolute)</p> <ul style="list-style-type: none"> • Between 2020 and 2025, the portfolio has a carbon budget of 1m per tonne/year, i.e. 5m tonnes. Cumulatively, the portfolio is responsible for the emission of 6 tonnes, or 20% more. • Between 2020 and 2025, the expected carbon intensity is 10t / mEUR invested, every year. On average, the portfolio's carbon footprint is 15t / mEUR invested, which is 50% higher. • This cumulated overshoot/undershoot is reflected in a portfolio temperature of 3 °C between 2020 and 2025.

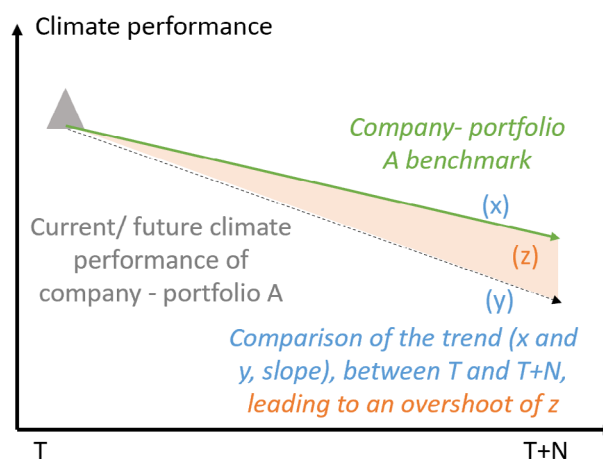
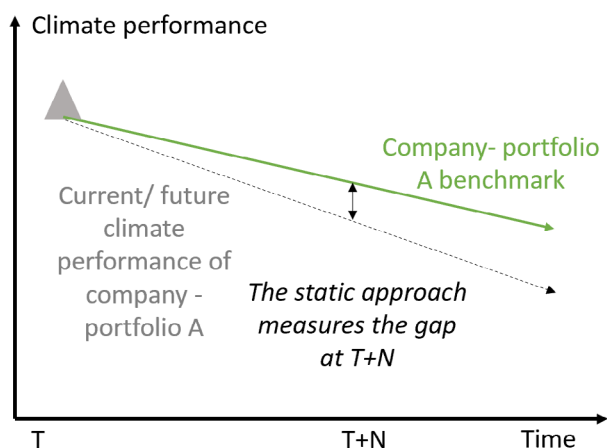
Because forward-looking data tends to be estimated linearly, absolute and relative dynamic alignment assessments, by budget or by the trend, give the same average result on the degree of alignment of a company or portfolio, as long as both are based on the same frequency of assessments - it is just expressed differently.

- Within a dynamic assessment using trends, the rate of change in climate performance of a company or portfolio climate performance is compared to its temperature benchmarks. It answers the question: is the direction and rate at which the company or the

portfolio climate performance change between t and $t+n$ sufficient to reach a certain target?

- A dynamic assessment by budget calculates the degree of overshoot or undershoot of the climate performance of a portfolio or company due to the mismatch in trends. It answers the question: what cumulative overshoot or undershoot does the differential in trend leads to? For example, between 2020 and 2030, the carbon emissions of this portfolio are 150 % higher, cumulatively, than its "budget". The assessment can also be expressed in technology exposure.

Figure 53: The difference between static and dynamic (absolute and relative) approaches (schematic, authors' view).



A company or portfolio can over- or under-shoot its budget or required yearly decarbonization rate within a given year, irrespective of its performance in previous years. **If the objective of the assessment is to capture compatibility with the temperature objective of the Paris Agreement, it is necessary to use a dynamic approach, in order to ensure that the overall carbon budget is met.** Indeed, it is the cumulated performance that matters in light of the carbon budget, rather than

the point-in-time gap relative gap between climate performance and its benchmark(s). In view of creating a most accurate picture, the assessment frequency is also of importance, especially for assessments over a long time horizon. In practice, method providers and investors have used a combination of static and dynamic approaches to capture different aspects of the story.

Figure 54: Review of the approaches chosen by different methods (non-exhaustive, alphabetical order)

Method	Spread or spread, cumulative or trend
ACT (quantitative part of the score)	Gap method: Static, gap assessment at point t + n. <ul style="list-style-type: none"> • Commitment gap: target vs Benchmark in 2025 • Action gap: Intensity vs Benchmark in 2020 Trend method: Dynamic, based on trend between t and t+5. Dynamic method by budget between 2015-2050 for locked-in emissions. GHGs, efficiency metric & absolute emissions for ratio method.
CDP-WWF Temperature Rating	Dynamic, by trend over the target time horizon. Differential in trend is expressed by temperature indicator directly.
EcoAct target temperature	Dynamic, by trend between the target base and end year. Differential in trend is expressed by temperature indicator directly. Absolute GHGs.
I Care & Consult SB2A	Dynamic, cumulated, between 2010 and 2050. Expressed in 1. % overshoot/ undershoot, 2. converted in temperature. Physical intensity metric.
PACTA 2 ° Investing Initiative	Multiple. <ul style="list-style-type: none"> • Relative current technology exposure gap; • Trend comparison; • Relative future technology exposure gap (t+5). Absolute technology metric.
right. based	Dynamic approach, cumulated, between 2018 and 2050. Economic intensity metric.
Transition pathway initiative	Static approach, gap assessment in 2030 or latest year of company's available data (performance or target). Oil & Gas: 2050. Physical intensity metric.
S&P Trucost SDA - GEVA	Dynamic, cumulated, between 2012 (or latest available) and T+5 (currently 2025). Expressed in 1. % overshoot/ undershoot, 2. converted in temperature. Physical or economic intensity metric depending on sector.

Choice 2: How to express the results of temperature alignment assessments?

A range of temperature alignment metrics. The results of the portfolio temperature alignment assessments can be expressed through various indicators. In its review of Article 173 reporting, I4CE counted three different families of metrics that have been used by insurers so far ([I4CE, 2018](#)):

- **Aligned vs not aligned with a 2°C trajectory:** the largest number of insurers reviewed published qualitative results, through a short explanation, in certain cases detailed at the sector-level (e.g. aligned for the utility sector, not aligned for the energy production sector). While this provides interesting

information, it remains partial and aggregated interpretation is difficult to interpret.

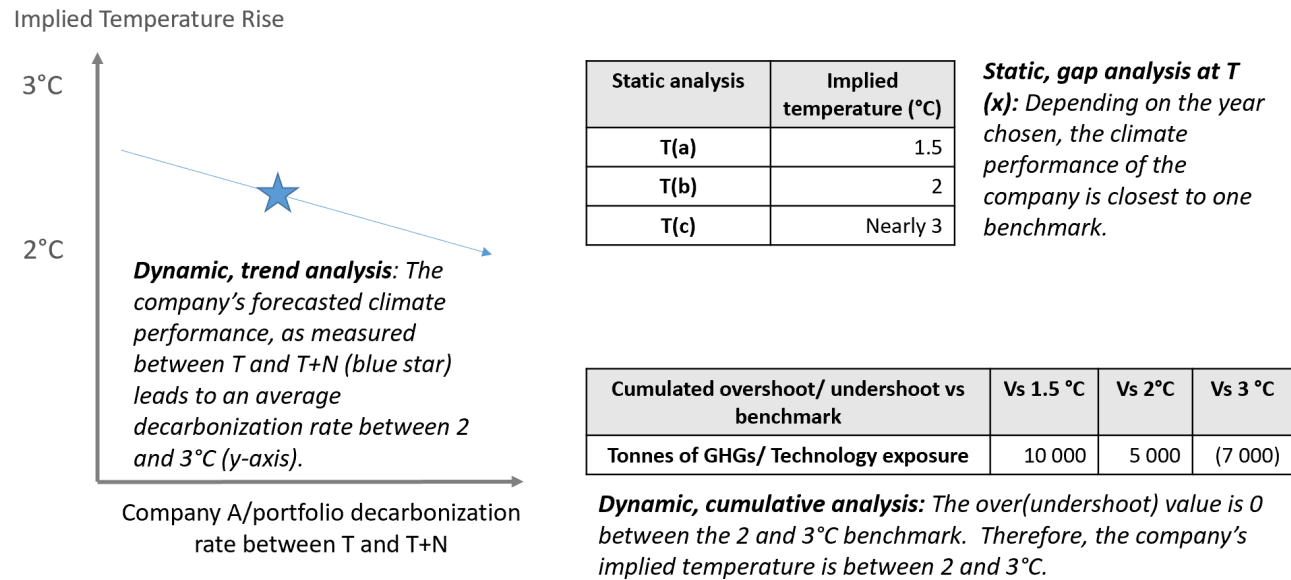
- **% overshoot/ undershoot** (for static or dynamic assessments using a cumulative approach) **or % deviation in trend** (for dynamic assessments using trends) relative to one temperature benchmark. The % overshoot/ undershoot is sometimes also given in absolute numbers (e.g. MW, carbon emissions, CAPEX), a ratio (150%, i.e. 50% overshoot), or a score.
- **Implied Temperature Rise (ITR):** this metric expresses the result of the temperature alignment assessment in a way that relates to the international temperature goal and that appears easy-to-communicate and comparable through time and companies/ portfolios. This metric is reviewed in detail below, including the differences in methodologies,

showing that in practice it is hard to use it for comparative purposes. Uncertainties embedded in this metric are also discussed.

How is the ITR metric computed? Most methods use interpolation-based methods – that is compare the static or cumulated gap and/or trend of the portfolio

or company climate performance with derived temperature benchmarks. While the calculation protocol varies slightly depending on the type of temperature alignment approach, the philosophical underpinnings are similar. Figures 55 below highlight how this is done for the different types of alignment approaches.

Figure 55: Deriving an ITR based on the temperature alignment approach chosen (schematic, authors’ view)



Whether the translation of the degree of (mis) alignment to an ITR metric is informative remains debatable. First, the extent of the (over)undershoot above a benchmark that represents the desired temperature trajectory (e.g. 2°C) is more actionable than an ITR metric as it highlights the extent to which emissions need to be reduced, or “green” activities expanded, to be 2°C-aligned. Second, as explained above, the ITR metric is derived based on the extent of the overshoot between the climate performance of a company or portfolio and a temperature benchmark. Therefore, both indicators are often available in methodologies that compute an ITR metric. **Why then use the ITR metric?**

One can argue that it is easier to communicate to a wider range of stakeholders because it creates a graphic system of equivalency with the international temperature rise limitation objective. On the other hand, it is worth recognizing that temperature alignment approaches are very simplistic in comparison to IPCC climate models and work: therefore, this system of equivalency is approximate at best, misleading in the worst cases for a range of reasons reviewed below.

- **Time myopia:** First, both static and dynamic temperature alignment assessments are very

dependent on the year of assessment/time horizon chosen.

This is especially true of static assessment that can give completely different results depending on the year chosen (see figure 56). However, even dynamic assessments suffer from time myopia. **When the results are translated into an ITR metric, it is implicitly assumed that the rate of change and/or cumulated overshoot have been the same and will remain the same prior/post-assessment date.**

Why is that? To understand, it is necessary to go back to how benchmarks are built. They are built based on trajectories issued from scenarios. These trajectories are associated with a remaining carbon budget from the starting date of the scenario to 2100, as this objective relates to limiting temperature rise below 2°C to 2100. Therefore, strictly speaking, the overshoot or trend of a company would need to be calculated from the start date of the scenario to 2100.

Start date. The starting point of a scenario, 2014 e.g. for IEA ETP 2017, is most often anterior to the latest available company-level reporting (2018) that is used to calculate current company or portfolio-level climate performance, because of lags in compiling average global emissions in any given year and deriving

scenarios. If the temperature alignment assessment starts in 2018, it does not capture what happened between 2014 and 2018, which is still relevant from a carbon budget perspective. The issue is similar when measuring the trend (see figure 56 for a graphic representation).

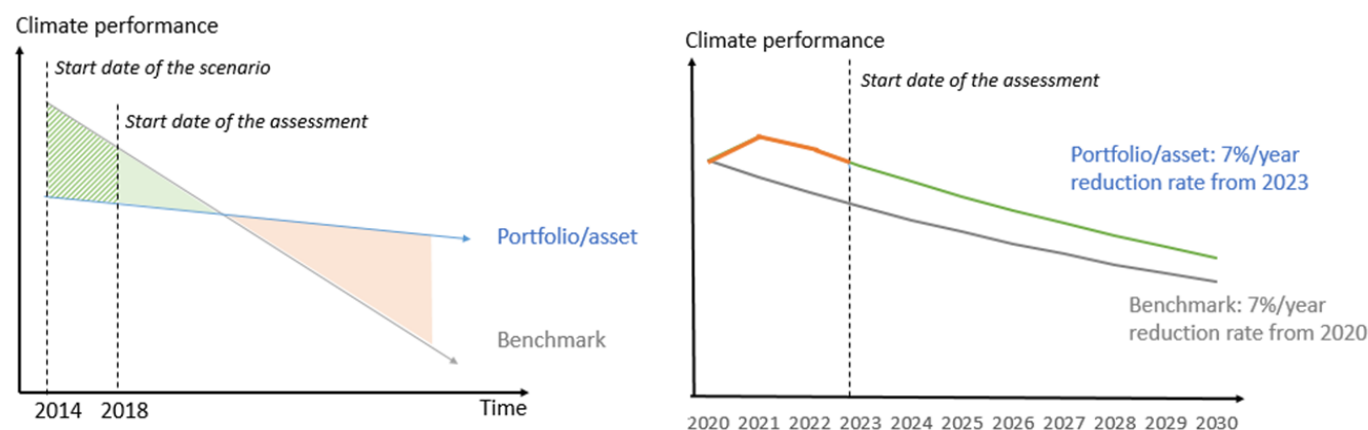
End date. The over(under)shoot or difference in required decarbonization trend is calculated between T and T+N, say 2018 and 2030, relative to a benchmark

built to 2060 (IEA ETP 2017) or 2100 (IPCC). Therefore, it is implicitly assumed within the ITR metric that the over(under)shoot will stay stable post-assessment date to 2100. Note that IEA scenarios themselves rely on hypotheses regarding what happens post-2050 or 2060 to assign temperature and probability levels to its scenarios: for example, the 2017 SDS scenario leads to 1.8°C with a 66% probability if net emissions remain at 0 post-2060.

Figure 56: The effect of using an assessment start date different than the scenario's start date in a cumulative dynamic assessment. In this example, the assessment starts in 2018, whereas the scenario starts in 2014.

(left panel: cumulative) Between 2018 and 2060, the portfolio overshoots its budget: the red area is larger than the plain green area. However, that overshoot is smaller when taking into account 2014 - 2018 (dashed green area).

(right panel: trend) The required decarbonization trend is 7% per year between 2020 and 2030 under a 2°C scenario (benchmark). If the assessment starts at a later date (2023 below), even if the decarbonization rate is 7% per year between 2023-2030, this may still lead to an overshoot because of what happened before 2023.



- **System myopia:** Second, the temperature metric assumes that everyone else (portfolio/ companies/ parts of the economy not captured by model e.g. citizens) do their part as well and/or rely on specific modeling assumptions on the behaviors of the rest of the economy.

Scenarios only capture parts of the economy. Depending on the scenario, a range of sectors are not modeled. For example, land use and land-use change emissions must be 0 within the IEA SDS scenario for it to limit temperature rise to 1.8°C with a 66% probability level in 2100 ([Carbon Tracker, 2018](#)). In addition, assigning a 2°C temperature to a portfolio assumes that, for the whole economy to be 2°C-aligned, other actors behave appropriately in the face of the needed transition to limit temperature rise under a certain level.

- **Compatibility:** A below 2°C company or portfolio

does not necessarily lead to a below 2°C world and may exhibit increasing absolute emissions if the method chosen does not include appropriate safeguards.

Let's take the example of an oil and gas company. Within a less than 2°C world, oil & gas production and companies still exist, even if the overall production volume has to decrease. Therefore, an oil & gas company can be 2°C aligned if it operates within its share of the budget. As a consequence, **it all comes down to the way the benchmark is calculated, and whether it reflects appropriately, in absolute terms, the overall budget of the specific company within its sector of operations.**

When using an absolute method by contraction to build the benchmark, the macro budget is respected by construction. It is therefore not an issue.

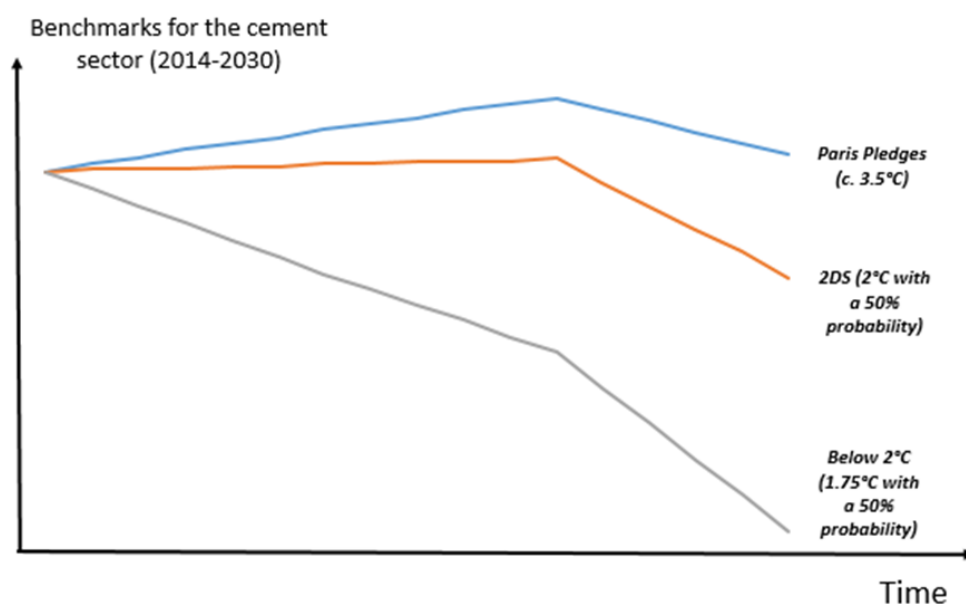
When using a contraction or convergence method by intensity (e.g. SDA-based), the answer is, it depends. For example, the “pure” SDA approach includes checks to ensure that the overall budget is respected, taking into account changes in market share. SDA-based methods used to build company-specific benchmarks within investment portfolios often do not include these checks, for data availability reasons. Therefore, even if all companies follow their benchmarks, the respect of the overall budget is not assured.

- **Rising uncertainties :** Temperature trajectories, as given by scenarios, are not linear. For example, the carbon budget in 2030 is not simply 50% higher within a 3 °C versus a 2 °C pathway ([van Vuuren et al., 2016](#)). In addition, a 20% deviation from the 2 °C benchmark of a utility company may mean that it is on a 3 °C trajectory – whereas the same percentage deviation for an automobile manufacturer may mean put it on a 4 °C trajectory.

- Therefore, it is useful to derive multiple temperature benchmarks corresponding to different temperature levels to capture this non-linearity. Yet, uncertainty is even higher for trajectories leading to higher temperature levels. Higher uncertainty ranges may potentially erase the benefits of capturing this non-linearity.

- In addition, providing a temperature range (e.g. 2 to 3 °C) rather than interpolating a specific temperature (e.g. 2.6 °C) based on the relative distance of the climate performance of the company or portfolio to the closest benchmark or on regression-analysis may better. Indeed, a specific figure may give a false sense of certainty, may not mathematically correct because of potential non-linearity between the 2 and 3 °C benchmarks. However, temperature ranges do not take into account “steps” effects. There may not be so much differences between a portfolio rather 1.5-2 °C and 2-3 °C, if the former is 1.9 °C and the latter 2.1 °C.

Figure 57: The importance of using multiple temperature benchmarks to capture non-linearity.



Expert track: Uncertainty in the global warming scenarios and the associated carbon budgets

Several sources of uncertainties. It is crucial to keep in mind that climate projections and global warming scenarios are subject to several sources of uncertainty.

- The first one is the dominant one in the short term (5-10 years) and associated to the intrinsic variability of the climate system.
- The second is related to the uncertainty on the future forcings of the climate system by the natural and anthropogenic forcing agents. The scenarios discussed in this report fix the available carbon budget but the emissions of other forcing agents are not prescribed and contribute to uncertainty.
- Third, the uncertainty of the future climate response to the forcings (model uncertainty) creates an additional spread between global warming scenarios coming from different models.

In addition to these uncertainties related to the physics of the climate system, another major source of uncertainty is related to the socio-economic aspects, such as political decisions, economic growth and the future availability of technologies required to implement the chosen scenarios, such as carbon capture and storage.

These sources of uncertainty (except the technological one) are represented in table 38, taken from IPCC AR5. At the 2100 horizon the strongest uncertainty comes from the choice of RCP scenario, however even if the scenario is prescribed and this part of uncertainty is not taken into account, the natural climate variability and inter-model spread still lead to a confidence interval of 1.5 degrees for the future temperature values.

This uncertainty in climate scenarios leads to an associated uncertainty in the remaining carbon budget for limiting global warming below 1.5 °C or 2 °C. The following table, from IPCC Special Report “Global warming of 1.5 °C” shows the percentiles of the remaining carbon budget for a 1.5 °C warming scenario together with the associated uncertainty bounds, in GT CO₂.

Table 38: Percentiles of the remaining carbon budget for a 1.5 °C warming scenario with associated uncertainty bounds

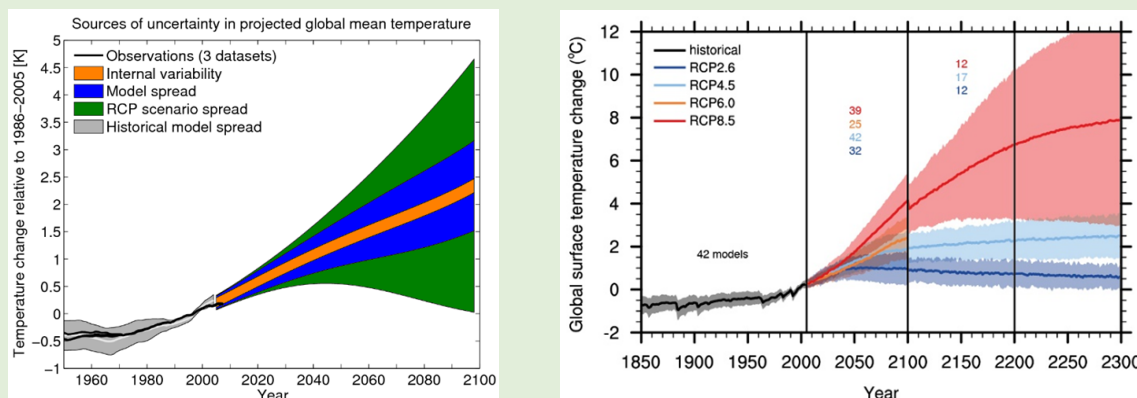
33rd percentile	50th percentile	66th percentile	Non-CO2 scenario variation	Non-CO2 forcing and response uncertainty	Climate response distribution uncertainty	Historical temperature uncertainty
840	580	420	+/- 250	-400 / +200	+100/+200	+/- 250

Uncertainty rises for higher temperature outcomes. As seen from Figure 58, taken from IPCC AR5, which compares the inter-model spread for different RCP scenarios, **the uncertainty of climate scenarios is higher for higher temperatures, since our knowledge of the behavior of the climate system in these temperature ranges is scarce and nonlinearities (tipping points) come into play.**

According to IPCC Special report, the absolute temperature characteristics of various pathways are more difficult to distinguish than relative features. Thus, the implied temperature rise metric computed by using IPCC scenarios as benchmarks should be seen as a relative measure of climate performance, allowing to compare different assets between one another, rather than an indication of a specific climate future. **Thus, an asset aligned to a 3 °C scenario has a worse climate performance than a 2 °C degree aligned one, but it is an overstatement to say that it leads us to a 3 °C world in 2100:** indeed, the different climate scenarios only start to diverge around 2050, and at that time the company in question may not even exist!

Finally, deeper emission reductions in the near term reduce the uncertainty both in the future climate response and in the future technology availability: to maximize impact and ensure robust transition investors should seek to align to the most stringent scenario where the emissions peak sooner and reliance on CSS is small.

Figure 58: (Left panel) Sources of uncertainties; (right panel) Intermodel spread for different RCP scenarios;



Choice 3: How to aggregate and weight the results at portfolio-level?

Two families of aggregation methods. There are two main overarching possibilities to aggregate climate metrics at the portfolio-level. These are similar to the aggregation methods used in the context of carbon footprinting and have therefore been well-studied.

- **Responsibility or ownership approach:** this approach assumes that if an investor owns 10% of an asset, he is responsible for 10% of the climate performance of the asset. It has therefore been shown to be better suited to measure “responsibility” ([Kepler Cheuvreux et al, 2015](#)), as it is an extension of the GHG Protocol logic, which allocates supply chain emissions to a company on a per share basis and forms part of a financial institutions Scope 3 “financed emissions”.
- **Weighted average by portfolio position:** this approach weights climate indicators at the portfolio-level based on positions. Conceptually, calculating portfolio footprint based on this approach has been shown to be better suited to measure risk exposure as this is not correlated to a portfolio percentage of ownership of an asset, but rather to the relative amount of a portfolio invested in this asset. ([Kepler Cheuvreux et al, 2015](#)). This approach is recommended by the TCFD.

What are the general characteristics of these two approaches, based on the financial industry’s experience with carbon footprinting?

General characteristics of the responsibility or ownership approach. The GHG Protocol states that “emissions from investments should be allocated to the reporting company based on the reporting company’s proportional share of investment in the

investee”. Choosing the responsibility approach raises additional questions. Indeed, **on what basis can ownership be calculated?**

- The first option is to calculate the ownership percentage based on market capitalization to attribute climate performance to listed equities. On the plus side, this approach is relatively simple, attractive to listed equity-only investors, and is consistent with the idea that the full climate performance of a financial asset should be allocated to its owners.
- On the negative side, it can lead to double-counting with corporate debt investors and is hardly replicable to other asset classes. For this reason, investors and regulators have pushed towards using enterprise value to calculate an investor’s ownership and attribute responsibility of the climate performance of investees to its financiers.
- Enterprise value has therefore been promoted as an appropriate aggregation method. However, it can lead to high year-on-year variations, for example if the investee raises more debt, therefore changing the debt-to-equity ratio and the responsibility allocation between the two types of asset classes and investors. Another criticism is that it puts at the same level two asset classes, equity, and debt that serve different functions, especially in the context of climate change.

General characteristics of the weighted average or portfolio weight approach. This approach is more intuitive as it follows the investment logic. An investor does not think in terms of the percentage of its ownership of investees, but rather in terms of its relative position in different investees. This approach attributes more weight to investees in which a larger share of the portfolio is invested. This statement is more suited to credit portfolio, as the investment allocation decision is based on book

value and is not sensitive to price changes. Also, given that total debt outstanding frequently changes as companies issue new debt, the ownership approach would cause high volatility in credit portfolio results.

Are these two approaches applicable in the context of temperature alignment assessments and how?

- **The portfolio “responsibility/ownership”** approach as used in the context of portfolio carbon footprinting needs to be adjusted to be applied in the context of temperature alignment assessments, for it to be applicable to portfolios of any size. A review of the main methodologies available on the market currently highlights two ways of doing so:

1. Aggregating climate performance at portfolio-level (either carbon/ technology exposure) using the “responsibility” aggregation approach; then deriving the temperature alignment benchmarks at portfolio-level, either using a sector-agnostic approach or a sector-specific approach weighted by sectors’ exposure; and finally performing the temperature alignment analysis at portfolio-level.

2. Weighting each investees temperature alignment metric by the each investees’ current

relative contribution to the total portfolio carbon emissions, calculated using the “responsibility” aggregation method (and one of the “ownership metric” as described above, e.g. market cap, EV, EV + cash or total assets).

- **The portfolio weight aggregation** approach is applicable to all types of metrics, from binary (“aligned”/ “not-aligned”) to ITR and over(under)shoot metrics. This approach simply derives the portfolio-level temperature alignment metric by weighting the underlying temperature alignment performance of its investees, based on portfolio weights. An additional weighting can be applied to represent the relative importance of each investee/ sector to the transition.

- In both cases, an additional adjustment factor can be used in the formula to reflect the relative importance of investees’ to the energy transition, by using for example the percentage contribution by an investee to total portfolio emissions as a proxy. This is highlighted in the table below. P.140 of this report discusses in more detail the use of such a factor and additional adjustments that can be performed at asset- and portfolio level.

Table 39: Aggregation protocol for each approaches in the context of temperature alignment assessments

Approach	Aggregation protocol
Portfolio ownership/ responsibility	<p>Option 1: Perform the temperature alignment assessment at the portfolio-level directly.</p> <p>(1) Calculate portfolio-level current and forecasted carbon footprint/ technology exposure at time T,..., T+N based on a chosen ownership metric (market cap, EV, total assets)</p> $\sum \frac{\text{Current value of investment } i}{\text{Investee company's value}} \times \text{carbon footprint or technology exposure of investee company } i \text{ in year } T..T + n$ <p>(2) Calculate portfolio-level temperature benchmark(s) at time T,..., T+N</p> $\sum \frac{\text{Current value of investment } i}{\text{Investee company's value}} \times \text{temperature benchmark of investee company } i \text{ in year } T, \dots T + n$ <p>(3) Assess the portfolio-level temperature alignment score by comparing (1) and (2) and express it in either binary terms (“aligned”/“not-aligned”, % deviation from a temperature trajectory and/or ITR)</p> <p>Applicable to approaches by budget, rather than trends, either static (at time T+N) or dynamic (from T to T+N), see p.128 for a definition of each.</p> <p>Option 2: Weight asset-level temperature alignment score based on a specific factor, for example percentage of portfolio-owned investees’ emissions relative to the portfolio’s total owned emissions (using market cap, EV, total assets).</p> $\sum \left(\frac{\text{Current value of investment } i}{\text{Investee company's value}} \times \text{investee } i \text{ emissions} \right) \times \text{temperature alignment metric } i$ <p><i>Total portfolio owned emissions</i></p> <p>Applicable to all alignment metrics (% deviation from temperature trajectory, ITR), regardless of the way it is calculated (by budget, by trend, static or dynamic), see p.128 for a definition of each.</p>
Portfolio weight	<p>Option 1: Weight asset-level temperature alignment metric by portfolio position</p> $\sum \frac{\text{Current value of investment } i}{\text{Current value of all investments}} \times \text{investee } i \text{ temperature alignment metric}$ <p>Applicable to all alignment metrics, regardless of the way it is calculated (by budget, by trend, static or dynamic), see p.128 for a definition of each.</p> <p>Option 2: Weight asset-level temperature alignment metric by portfolio position and an additional adjustment factor, e.g. relative importance to the transition.</p> $\sum \frac{\text{Current value of investment } i}{\text{Current value of all investments}} \times \text{investee } i \text{ temperature alignment metric} \times \text{adjustment factor}$ <p>Applicable to all alignment metrics, regardless the way it is calculated (by budget, by trend, static or dynamic), see p.128 for a definition of each.</p> <p>Option 2 can be applied without taking into account a portfolio’s position in a company, and weighting an investees’ temperature alignment score by an adjustment factor, e.g. contribution to total emissions.</p>
<p>** The choice of adjustment factor, such as contribution to total portfolio’s emissions, (in green above) is discussed in the next section.</p>	

Each of these approaches has pros and cons.

CDP and WWF International (2020) performed a detailed review of weighting options in the consultation paper for the development of a temperature scoring methodology and outline six different weightings approaches, that correspond to the two families highlighted on table 39. For example, option 2 of the ownership approach above corresponds to CDP-WWF weightings by “Market-owned emissions” (MOTS), “Enterprise owned emissions” (EOTS), “EV+Cash emissions” (ECOTS), and “total assets emissions” (AOTS), depending on the ownership metric chosen. Option 1 of the portfolio weighting approach corresponds to CDP-WWF weighted average temperature score (WATS).

Tradeoffs between usability and effectiveness.

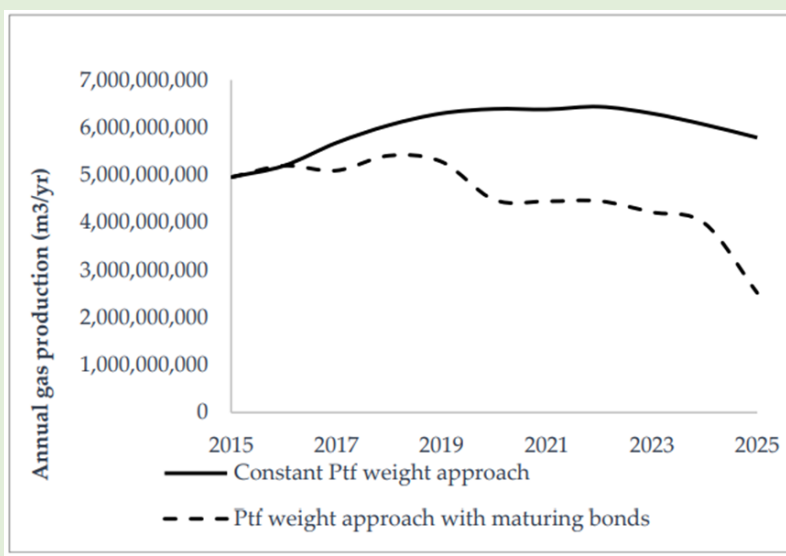
According to CDP and WWF International, an appropriate aggregation approach in the context of portfolio temperature alignment needs to support a number of objectives, namely: 1. Enable alignment with a 1.5°C pathway, 2. Support better disclosure of GHG emissions by corporations and 3. Support standardization of methods. They find that ownership approaches are best suited to these objectives, overall. At the same time, they find that when compared over a range of principles (comparability, applicability, reliability, clarity, timeliness, and completeness), approaches by portfolio position are best and easier to apply. Indeed, ownership approaches are more sensitive to fluctuations in the ownership metric, e.g. market cap or enterprise value that limits year-on-year comparison if not kept “fixed”.

Expert track: Incorporating investors' commitments into forward-looking assessments

These two high-level aggregation approaches have been developed in the context of portfolio carbon footprinting, which is, by construction, a static metric. In order to attribute changes to actual decarbonization and allow for time comparison, portfolio and asset value is held constant through time. **When doing ex-ante assessment, investors may want to incorporate and test for the effect of their commitments in the forward-looking assessment.**

- **Debt portfolio.** Keeping portfolio position and value static through time assumes refinancing of maturing debt. As an example, 2° Investing Initiative constructed a dummy corporate bonds portfolio, using the weighted average approach, and estimated its annual gas production over 10 years. The full line represents the trajectory with no maturing of bond instruments (or full refinancing) whereas the dotted line represents the trajectory taking into account bonds maturity (and assuming no refinancing). As shown on figure 59, the refinancing assumption can lead to different results (2° Investing Initiative, 2018). Investors that have a no-refinancing strategy of certain sectors or companies, such as oil & gas, may incorporate this in their methodology.
- **Equity portfolio.** Investors that have commitments to divest from specific sectors or companies by a set date may incorporate this in their assessment. If a weighted approach is used, other sectors may be reweighted to reflect divestment, everything else being equal. If a responsibility approach is used, the results can be reweighted up to 100% portfolio value.

Figure 59: Integrating maturing bonds into debt portfolio assessment (2° Investing Initiative, 2018).



Choice 4: Using additional adjustment factors?

Are all companies and portfolios equivalent in terms of their relative importance to the low-carbon transition?

Temperature alignment assessment is relative: the company or portfolio climate performance is compared to what it should be according to one or several temperature benchmarks. Therefore, any company or portfolio may be aligned with a 2°C trajectory regardless of whether it operates in/ finances a high stake or low stake sector in terms of achieving the transition.

In parallel, investment portfolios represent only parts of the economy. Let's take a hypothetical portfolio that is invested 100 % in media companies, all of which aligned with their 2°C temperature benchmark. Assigning a 2°C alignment score to this portfolio assumes that, for the whole economy to be aligned with a 2°C trajectory, other investment portfolios finance in the “appropriate”/ “2°C aligned” proportion other sectors, such as renewable energy.

This raises the questions:

- Is the 2°C of a media company equivalent to the 2°C of an oil & gas company in terms of their relative importance to the low-carbon transition, and if not, should the results be adjusted or weighted to reflect this when aggregating at portfolio-level?
- Is the 3°C of a portfolio only invested in media equivalent to the 3°C of a portfolio invested in the power sector, and if not, should the portfolio-level results be adjusted to reflect exposure to sectors relatively more important in the context of the transition?

Data providers and investors have therefore introduced additional calculation protocols to reflect within the relative importance of different sectors to the low-carbon transition in temperature alignment metrics and whether the investment portfolio finances each sector in the right proportion.

- **At asset-level**, the best achievable Implied Temperature Rise score (e.g. 1.5°C) can be bounded based on the sector of operation.

For example, the “best” Implied Temperature Rise score that Oil & Gas or coal companies may achieve could be floored, e.g. at 4°C. This means that a portfolio highly invested in this sector may not be able to reach a below 2°C temperature. This puts more emphasis on sector allocation.

- **When aggregating the results at the portfolio-level**, the temperature alignment result of each company can be assigned a weighting to reflect its importance to the transition (see how the adjustment factor is used in aggregation approaches on table 40).

Oil & Gas companies' temperature alignment results may be weighted more heavily to reflect their higher contribution to current emissions and the higher required rate of decarbonization required. This puts more emphasis on stock selection.

- **At the portfolio-level**, the final temperature alignment metric can be adjusted based on the portfolio sector allocation, by adjusting the overall portfolio result if it is not “sufficiently” invested in high-stake sectors in terms of achieving the low-carbon transition. Similarly, constraints may be imposed on the percentage invested in high versus low climate impact sectors, so that portfolios not “sufficiently” invested in high-stakes sectors are penalized.

These adjustments raise methodological questions that each provider has solved in their own way.


- How to determine a science-based temperature bounding of each sector?
- How to derive a company or sector-level weighting factor? Should it be based on current or future sector contribution to global GHGs emissions? How can a sector contribution be calculated when Scope 3 emissions are included? How to derive a weighting factor that takes into account “green” technologies and avoided emissions?
- When assigning sectoral constraints or adjusting portfolio results based on sector allocation, which specific sectors should be considered high stakes or low stakes and based on what criteria? Where do we draw the line? Should the criteria also include the “positive side of the story”, i.e. solution providers, and if so how? Should sectoral constraints imposed for specific sectors or groups of sectors?

Specific adjustments performed by data providers and investors are highlighted in the table below.

Table 40: Example of adjustments performed by data providers

Asset-level	
Bounding	<p>In Carbon4 Finance methodology, companies within a specific sector have their maximum transition scoring (CIA) bounded based on the ability of the sector to be a solution for the low carbon transition. For example:</p> <ul style="list-style-type: none"> • Electricity providers: A • Cement manufacturers: B • Oil & Gas: C • Low-stake sectors: C
	<p>In EcoAct methodology, when companies do not disclose an absolute reduction target, a different “default” temperature is assigned depending on its sector of operations (the more GHG intensive the sector, the higher the “default” temperature). The “default” temperature is higher than what is attributed to companies with targets, even for low-stake sectors. When a target is disclosed, no bounding is applied (any company can be 1.5 or 2 °C as long as it fits the required criteria).</p> <p>Therefore, a better score is achieved by investing in companies with “aligned” targets, regardless of their sector of operation.</p>
When aggregating asset-level results at the portfolio-level...	
Weighting	<p>CDP and WWF (2020) International discuss in detail six portfolio-level aggregation protocols, five of which rely on weighting the results by a company’s contribution to portfolio’s total emissions (in addition to additional weighting mechanisms by portfolio position or ownership. This puts more weight on the Implied Temperature Rise score (ITR) of companies that contribute the most to a portfolio’s carbon emissions, therefore where the decarbonization stakes are higher.</p> <p>The Influence Map methodology draws upon the 2 °C Investing Initiative PACTA results that are provided at the technology level to produce a 2 °C alignment metric at the portfolio level (+100). Two weighting mechanisms are used in addition to portfolio holdings to reflect the relative importance of technologies and sectors to the transition.</p> <p>First, the technology-specific deviations from the 2 °C benchmark are averaged based on the relative importance of each technology to the transition. This is calculated based on the extent to which each technology’s emissions contributions must change between 2019 and 2050 as outlined by the B2DS scenario. The focus is on the required change over time to overweight technologies that must expand or contract significantly in the face of the transition. In order to compute the emission contribution over time of “green” technologies with a 0 footprint, the method uses the concept of avoided emissions – assuming that in the absence of the technology, the resultant production gap would be filled with “brown” technologies to meet the same global demand.</p> $\text{sector alignment} = \frac{\sum (P_t \times T_t \times A_t)}{\sum (P_t \times T_t)}$ <p style="text-align: right;"><i>With A = (mis)alignment or temperature of each technology; P = portfolio production for each technology; = relative importance of each technologie to the transition</i></p> <p>Second, sector alignments are aggregated at the portfolio-level based on each sectors’ current contribution to global emissions. Indeed, each sector covered by the assessment (Oil & gas, power and transport) must significantly decrease their absolute emissions by 2050. To reflect this, each sector is weighted according to its current contribution to global emissions, so that the most emitting sectors today receive the highest weighting.</p> $\text{Portfolio Alignment} = \frac{\sum (V_t \times S_t \times A_t)}{\sum (V_t \times S_t)}$ <p style="text-align: right;"><i>With A = sector (mis)alignment or temperature; S = sector’s current contribution to global emissions; V = portfolio’s exposure to sector (holding value)</i></p>

Portfolio-level

<p>Adjustments</p>	<p>Mirova accounts for cases where the portfolio has relatively low exposure to “high-stakes” sectors in the context of the energy and ecological transition. As highlighted in their report “Aligning Portfolios with the Paris Agreement” (2020):</p> <ul style="list-style-type: none"> • “A portfolio exclusively invested in healthcare and media, for example, is neither contributing to nor obstructing the fight against climate change, so we consider it in line with the status quo: +4 °C; • Portfolios and indexes with very little investment in “high-stakes” sectors are pulled linearly toward +4 °C, in proportion to the difference between its “high-stakes” exposure and the “high-stakes” exposure of the MSCI World (typically about 30%). This adjustment is reflected in the equation below.” $(Eq. 5) \quad t_{adjusted} = \begin{cases} 1.5 & t < 1.5 \\ 4 \left(\frac{s-p}{s} \right) + t \left(1 - \frac{s-p}{s} \right) & 1.5 \leq t \leq 6, \text{ if } p < s \\ t & 1.5 \leq t \leq 6, \text{ if } p \geq s \\ 6 & t > 6 \end{cases}$ <p> $t_{adjusted}$ = final climate trajectory in °C t = climate trajectory calculated in eq. 4 s = portion (by weight) of high-stakes issuers in the MSCI World (typically ~ 30%) p = fraction of portfolio/index investments in “high-stakes” assets </p>
<p>Constraints</p>	<p>In order to decrease “greenwashing risk”, i.e. to avoid index developers to divest from high climate impact sector and invest towards climate-neutral sectors to achieve the year-on-year decarbonization requirement of the PAB, the TEG imposes a sectoral constraint. The constraint applies to all sectors as a group rather than on a sector-to-sector basis. It also includes voluntary criteria for the “green-brown” sector allocation that may be significantly larger (at least factor 4) in PAB compared to the reference investable universe. (Natixis 2019)</p> <div style="display: flex; align-items: center; justify-content: space-around;"> <div style="border: 1px solid black; padding: 5px; margin-right: 20px;"> <p>GICS classification of high and low impact sectors</p> </div> <div style="text-align: center;">  </div> <div style="display: flex; flex-direction: column; align-items: center;"> <div style="text-align: center; margin-bottom: 10px;"> <p style="color: #008000; font-weight: bold;">High climate impact</p> <hr style="width: 100%;"/> </div> <div style="text-align: left; font-size: 0.8em;"> <p>Energy equipment's & services Oil, gas & consumable fuels Chemicals Construction materials Containers & packaging Metals & mining Paper & forest products Capital Goods Transportation Automobiles and components Food Beverage and Tobacco Real Estate Semiconductors & Semiconductor Equipment Technology Hardware and Equipment Utilities</p> </div> </div> <div style="display: flex; flex-direction: column; align-items: center;"> <div style="text-align: center; margin-bottom: 10px;"> <p style="color: #008000; font-weight: bold;">Low climate impact</p> <hr style="width: 100%;"/> </div> <div style="text-align: left; font-size: 0.8em;"> <p>Commercial and professional Services Consumer Durables & Apparel Consumer Services Food & Staples Retailing Health Care Equipment and Services Household & Personal Products Media & entertainment Pharmaceuticals Biotechnology & Life Sciences Retailing Software & Services Telecommunication Services Banks Diversified Financials Insurance</p> </div> </div> </div>

5. DETAILED REVIEW OF DATA PROVIDERS

Table 41: Summary table

	ARABESQUE*	CARBON 4 FINANCE	CDP-WWF TEMPERATURE RATING	ECOACT	URGENTEM	I CARE & CONSULT	ISS	MSCI CARBON DELTA**	RIGHT. BASED	S&P TRUCOST	2° INVESTING INITIATIVE PACTA
METRIC	GHGs	GHGs	GHGs	GHGs	GHGs	GHGs	GHGs	GHGs	GHGs	GHGs	Technology, GHGs
PERIMETER	Scope 1 & 2	Scope 1, 2 and 3 where relevant	Scope 1, 2, and 3 where relevant	Scope 1 & 2, inclusion of Scope 3 indirectly	Portfolio: full value; sector & company: Scope 1	Scope 1, 2 and 3 where relevant	Scope 1, Scope 3 for oil & gas	Scope 1	Scope 1, 2 and 3	Scope 1 & 2, Scope 3 for oil & gas and automotive	Scope 1, 2 or 3 where relevant
SECTOR COVERAGE	High	High	High	High	High	Average; high with a combination of methods.	High	High	High	Average; high with a combination of methods	Average
POSITIVE IMPACT	No	Avoided emissions	No	No	No	Specific trajectories for “enabling” products & services	No	No	No	No	Specific trajectories for green share
FORWARD-LOOKING	Fixed (no forecasts)	Qualitative score taking into account multiple data points	Targets	Targets	Fixed (no forecasts)	Combination (targets, historical trends)	Combination (targets, historical trends)	Low-carbon revenue forecasts	Depends on method: extrapolation; targets	Combination (targets, historical trends, asset-level datasets)	Asset-level data
SCENARIO	IEA ETP	IEA ETP	IPCC	IPCC	User-defined (IPCC, ETP)	IEA ETP	IEA ETP	NDCs, UNEP Gap report	User defined - IEA ETP	IEA ETP; IPCC	User defined - IEA ETP


	ARABESQUE*	CARBON 4 FINANCE	CDP-WWF TEMPERATURE RATING	ECOACT	URGENTEM	I CARE & CONSULT	ISS	MSCI CARBON DELTA**	RIGHT. BASED	S&P TRUCOST	2° INVESTING INITIATIVE PACTA
BENCHMARK TYPE	Economic intensity; absolute (trend indicator)	Score	Multiple to match company targets format	Absolute emissions	Portfolio: intensity; sector & company: absolute	Physical intensity	Economic intensity	Economic intensity	Economic intensity	Physical intensity; economic intensity	Absolute technology exposure
ALLOCATION	Sector-specific convergence	Sector- agnostic convergence	Sector-specific/ agnostic contraction	Sector- agnostic contraction, sector- specific	Sector- agnostic/ specific contraction	Company- specific convergence	Company- specific convergence	Sector- specific convergence	Sector- specific contraction	Company- specific convergence; overall contraction	Company- specific contraction/ expansion
TIME HORIZON	2030 and 2050	Undefined	Target base year to 2025-2030; to 2030+	Undefined: Target time horizon	2015-2060	2010-2050	2018-2050	2030	2018-2050	2012-2025 (T+5)	2018-2023 (T+5)
ALIGNMENT TYPE	Point-in-time gap	Point-in-time gap	Trend	Trend	NA	Cumulative over(under) shoot	Cumulative over(under) shoot	Point-in-time gap	Cumulative over(under) shoot	Cumulative over(under) shoot	Trend

*Methodology details and results presented use Temperature Score V1.1, to be released by Q3 2020.

** Currently working on updates: integration of Scope 2 and 3, company targets, aggregation of sector-specific and sector-agnostic temperatures and framework to include future low-carbon revenues.

arabesque s-ray	<h2 style="text-align: center; color: green;">ARABESQUE S-RAY TEMPERATURE™ SCORE</h2> <p>The Arabesque S-Ray Temperature Score attributes a near-term (2030) and long-term (2050) point-in-time temperature score to companies' Scope 1 and 2 emissions intensity. This indicator is completed by a target, trend and scope 3 metric.</p> <p>Methodology details and results presented use Temperature Score V1.1, to be released by Q3 2020.</p>
Use case	
Assessment question	<p>How does the current GHGs emission intensity (per revenue) of the companies in my portfolio compare with what it should be in 2030 and 2050 under different temperature trajectories as provided by the IEA ETP?</p>
Conditions for the portfolio to be aligned with a 2 °C or well below 2 °C trajectory?	<p>Be invested in companies that have a validated science-based target; and/or that have a current GHGs emission intensity per unit of revenue in line with its direct sector intensity in 2030 and 2050 under the ETP 2DS scenario.</p>
Applicability	
Investment strategies & portfolio	<ul style="list-style-type: none"> • Applicable to companies operating in multiple regions of the world (global scenario); • Growth companies can achieve a below 2 °C temperature if they decouple their emissions by the required rate, regardless of the growth in their absolute emissions. However, need to decrease their absolute emissions to get a good “trend” score; • Applicable to diversified and thematic portfolios; • “Solutions”/ “Greening by” companies assessed based on their direct emissions.
Asset classes	<p>Listed equity</p>
Coverage	<p>3 000 companies based on size and involvement/ coverage in initiatives (CA100+ and TCFD e.g.)</p>
Sector-coverage	<p>All, split between the IEA sectors (Power, industry, transport and other) and mapped to FactSet industry classification.</p>
Usability	
Output	<p>Implied Temperature Rise score giving a near- and far-term temperature alignment (1.5 °C/2 °C/2.7 °C/>2.7 °C /3 °C) along with three other indicators:</p> <ul style="list-style-type: none"> • Target - Does the company have a target with the Science Based Targets initiative to reduce GHG emissions to a level compatible with a 2 °C scenario? • Trend – Have the company's recent emissions reductions followed the trajectory that is required to reach net zero emissions and limit global temperature rise to 1.5 °C? • Scope 3 – Does the company report some part of their Scope 3 emissions?
Updates	<p>Corporate disclosures are updated annually for each company (rolling basis). Latest available data for company disclosure (no more than 2 years); latest scenario data. Benchmark updated every 6 months. The historical dataset is available back to 2013.</p>
Accessibility	<p>Online platform; csv or excel file.</p>
Methodology development	
Data sources	<p>Company reporting; IEA ETP scenario; IPCC Special Report on 1.5 °C; SBTi Database; OECD GDP Forecasts; UN National Accounts.</p>

Data checks & quality assurance; Management of uncertainty	Cross-checking, outlier detection and company trend analysis. Methodology based on the most likely possibilities; does not use Scope 3 emissions which are often not reported or done so inconsistently; no incorporating of estimated emissions data in the scoring; no estimation of future behavior (i.e. instead of utilizing estimations, project that their emissions intensity ratio will remain the same in the future is just as, this is just as likely as it increasing or decreasing by a certain amount).
Temperature alignment assessment recipe	
Step 1: Bottom-up calculation of the current and forward-looking climate performance of each company	
<ul style="list-style-type: none"> Collect reported data on Scope 1 and 2 GHGs emissions; Scope 1 and 2 should be reported separately; No forecast of future climate performance (emissions intensity is fixed). 	
Step 2: Choice of scenario and temperature trajectories	
<ul style="list-style-type: none"> Use IEA ETP 2017 for >2.7 (above RTS), 2.7 (RTS), 2 (2DS) and 1.5 (B2DS) degrees up to 2050; 	
Step 3: Deriving temperature alignment benchmarks	
<ul style="list-style-type: none"> Derive sector-specific intensity benchmark for each sector available in the IEA ETP scenario, by dividing absolute emissions of each sector by sector-specific GDP; Sector split: Power, industry, transport and other; Sector-specific GDP is derived by using global GDP forecast under IEA ETP and historical sector split (OECD and UN National Accounts); 	
Step 4: Temperature alignment assessment	
<ul style="list-style-type: none"> Implied Temperature Rise score covers scope 1 and 2; scope 3 excluded at the moment. Therefore, automobile manufacturers' scope 1 and 2 are assessed relative to the "industry sector" benchmark; Oil & Gas scope 1 and 2 are assessed relative to the "other sector" benchmark. Compares current emissions intensity with what it needs to be under different scenarios in 2030 and 2050. Incomplete or non-disclosure score of 3 °C to reflect a business-as-usual case. Companies that have an emissions target approved by the Science Based Targets Initiative automatically gets a score of 2 °C, even if they would otherwise have a score of 2.7 or >2,7 score, to recognize and reward the fact that they have an awareness of how to reduce their emissions. 	
Step 5 (Optional): Aggregation at portfolio-level	
<p>Option 1:</p> <ul style="list-style-type: none"> Sum all companies' emissions and divide by sum of revenues to get a portfolio level Scope 1+2 intensity (unweighted). Build a weighted-average benchmark based on IEA and sector composition of the portfolio. For example, in a portfolio with companies operating only in the Industry sector, the benchmark is the Scope 1 and 2 emissions intensity of the Industry sector from IEA for each scenario. Evaluate the portfolio emissions intensity against this new benchmark to generate the portfolio score. <p>Option 2: (by counting): Count the number of companies that receive a particular score and then the percentage of the portfolio that this represents (weighting by positions).</p>	
Step 6 (Optional): Complement the Implied Temperature Rise indicator with additional metrics	
<ul style="list-style-type: none"> Trend indicator identifies companies whose year-on-year emission reductions over the past three years are in line with those required to reach net zero emissions by the mid-2060s and limit global temperature rise to below 1.5 °C – calculated as a decrease of 3% to 15% in absolute GHGs. The rate is not sector-specific but relates to the relevant time horizon (2010-2019, 2019-2029). Identify companies that report on part of their Scope 3 emissions. 	

	<h2 style="text-align: center; color: green;">CARBON4 FINANCE TEMPERATURE</h2> <p>The Carbon4 Temperature methodology builds on the Carbon Impact Analytics (CIA) database and methodology. Each company is attributed a score that is function of its induced emissions, avoided emissions and forward-looking strategy; scores are aggregated at portfolio-level before the temperature alignment assessment is performed.</p>
Use case	
Assessment question	What is the temperature trajectory of a portfolio based on its constituents' current and future climate performance, as measured by a score?
Conditions for the portfolio to be aligned with a 2 °C or well below 2 °C trajectory?	<ul style="list-style-type: none"> • Be invested in companies that have 1. High emissions savings and 2. Low induced emissions compared to their peers; • Be invested in companies that have an adequate forward-looking climate strategy; • Have a green on brown share ratio consistent with climate scenarios; • Be invested at least 40% in high-stakes sectors as defined by Carbon4.
Applicability	
Investment strategies & portfolio	<ul style="list-style-type: none"> • Applicable to companies operating in multiple regions of the world (global scenario); • Growth companies can achieve a below 2 °C temperature if they decouple their emissions by the required rate, regardless of the growth in their absolute emissions; • Applicable to diversified portfolios (invested at least 40% in high-stakes sectors); • "Solutions"/"Greening by" companies assessed based on both their induced and avoided emissions.
Asset classes	Listed equity and corporate bonds; compatible methodologies for sovereign bonds, infrastructure and private equity.
Coverage	10 000 companies including 3 000 companies with a bottom-up analysis: 600 equities in Europe, 500 in the US, 1700 in the world, 400 € fixed-income issuers
Sector-coverage	All, with a bottom-up analysis for ~50 sub-sectors
Usability	
Output	At portfolio and company-level : <ul style="list-style-type: none"> • Carbon Impact Analytics score and distribution; • Forward-looking score distribution; • Carbon footprint (multiple metrics); • Emissions savings; • Savings/induced ratio: carbon impac ratio; Portfolio level temperature trajectory (Implied Temperature Rise metric).
Updates	Company scores are updated each year, 2 °C benchmarks every 2 years. Company-level and alignment time series available over 4 years.
Accessibility	Online platform and download;
Methodology development	
Data sources	Company financial and extra-financial reports; IEA scenarios; LCA datasets...
Data checks & quality assurance; Management of uncertainty	Internal validation by senior analysts; The methodology has been developed to be able to compare the performance of companies and then portfolios. So even if the uncertainty exists to assess the absolute figures, the bottom-up approach ensures the relative assessment (Asset A performs better than asset B).

Temperature alignment assessment recipe

Step 1: Bottom-up calculation of the current and forward-looking climate performance of each company


1. Split the company activities' between **CIA sub-sectors** (56);
2. Recalculate scopes 1, 2 and 3 emissions; Use Scope 1 and 2 reported data if consistent; estimated data if not; systematically use calculated Scope 3 data (even if reported) for relevant sectors.
3. Estimate **emissions savings** (even if reported) and compute the **savings/induced emissions ratio**. For some sectors, elements of "temperature alignment assessments" in calculating avoided emissions: IEA ETP 2DS 2030 power intensity used as reference to calculate the avoided emissions of the utility sectors e.g. For high-carbon intensity and enabling sectors, the reference baseline for the calculation of emissions savings is not built on 2°C scenario.
4. **Aggregate the results at company-level.**
5. **Evaluate the likely evolution of low-carbon R&D and CAPEX, strategy and positioning of the firm, GHG emissions reduction targets over a ++ to – scale** (4 rating levels). Where possible (homogeneous sectors), category thresholds are build based on IEA benchmark in ETP 2DS scenario. Best-in-class approach where not possible.
6. **Derive the company-level Carbon Impact Analytics score across 5 categories** from high contribution to climate transition to incompatible, including a neutral category, also used for low-stake sectors.
 - a. Induced and emissions savings as main predictor of the CIA category of a company.
 - b. Qualitative score (step 1.5 above) is used to adjust the category (+/- one level).
 - c. CIA is bounded per sector based on the ability of the sector to be a solution for the low carbon transition: electricity providers can achieve an A, cement cannot achieve higher than a B, oil & gas companies cannot achieve higher than a C. Low stakes companies cannot achieve higher than a C.

Step 2: Aggregation at portfolio-level of the CIA score

7. Aggregation based on portfolio weights.

Step 3: Deriving temperature alignment benchmarks

8. The most representative climate scenario for the business as usual economy is the Intergovernmental Panel on Climate Change (IPCC) RCP 6.0 scenario, it projects a temperature increase of 3.5°C by the end of the century. It is benchmarked to the entirety of the CIA universe - 2000 companies - which is used as a proxy for climate performance. **The average CIA grade represents 3.5°C.**
9. **2°C aligned benchmark is based on the average score of the Euronext LC100.**
10. Establish a "sigmoid" curve between the two that translate portfolio score into an Implied Temperature Rise metric.
11. Bound min/max Implied Temperature Rise score between 1.5 and 6°C.
12. Adjust portfolio temperature based on sector allocation.

	<h2 style="text-align: center;">CDP-WWF TEMPERATURE RATING</h2> <p>CDP-WWF Temperature Rating provides temperature ratings in °C associated with publicly reported corporate GHG emission reduction targets. Based on a CDP/WWF public methodology, It assesses and rates short, medium, and long-term corporate ambition against a wide range of end of century (2100) temperature outcomes, between 1.5-4 °C. It therefore translates reported corporate targets into long-term temperature trajectories.</p>
Use case	
Assessment question	To what degree do corporate targets within a portfolio translate?
Conditions for the portfolio to be aligned with a 2 °C or well below 2 °C trajectory?	Be invested in companies whose emission reduction targets have the appropriate coverage and are in line with the required emissions decarbonization rate under a selection of IPCC scenarios.
Applicability	
Investment strategies & portfolio	<ul style="list-style-type: none"> • Applicable to companies operating in multiple regions of the world (global scenario); • Focus on intensity and absolute emissions, depending on how corporate emission reduction targets are expressed; • Applicable to diversified and thematic portfolios; • “Solutions”/ “Greening by” companies assessed based on their decarbonization targets.
Asset classes	Listed and non-listed equities and corporate bonds.
Coverage	4 000 companies selected based on CDP disclosure. All companies can be scored, regardless of if they have public targets or not.
Sector-coverage	All sectors will be covered by the method, including intensity targets from companies based in heavy industry sectors such as cement & concrete, steel & iron, aluminum, power, and transportation services.
Usability	
Output	<ol style="list-style-type: none"> 1. Harmonized company-level targets i.e. an overview of the target types of each company. 2. Implied temperature of corporate ambition i.e. temperature score per company. 3. Implied temperature of portfolio and indices i.e. temperature score per given portfolio or index.
Updates	The dataset will be updated on a monthly basis with the latest targets being approved by the SBTi in addition to the annual disclosure of new corporate GHG reduction targets. Ex-post tracking of progress against targets will be featured in future versions of the Temperature Rating method.
Accessibility	The methodology on which CDP-WWF Temperature Rating is built, co-developed by CDP and WWF, will be fully open source and publicly available. The underlying tools and data outputs will be a commercial paid for product. The first iteration of the dataset will be ready in June 2020.
Methodology development	
Data sources	CDP / WWF temperature scoring methodology CDP reported and modelled emissions dataset CDP cleaned target dataset IPCC IAMC SR1.5 database
Data checks & quality assurance; Management of uncertainty	CDP disclosure data is cleaned each year after the disclosure cycle. All disclosed targets are run through a screening and quality check procedure. Creation of a scenario set that matches a normative precautionary preference in regard to overshoot and carbon removal..

Temperature alignment assessment recipe

Step 1: Harmonization of GHG emissions reduction targets as disclosed by companies, including but not limited to companies with committed and validated science-based targets.

- **Harmonize corporate targets** to the same time horizon, scope and metric and decide whether the targets fit the minimum coverage requirements.
- The methodology analyses both **scope 1 and 2; and scope 1, 2 and 3 targets** (2 separate analysis).
- Targets cover all GHG emissions. Other forms of targets such as renewable energy procurement are not considered at this time. Only the decarbonization aspect is taken into account.
- The implied target decarbonization rate (ambition) is measured between the target base year and the target year. **The target timeframe is not harmonized for all companies. Instead, targets are classified as short term (2021-2024), mid-term (2025-2035) and long term (2035+).** Scores are generated only for all timeframes but the mid-term timeframe is considered the key timeframe as it currently represents the main time period for corporate ambition.

Step 2 & 3: Choice of scenario and temperature trajectories and deriving temperature alignment benchmarks.



- Based on **IPCC scenario set**.
- **Creation of a scenario set that matches a normative precautionary preference in regard to overshoot and CDR** i.e. specific emission pathways for absolute, physical and economic intensity metrics;
- Development of **best-fitting linear regression models** to describe the relationship between scenario variables (matching the general structure of corporate GHG targets) and end of century temperature outcomes.
- **Sector-specific** where possible: fossil fuels, cement & concrete, steel & iron, aluminum, power, and transportation services.

Step 4: Company-level temperature alignment assessment

- Derive sector-specific intensity benchmark for each sector available in the IEA ETP scenario, by dividing absolute emissions of each sector by sector-specific GDP; Sector split: **Power, industry, transport and other;**
- Sector-specific GDP is derived by using global GDP forecast under IEA ETP and historical sector split (OECD and UN National Accounts);

Step 5: Aggregation at portfolio-level

- Temperature scores are allocated based on an **enterprise ownership weighting approach**: The portfolio temperature rating is the weighted average temperature rating of investee companies. Both greenhouse gas and financial metrics are used to determine the weightings. Each weight reflects the share of a company's emissions owned by the portfolio divided by all emissions owned by the portfolio. The share of a company's emissions owned by the portfolio is the share of the enterprise value owned by the portfolio times the company's GHG emissions.

  ClimFIT	<h2 style="color: green; text-align: center;">ECOACT CLIMFIT TEMPERATURE</h2> <p>EcoAct applies a mosaic of methods to derive various alignment and Implied Temperature Rise metrics for companies and portfolios. The following review is based on one of the methodologies they offer to their investor clients. This method measures the Implied Temperature Rise associated with declared company targets.</p>
Use case	
Assessment question	To what degree do corporate targets within a portfolio translate?
Conditions for the portfolio to be aligned with a 2°C or well below 2°C trajectory?	Be invested in energy companies that produce 100% renewable energy and/or have a validated science-based target and/or have publicly declared targets on Scope 1 and 2 that imply a decarbonization rate equal to the global average yearly decarbonization rate needed under a 1.5°C, well below 2°C and 2°C scenario and have a scope 3 target if scope 3 > of 40% Scope 1,2 and 3.
Applicability	
Investment strategies & portfolio	<ul style="list-style-type: none"> • Applicable to companies operating in multiple regions and sectors of the world (global scenario); • Focus on absolute targets, thereby ensuring that the global emissions budget is respected, regardless of the portfolio/ company type (growth, value); • Applicable to diversified and thematic portfolios; • “Solutions”/ “Greening by” companies assessed based on their Scope 1, 2 and 3 targets.
Asset classes	Listed Equity, Corporate Bonds, Commercial Loans and Notes (corporate level assessment)
Coverage	50 000 firms (estimated data) 3000+ including MSCI World + ACWI (reported data)
Sector-coverage	All (GICS sectors)
Usability	
Output	Harmonized target dataset; Implied Temperature Rise of companies’ targets; Implied Temperature Rise of sectors and HQ location ; Implied Temperature Rise of portfolios; Temperature trajectory over several years.
Updates	Database is updated once a year; historical datasets are available from 2017.
Accessibility	EcoAct provides clients, on demand, with underlying analysis, model, and method
Methodology development	
Data sources	EcoAct database; SBTi “Companies taking action”; IPCC scenario; Corporate Reporting
Data checks & quality assurance; Management of uncertainty	Uncertainty is managed through recommendations to clients on the limits of available reported data and inner limits of assumptions within the methodology aiming at bigger coverage and advisory on communication around its insights.

Temperature alignment assessment recipe

Step 1. Harmonization of GHG emissions reduction targets as disclosed by companies, including but not limited to companies with committed and validated science-based targets.

- Use the **minimum coverage requirements of the SBTi** to accept/reject Scope 1 and 2, and determine whether a company should have a Scope 3 target.
- Use only **science-based target validated, committed or absolute targets**.
- Renewable energy targets not taken into account, supplier and customer engagement targets for Scope 3 included, but represent a small share of Scope 3 targets).
- Measure the **implied target decarbonization rate** (ambition) between the target base year and the target year. The target timeframe is not harmonized for all companies since the target time frame is based on current targets of companies.

Step 2 & 3. Choice of scenario and temperature trajectories and deriving temperature alignment benchmarks


- **Decarbonization rates based on SBTi absolute contraction method, itself based on IPCC:**
 - 1.23% annual linear reduction rate: 2 °C (50% chance)
 - 2.5% annual linear reduction rate: well below 2 °C (66% chance)
 - 4.2% annual linear reduction rate: 1.5 °C (50% chance)
- **Sector-agnostic.**

Step 4. Temperature alignment assessment

- **Classify companies within 6 high-level categories** based on the decarbonization speed of absolute Scope 1 and 2 targets (as defined in Step 2), the existence of a reduction target on Scope 3 emissions (if represents over 40% of total emissions), participation to the SBTi, and main operating sectors when no disclosure (decision tree).
- When **companies do not report targets**, or targets with insufficient coverage, or intensity targets not validated by the SBTi, attribute an Implied Temperature Rise score based on the sector of operations - conduct analysis on sector intensity and divide companies into four groups: highly emissive, emissive, relatively emissive, less emissive. Each company is then **rated according to its sector, and therefore rated accordingly to the group's Implied Temperature Rise** (between 3 °C (Business-as-Usual) and 5,5 °C).
- Temperature levels: **1,5 °C; Well below 2 °C; 2 °C; 3-3,4 °C; 3,5-3,9 °C; 4-4,9 °C, 5-5,5 °C.**

Step 5. Portfolio aggregation.

- Aggregate at portfolio level: weighted average based on portfolio positions/ unweighted.
- Additional weightings are available on demand, namely assets, sales, investor ownership and corporate capital structure (market capitalization, enterprise value, debt outstanding etc.) types of weightings.

	<p style="text-align: center;">URGENTEM</p> <p>Urgentem (previously Engaged Tracking) provides an “alignment” and “target-setting” module on its climate data platform. The analysis shows what should be a portfolio, sector or company decarbonization rate and absolute emissions in order to be in line with a user-defined temperature trajectory.</p>
Use case	
Assessment question	How far is my portfolio (as well sectors and companies within the portfolio) from where it should be in 2020, 2025, ... to 2060 under different temperature scenarios?
Conditions for the portfolio to be aligned with a 2 °C or well below 2 °C trajectory?	Invested in companies that decarbonize at the required rate under different temperature scenarios and/or have current absolute emissions lower than its 2 °C emission allowance.
Applicability	
Investment strategies & portfolio	<ul style="list-style-type: none"> • Applicable to companies operating in multiple regions of the world (global scenario); • Focus on absolute emissions, thereby ensuring that the global emissions budget is respected, regardless of investment strategy (growth or value); • Applicable to both thematic and diversified portfolio; • “Solutions”/ “Greening by” companies assessed based on their direct emissions.
Asset classes	Listed equity and corporate bonds.
Coverage	4,500 companies directly analyzed based on the world’s largest indices (MSCI ACWI, S&P 500, STOXX 600, FTSE 100 etc.). Inference tool for the remaining public and private companies.
Sector-coverage	All sectors, split between 10.
Usability	
Output	<ul style="list-style-type: none"> • Portfolio, sector and company-level budget for different temperature trajectories; • Current portfolio, sector and company level Scope 1, 2 and 3 emissions;
Updates	Company-level emission dataset updated annually; scenario data reviewed on an ad-hoc basis following major publications by the IPCC and IEA.
Accessibility	Online platform, data downloads, API integration.
Methodology development	
Data sources	Urgentem Scope 1, 2 and 3 dataset; IPCC 1.5 LED, P1 and P2, IEA ETP
Data checks & quality assurance; Management of uncertainty	A combination of human (QA team) and automated (software tool) checks to ensure data validity. Engagement with companies to validate emissions figures. Probability distribution within every industry and category (Scope 1, 2 and 3 categories) for each data point; inference and Winsorization to outliers. In terms of the underlying scenarios, use the estimates of total carbon emissions changes over time in line with a 50% probability of outcome.

Temperature alignment assessment recipe

Step 1: Bottom-up calculation of the current and forward-looking climate performance of each company

- **Reported data** for company-level GHG footprints.
- When no reporting, **estimation model** based on reported industry intensity distributions.
- Scope 1, 2 and 3 for portfolio-level analysis; Scope 1 for sector and company analysis (Scope 2 and 3 in production).
- No double-counting procedure in this module.
- Companies are mapped one to one to BICS sectors (coming: SASB SICS).
- **Includes 3 year historical trend data.** Company targets and momentum will be incorporated in the near future to estimate future emissions trajectory.

Step 2: Choice of scenario and temperature trajectories

- Scenarios: **IPCC 1.5 LED, P1 and P2, IEA ETP (user choice)**

Step 3: Deriving temperature alignment benchmarks

Portfolio-level:


- Derive what the portfolio GHG footprint intensity (per market cap or revenue, Scope 1, 2 and 3) is compared to what it global average emissions intensity (a global index of large and mid-caps from developed and emerging markets as a proxy). Emissions and market share are weighted averages by portfolio position.
- Derive what the portfolio GHG footprint **decarbonization rate should be under different scenarios**. Portfolio temperature trajectories are calculated based on the **global rate of decarbonization** as embedded in the chosen scenario.
- **Base 100 = 2017 – to 2060.**
- 100%: Estimated global emissions intensity per unit of revenue (or market cap) in 2017.

Sector-level & company-level:

- Highlights the absolute Scope 1 emissions of each of the sectors within the portfolio and details the emissions allowance remaining to meet the chosen scenario trajectory and year.
- Further disaggregate sector-level budget to BICS sectors as given by scenarios output using market share.
- Industry budget trajectories are scaled down to the company-level by market share.
- Scope 1 only at the moment, Scope 2 and 3 in development.

Step 4: Temperature alignment assessment

- No Implied Temperature Rise metric: **compares the current portfolio, sector and company climate performance with its required forward-looking trajectory under different temperature scenario.**
- The company's Scope 1 figures for the past 3 years are plotted on the temperature trajectories to determine whether the firm is demonstrating positive or negative momentum.
- Additional information is provided, such as: does the company have a committed or validated science-based target?

	<h2 style="text-align: center; color: green;">I CARE & CONSULT SB2A / SBAM</h2> <p>The SB2A measures temperature alignment at company-level, based on past and forecasted climate performance and how it compares to company-specific decarbonization trajectories (SDA approach). ICC also offers a top-down analysis that can be applied to any company based on its revenue and sector split. The combination of bottom-up and top-down approach is the Climate SBAM database.</p>
Use case	
Assessment question	To what degree does the cumulated over(under)shoot of company's climate performance between 2010 and 2050 translate, relative to their company-specific temperature trajectory benchmarks ?
Conditions for the portfolio to be aligned with a 2 °C or well below 2 °C trajectory?	Be invested in companies whose past and forecasted year-on-year rate of decarbonization per unit of production is in line with its company-specific intensity benchmark, converging to the required sector-level intensity by 2050.
Applicability	
Investment strategies & portfolio	<ul style="list-style-type: none"> • Applicable to companies operating in multiple regions of the world (global scenario); • If absolute emissions of a company are growing, the company must reduce its emission intensity by the required rate to achieve a below 2 °C temperature, • Applicable to diversified and thematic portfolios; • “Solutions”/ “Greening by” companies assessed based on their product mix, sales segment and contribution to the low-carbon transition.
Asset classes	Listed securities (equity and corporate bonds), private equity, real assets (real estate and infrastructure)
Coverage	Any listed securities; Standard package of bottom-up analysis = MSCI World constituents
Sector-coverage	Top-down analysis: all, split in 100 sub-sectors. Bottom up analysis: Electric Utilities; Steel; Aluminum; Cement; Automobile Manufacturers; Passenger transport operators; freight operators; Oil & Gas; Agriculture; Food & beverages; (2020: Real Estate and Home Building companies); Electric equipment, Auto parts, Transport OEM, Energy equipment; (2020: Building products); (2020: Finance)
Usability	
Output	<ul style="list-style-type: none"> • Implied Temperature Rise score of companies • Implied Temperature Rise score of portfolios • Emissions overshoot/undershoot versus the 2DS trajectory
Updates	Database updated every 6 months; prior versions of the database available over 3 years.
Accessibility	Currently xls/csv delivery, moving to online database by Q3 2020
Methodology development	
Data sources	Company reporting, IEA ETP scenario, International Climate reporting systems (EU Automobile, ...)
Data checks & quality assurance; Management of uncertainty	Data checks at company and sector level; triangulating targeted decarbonization with historical trends; discounting target ambitions based on participation in industry-initiatives.

Temperature alignment assessment recipe

Step 1: Bottom-up calculation of the current and forward-looking climate performance of each company

- **GHGs intensity** as the main variable, where possible per sector-specific unit of production;
- Based on reported data only for GHGs; GHG intensity can be recalculated (Oil & gas e.g.); product and sales mix for equipment sectors;
- Assessed on the “**relevant**” **scope based on sector**: e.g. Scope 1 and 2 for steel manufacturers, scope 3 use of sold products for auto-manufacturers; scope 1+2+3 for O&G players;
- **One-to-many company-sector mapping**;
- Calculation of emission intensity trend **from 2010** (or any closest year with available data);
- Historical extrapolation or targeted climate performance, discounted based on its credibility (based on its participation in industry initiatives and validated/ committed science-based target).

Step 2: Choice of scenario and temperature trajectories

- Based on **IEA ETP 2017**: B2DS, 2DS and NPS

Step 3: Deriving temperature alignment benchmarks

- Where available, use **sector-specific trajectories** per unit of production based on IEA ETP. Not further adapted to companies based on market-share as in SDA. Method by convergence: takes into account company's intensity starting point and decarbonization rate needed to converge to sector intensity by 2050 under different temperature constraints (SDA-like approach within SBT).
- **Further expand IEA ETP trajectories to additional sectors** (e.g. auto components, electrical equipment, agriculture and food) by using additional sources and developing models.
- Can include an intensity benchmark adjustment if sector outputs grows faster than that in scenario.

Step 4: Company-level temperature alignment assessment


- Calculates the **cumulated overshoot/ undershoot from 2010 to 2050** of carbon emissions relative to the temperature trajectory that the company should follow to converge by 2050 (vs sector average).
- 2010-2014: Comparison of company historical climate performance with sector-average; post 2014: comparison of company historical and future climate performance with temperature trajectories.
- Implied Temperature Rise score is bounded between 0.5°C and 6,5°C

Step 5 (optional): Complement with top-down analysis for companies not covered by the above process

- For each sector/region brick, an average Implied Temperature Rise metric is developed by using IEA scenarios, extrapolation, statistical data or regional/sector IEA scenarios.
- Retrieve the company's turnover split by segment and region and built a weighted Implied Temperature Rise metric.
- Banks and financials are covered by the sectoral split of their loan books/investments and their regional breakdown.
- In partnership with Arvella Investments

Step 6: Aggregation at portfolio-level

- Weighted based on portfolio position.

	<h2 style="text-align: center;">ISS-ESG CLIMATE SCENARIO ANALYSIS</h2> <p>The ISS-ESG Climate scenario analysis analyzes the emission intensity from the direct emission of a company to see which climate scenario it is aligned with based on its market share's carbon budget.</p>
Use case	
Assessment question	To which climate scenario is the direct emission intensity of a company and/or portfolio aligned with, based on its market share's carbon budget, until 2050?
Conditions for the portfolio to be aligned with a 2 °C or well below 2 °C trajectory?	<ul style="list-style-type: none"> • Portfolio-level: Be invested in companies' that have decarbonized historically at a rate in line with their Scope 1 budget to 2050 under a 2DS scenario. • Company-level: Be invested in companies' that historically have decarbonized at a rate sufficient for their carbon intensity to converge in 2050 at sector-level and/or that have a sufficiently strong science-based target; be invested in oil & gas companies that decrease their production in line with IEA 2DS scenario; be invested in utility companies that decarbonize their carbon intensity per MWh in line with their regional scenario.
Applicability	
Investment strategies & portfolio	<ul style="list-style-type: none"> • Applicable to companies operating in multiple regions of the world (global scenario); geographical context taken into account in some cases; • Focus on both intensity and absolute emissions, thereby ensuring that the global emissions budget is respected, regardless of investment strategy (growth or value); • Applicable to diversified and thematic portfolios; • "Solutions"/ "Greening by" companies assessed based on their direct emissions.
Asset classes	Listed equity and corporate bonds. Bespoke methodologies for other asset classes.
Coverage	Over 25 000 companies.
Sector-coverage	All, IEA sectors further split between 123 sub-sectors.
Usability	
Output	<ul style="list-style-type: none"> • Company alignment over time with the 2DS, 4DS and 6DS (per year until 2050) – SDS alignment planned for end of Q2 2020; • Expected company emissions (tCO₂ per year until 2050); • Company carbon budget over time (tCO₂ per year until 2050); • Percentage of carbon budget used (%) (per year until 2050); • Portfolio alignment (top-down); • Implied Temperature Rise range on a bespoke level.
Updates	The scenario analysis data is updated at the end of each year (12/31) together with annual update of company emissions. The scenario dataset and company emissions are available offline from year 2012 onwards in raw format. Three years of historical data is available on automatic reporting platform (Portfolio Analytics).
Accessibility	In raw data format (2012-2050), In Climate impact reports (2017Q4 onwards)
Methodology development	
Data sources	IEA ETP 2015; CDP; Company reporting; Science based target initiative; Internal modelling of historical emissions and trajectory rates.
Data checks & quality assurance; Management of uncertainty	Compare reported emissions between sources and estimation models; adjust for reporting methodology updates on company level; in-house developed trust metric which give a score from 1-100 of reporting quality of reported emissions. Combine 5 years of historical data together with SBT reported targets and commitments to estimate the emissions from now until year 2050. On economical level, no growth estimates in market share between sectors or companies. Instead data is updated annually includes any changes in market dynamics.

Temperature alignment assessment recipe

Step 1: Bottom-up calculation of the current and forward-looking climate performance of each company

- Collect **company-reported GHG data**; when no reporting, **estimation using ISS ESG estimation model** (LCA & EEIO for scope 3 and regression-based for scope 1&2);
- **Normalized by revenue** for all sectors **but utilities** (MWh) and **oil & gas companies** (bboe);
- **Analysis on Scope 1; scope 3 modelling for fossil fuels only**. Scope 2 is not included in the current analysis to avoid double counting issues at portfolio level as the results are expressed in absolute emission numbers and budget.
- Forward-looking climate performance calculated to **2050**, based on:
 - **5 years of historical emission intensities** on company level. Output specific approaches used for utilities and Oil & Gas sector (reserves & production)
 - **Companies with either validated or committed science-based target** get a favorable tilt in the emission trajectory to 2050.

Step 2: Choice of scenario and temperature trajectories

- **ETP 2015 to get a broad 2-6 degree scenario level**. Currently working on update to release scenario analysis based on WEO 2019, expected release end of Q2 2020. The release will also include additional sector-specific models.

Step 3: Deriving temperature alignment benchmarks


- Break down the IEA **absolute budget at sector-level** for the 2DS, 4DS and 6DS;
- Further break it down into sub-sectors. For example, the Power sector is broken down into Mixed Electricity, Gas distribution, Electric Utilities, Conventional Electricity and Alternative Electricity based on ISS internal classification of companies (200 CNI subsectors available in the scenario analysis).
- **Derive an intensity benchmark** by dividing absolute emission budget per sector and sub-sector with GDP forecasts per sub-sectors: since the analysis covers several decades, each sector is expected to grow in line with the world GDP. Therefore, the same expected growth rate is applied to each sector and company (IEA).
- **A company-specific decarbonization benchmark is calculated** taking into account current performance (year of assessment) and the **required convergence economic intensity in 2050** under different scenario.
 - For utilities, the regional mix of operations is used to determine the company-specific benchmark.
 - For **oil companies**, the benchmark is build based on production: all companies should reduce their production base on a specific rate, regardless of their starting point, that corresponds to the scenario (**= contraction method**).

Step 4: Company-level temperature alignment assessment

- The **overall carbon budget per company and over(under)shoot**, based on constant market share assumption, is calculated based on the comparison between the company-specific carbon budget (as calculated based on the decarbonization trend derived in Step 3) and its forecasted absolute emissions.
- If a company has a committed or validated science-based target may not be considered in line with the 2di scenario, depending on its budget and historic performance.

Step 5: Aggregation at portfolio-level

- All the **portfolio holdings' carbon budgets are consolidated into one based on ownership**. The alignment is then decided based on the Scope 1 emissions generated by the holdings compared to the portfolio carbon budget. The analysis is done based on absolute emissions.
- The overall Implied Temperature Rise score is inferred from gap analysis at the end of the time horizon.

	<h2 style="text-align: center; color: green;">MSCI WARMING POTENTIAL</h2> <p>The MSCI Warming Potential methodology derives an implied temperature rise (referred to as “Warming Potential”) for companies and portfolios by benchmarking company-specific emissions trajectories and green revenue projections to climate scenario-informed warming curves. The Warming Potential methodology will continue to evolve as the granularity and availability of climate data improve; as such, this section presents the current methodology as well as areas of ongoing research that could inform future methodology updates.</p>
Use case	
Assessment question	To assess the implied global temperature rise associated with portfolio companies’ emissions intensity trajectories, considering the portfolio companies’ sectors of activity, current emissions intensities and projected future green revenue.
Conditions for the portfolio to be aligned with a 2°C or well below 2°C trajectory?	In order for a portfolio to be aligned with a 2°C or well-below 2°C trajectory based on the MSCI Warming Potential methodology, the portfolio must be invested in companies that (a) currently have an emissions intensity consistent with a 2°C or below world by 2030; or (b) can be expected to grow their green revenue at a sufficiently high rate to bring their emissions intensity consistent with a 2°C or below 2°C scenario by 2030.
Applicability	
Investment strategies & portfolio	<ul style="list-style-type: none"> • Applicable to strategies and portfolios across multiple regions of the world (global scenarios); • Applicable to diversified, thematic or conviction (concentrated) portfolios ; • Identifies companies that can achieve a below 2°C temperature if they decouple their direct emissions from economic growth by the rate required by various temperature scenarios; • Identifies “solutions”/ “greening by” companies based on their future green revenue forecasts (using current green revenue estimates and analysis of low-carbon patents).
Asset classes	Corporate issuers of equities and bonds.
Coverage	The companies represented in the MSCI ACWI Investable Markets Index (MSCI ACWI IMI), which is approximately 9,000 companies, as of June 2020.
Sector-coverage	All Global Industry Classification Standard (GICS®) sectors represented in the MSCI ACWI IMI (GICS is a global industry classification standard jointly developed by MSCI and Standard & Poor’s).
Usability	
Output	<ul style="list-style-type: none"> • Warming Potential temperature for companies and portfolios. • Continuum of temperatures between 1.3 and 6.0°C. • Sector-agnostic, sector-specific and combined.
Updates	Quarterly.
Accessibility	Online platform (ESG Manager), flat files and API.
Methodology development	
Data sources	<p>Company-level data: company disclosures (financial and extra-financial), MSCI ESG Research LLC’s proprietary estimates of carbon footprint where required, MSCI ESG Research Environmental Impact Metrics and patent data from over seventy patent offices worldwide (for current and projected low-carbon revenue).</p> <p>Scenario data: analysis of the Nationally Determined Contributions (NDCs), scenario data from various Integrated Assessment Models, ensemble of scenarios published yearly in the UNEP Emissions Gap Reports.</p>
Data checks & quality assurance; Management of uncertainty	All company-level input data goes through a robust quality control process, including review by analysts of disclosed data and submitting data to companies annually to check its accuracy. In addition, Warming Potential results are subject to quality checks by analysts on aggregate statistics and an investigation of outliers.

Temperature alignment assessment recipe

Current methodology (as of June 15th, 2020)

Step 1: Bottom-up calculation of the current and forward-looking emissions intensity for each company

- Collect company's reported **data Scope 1 emissions intensity** per dollar revenue
- Where a company has no reported data, **estimate** its Scope 1 emissions intensity using proprietary carbon footprint estimation model
- **Project company's future low-carbon revenue**, based on company-specific estimates of its current low-carbon revenue as well as its granted low-carbon patents
- Estimate company's future emission intensity based on current intensity and future green revenue projections

Step 2: Construction of warming curves ("temperature alignment benchmarks", in this report)

- **Derive carbon budgets per sector for scenarios consistent with different temperature targets:** 3.8°C (business as usual scenario), 3.0°C ("NDC" scenario), 2°C and 1.5°C scenarios (carbon budget taken as the mid-range of the ensemble of scenarios published in the UNEP Emissions Gap Report)
- **Map those scenarios to the universe of companies covered** (a subset of the global economy) and compute what Scope 1 intensities of revenue correspond to different temperatures in each sector
- Draw the "warming curves", relating such sector intensities to temperatures
- In total, 11 "sector-specific" curves are created, following a proprietary taxonomy of sectors ("Emission Sectors") developed specifically for the purpose of analysing emissions and climate policy
- In addition, a "sector-agnostic" curve is also created. The sector-agnostic curve is representative of all sectors represented in the universe of companies covered

Step 3: Temperature alignment assessment

- **Compute a company's sector-specific Warming Potential temperatures**, based on the company's projected emissions intensity for the activities it carries out in each sector. In each sector, the Warming Potential is based on the distance between a company's emission intensity in that sector and the required sector intensity in 2030 under different temperature assumptions.
- For companies active in more than one sector, sector-specific temperatures are revenue-weighted to produce the company's overall sector-specific Warming Potential temperature
- Compute a company's **sector-agnostic Warming Potential** based on its overall future emissions intensity and the sector-agnostic warming curve
- The **combined Warming Potential** is computed as the average between the sector-specific and sector-agnostic measures

Step 4: Aggregation at portfolio-level


- Company-level Warming Potential temperatures are weighted based on portfolio holdings to produce the portfolio-level Warming Potential

Further areas of ongoing research

MSCI ESG Research is currently researching potential updates to the Warming Potential methodology, including:

- Integration of Scope 2 and Scope 3 emissions into the analysis
- Integration of company decarbonization targets into the analysis
- Revisions to the aggregation of sector-specific and sector agnostic temperatures
- Revisions to the treatment of future low-carbon revenue in the model
- Expansion of the scope to cover Sovereign exposures

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	<p>RIGHT. BASED ON SCIENCE: X-DEGREE COMPATIBILITY MODEL</p> <p>The X-Degree Compatibility (XDC) Model determines the contribution of single economic entity to global warming under various scenarios, including <2 °C scenarios.</p>
Use case	
Assessment question	What would be the temperature increase by 2050 if the world operated as intensively as the entity under consideration under the chosen scenario? The entity can be a project, company, portfolio, or a country.
Conditions for the portfolio to be aligned with a 2 °C or well below 2 °C trajectory?	An XDC of <2 °C does not necessarily mean that the company's performance and trajectory is compatible with a <2 °C world. A company that is <2 °C –aligned has an Baseline/Scenario XDC maximum equal to its Target XDC as calculated under a given <2 °C scenario.
Applicability	
Investment strategies & portfolio	<ul style="list-style-type: none"> • Possible to derive a geography-specific Baseline and Target XDC if data is available; • “Growth” companies can achieve a below 1.5 °C temperature if they decouple their emissions by the required rate, regardless of the growth in their absolute emissions; • Applicable to diversified and thematic portfolios; • “Enabling” / “Solutions”/ “Greening by” companies assessed based on Scope 1, 2 and 3 emissions.
Asset classes	Publicly or privately traded companies, corporate bonds, government bonds
Coverage	Currently 4.500 companies for Baseline XDC (approx. 98% coverage of MSCI World), 4.500 companies for Target XDC, upon request companies for Scenario XDC.
Sector-coverage	Baseline XDC for 40 double-digit NACE Sectors, Target XDCs for all sectors that are covered by <2 °C-scenarios and have defined emissions budgets.
Usability	
Output	<p>How many °C the Earth would warm up to by 2050, if all companies were to operate as emissions intensively as the one at hand</p> <ul style="list-style-type: none"> • Baseline XDC: ... under the consideration of SSP2 assumptions on the rate of decoupling of emissions and financial activity? • Scenario XDC: ... under a company-specific scenario (such as: what if the company reaches its own climate target)? • Sector XDC: ... as the sector under consideration? • Portfolio-level XDC: ... as the weighted average of companies within a portfolio? • Target XDC: What company-specific XDC can be considered in line with an established <2 °C-Scenario, such as the 1.75 BD2S IEA scenario?
Updates	Updates once per year. Latest: 2018. All data from 2016 on. Some data available from 2013 (Solactive Europe 600).
Accessibility	Excel & CSV file, Python code available for students and academics, online tool (Q1 21)
Methodology development	
Data sources	Scope 1-3 emissions (Urgentem, formerly Engaged Tracking); gross value added (GVA; FactSet Research Systems); Global GVA (World Bank and OECD); base year atmospheric GHGs concentration (NOAA); SSP2 Marker scenario decoupling rates (IIASA); company's targets (report, CDP); Climate Model (FaIR)
Data checks & quality assurance; Management of uncertainty	Standardized data quality certification process; outliers check; open source technology and models; centralized organization of code; build a model to have access to all parameters and variables; launch of an uncertainty quantification project through the right.open project in collaboration with academia.

Temperature alignment assessment recipe

Step 1: Bottom-up calculation of the current and forward-looking climate performance of each company

- Gather **current companies' scope 1, 2 and 3 emissions** from Urgentem (formerly Engaged Tracking);
- When no reporting, use Urgentem **estimation model** (regression-based);
- Compute companies' emissions **intensity per unit of value added**;
- **Adjust for double-counting**: divide Scope 2 and 3 emissions by 2; keep 100% of scope 1;
- **Forecast each company's emission intensity per unit of value added to 2050** based on current climate performance and evolution rates as embedded in different scenarios.
 - **Baseline scenario**: company-specific emissions intensity decouple at the global average rate derived from the Marker Scenario of the Shared Socio-Economic Pathway 2 (SSP2).
 - **Scenario XDC**: financial performance of the company and emissions evolve based on a company-specific scenario, such as communicated climate targets, if any. Therefore, the rate of decoupling results from e.g. the climate-targets-induced emissions reductions. For all years and emissions scopes not covered by the scenario, baseline growth rates of both emissions and GVA are assumed.
 - The XDC Model allows to change underlying assumptions to create additional scenarios.

Step 2: Derive company-specific XDC values corresponding to each scenario

- **Scale up each company emissions** between 2018 and 2050 based on global GVA. The result is the **absolute amount of emissions** that would have reached the atmosphere by 2050 if all companies operated as emission intensively as the one at hand under the chosen scenario.
- **Input this global emission figure into the FAIR climate assessment model** and calculate the change in temperature compared to pre-industrial level these emissions would lead to.

Step 3: Derive additional XDC values to put the company-specific XDC into context

Since companies have very different economic emission intensities due to the diverse nature of their business models, a cross-sectoral comparison of company-specific XDCs (see above) should be avoided.

- **Sector XDC**: Aggregate data on GVA and Scope 1-3 emissions for a minimum number of relevant companies within a NACE sector. Calculate the quantity of absolute emissions that would reach the atmosphere by 2050 if all companies operated as intensively as this sector. Input in FAIR model and derive Sector XDC, expressed as temperature.
- **Target XDC**: **Compute the required reduction rate under the IEA B2DS at sector or sub-sector level based on IEA segmentation**. Apply the reduction rates to base year sector/company emissions intensity, disaggregated between Scope 1 (reduction rate of the sector), Scope 2 (reduction rate of the Energy sector) and Scope 3 (all sectors), to 2050. Adjust the curves based on the differential GDP growth under the IEA B2DS and SSP2 scenarios. Scale up the sector emissions intensity to absolute emissions, input in FAIR model and calculate Target XDC.
- **A range of other XDCs can be generated based on user input on key parameters.**

Step 4: Aggregation at portfolio-level

- The XDC Model is a non-linear model. Therefore, the weighted average of company's emissions intensity by portfolio position to 2050 and input it in the XDC Model allows to calculate the Portfolio XDC (same logic as company-level XDC).

Trucost ESG Analysis S&P Global	<h2 style="color: green; text-align: center;">S&P TRUCOST SDA-GEVA MODEL</h2> <p style="text-align: center;">The SDA-GEVA approach measures portfolio alignment at investee company-level, based on their realized and future climate performance and how it compares to sector-specific decarbonization pathways (SDA) or, if not available, to sector agnostic pathways (GEVA).</p>
Use case	
Assessment question	To what degree does the cumulated over(undershoot) of the past and future climate performance of companies – across all sectors - versus their company-specific trajectory under a 2 °C scenario translate?
Conditions for the portfolio to be aligned with a 2 °C or well below 2 °C trajectory?	<ul style="list-style-type: none"> • Be invested in companies whose forecasted rate of decarbonization per unit of production (based on asset-level data, targets, and extrapolation) is in line with its company-specific benchmark, converging to the required sector-level intensity by 2050. • Be invested in companies whose emissions per unit of value-added decrease at the same rate as the RCP2.6 scenario year-on-year.
Applicability	
Investment strategies & portfolio	<ul style="list-style-type: none"> • Applicable to companies operating in multiple regions of the world (global scenario); • Growth companies can achieve a below 2 °C temperature if they decouple their emissions by the required rate, regardless of the growth in their absolute emissions; • Applicable to diversified and thematic portfolios; • “Solutions”/ “Greening by” companies assessed based on their direct emissions.
Asset classes	Listed equity, corporate bonds and corporate loans
Coverage	1,800 companies (80% of global market capitalization and investment grade; 90% of global GHG emissions). 4% of companies with SDA; 96% of companies with GEVA in terms of number of companies. 40% of companies with SDA in terms of total GHG emissions.
Sector-coverage	SDA: Electric Utilities; Steel; Aluminum; Cement; Automobile Manufacturers; Passenger transport operators; freight operators; Oil & Gas. GEVA: All others (and classified by GICS sub-industry/industry group)
Usability	
Output	<ul style="list-style-type: none"> • Company-level, sector-level and portfolio-level Implied Temperature Rise metric • % over(undershoot) and absolute emissions • % over(under) carbon gap per mn invested • Intensities for each year and each company per unit of production or value add
Updates	Database updated once a year, following companies’ disclosure (see below). Data available from 2012.
Accessibility	Datafeed: Trucost EDX (FTP feed) ; S&P XpressFeed (available in July 2020). Reporting service: Integrated into Trucost Portfolio TCFD Audit Service Tools: Excel Tool + Trucost on MI Desktop (available in October 2020) Indices: S&P Paris Aligned Benchmark & Climate Transition Benchmark Index Series
Methodology development	
Data sources	Annual Reports, CSR reports, Company website, CDP, Trucost company engagement (Trucost Environmental Register); asset-level data from in-house research (e.g. S&P MI Energy)
Data checks & quality assurance; Management of uncertainty	Dedicated Quality Management System in place which consists of a number of procedures and quality checks. In addition, S&P Trucost systematically indicates: 1. the source of each data point (Exact Value from Annual Reports, etc.), 2. the type of sources used to calculate future emissions, 3. data on each asset (asset name, fuel type, country, year of construction, development stage etc.) for asset-level data.

Temperature alignment assessment recipe

Step 1: Bottom-up calculation of the current and forward-looking climate performance of each company

- **Scope GHGs 1 and 2** from 2012 onwards or latest available for all companies across all sectors;
- **Horizon year is 2025** because CAPEX data are only available for the next 5 years and targets data are generally short or medium term targets
- **Scope 3 “use of sold product” for automobile manufacturers and O&G**, based on:
 - Barrels of oil & gas, vehicles per model/country/fuel etc. (production data reported by companies);
 - Reported Scope 3 data (from CDP).
- No estimation when companies do not report past emissions: excluded from the temperature alignment analysis.
- **Estimate the future climate performance of each company based on specific data hierarchy:**
 - Disclosed emissions reduction targets if consistent with asset-level data and/or historical trends;
 - If not, asset-level data based on internal datasets such as, for example, S&P World Electric Power Plants;
 - If no asset-level data, then unchecked disclosed emissions reduction target;
 - If not, company-specific historical emissions trends for companies with homogeneous activities;
 - GICS sub-industry average historical emissions trends;
 - No change in emissions intensity;
- Sub-industry historical trends in value-add (gross profits/ revenue minus COGS) are applied (inflation-adjusted).

Step 2: Choice of scenario and temperature trajectories

- Use **IEA ETP** for homogeneous sectors; **IPCC RCPs & SR1.5** for heterogeneous sectors (see p.137 of IPCC SR1.5 report for consistency checks).


Step 3: Deriving temperature alignment benchmarks

- **Homogeneous sectors** where a sector-specific trajectory is available in IEA ETP:
 - SDA approach: sector- and company-specific temperature benchmarks per unit of production.
 - Based on the convergence principle – takes into account company’s intensity starting point and decarbonization rate needed to converge to sector intensity by 2050 (T+5) under different temperature levels. Analysis is cut off at 2025 (T+5).
- **Heterogeneous sectors** and/or sectors with no specific trajectory in IEA ETP:
 - GEVA approach: all companies should reduce their emissions per unit of value add at the same rate, regardless of their sectors and starting points (contraction principle).
 - Based on sector-agnostic temperature benchmarks from IPCC RCPs and SR1.5.
- **For auto and oil & gas:** Scope 1&2 GEVA assessment and SDA assessment focusing on Scope 3 downstream.

Step 4: Temperature alignment assessment

- Between 2012 and T+5 (currently 2025), **calculate the cumulated overshoot/ undershoot** of carbon emissions relative to the different temperature benchmarks as derived in step 3.
- Company-level:
 - Translate the overshoot/undershoot to an **Implied Temperature Rise metric** at company and portfolio-level. The Implied Temperature Rise range is attributed based on the temperature benchmark that minimizes the total overshoot/undershoot.
- Portfolio-level:
 - The same logic is applied at company- and portfolio-level. At portfolio-level, company-level overshoot and undershoot is summed before applying temperature: therefore, the overshoot of one company can be compensated by undershoot of another and there is no need for additional sector-weighting.
 - Company-level overshoot/undershoot is aggregated at portfolio-level based on ownership share (calculated based on enterprise value). A weighted average can also be calculated.
- Portfolios can have the following alignments: **<1.5, 1.5-2, 2-3, 3-4, 4-5 and >5**.

Possibility to calculate a weighted average figure based on the % of alignment for each company

	<h2 style="text-align: center; color: green;">2° INVESTING INITIATIVE PACTA</h2> <p>The 2°C portfolio assessment was developed in the context of the Sustainable Energy Investing Metrics project. The objective of the assessment framework is to measure the alignment of financial portfolios with 2°C decarbonisation trajectories. Two methods, FinanceMap by InfluenceMap and More Impact, allow to aggregate the results at portfolio-level.</p>
Use case	
Assessment question	<p>PACTA: How do the capex plans of companies active in climate relevant sectors within the portfolio's compare to climate technology & sector trajectories?</p> <p>FinanceMap gives a score that summarizes the portfolio's alignment (discrepancy) with a Paris Aligned climate scenario in relevant sectors & technologies (with sufficient data availability).</p> <p>MoreImpact calculates the portfolio's average temperature range compared to a set of scenarios for climate relevant sectors & technologies.</p>
Conditions for the portfolio to be aligned with a 2°C or well below 2°C trajectory?	<p>Be invested in companies that plan to add and retire capacity, at a technological level, in line with required expansion and contraction levels.</p>
Applicability	
Investment strategies & portfolio	<ul style="list-style-type: none"> • Applicable to companies operating in multiple regions of the world (global scenario); can be regionalized (emerging vs developed markets); • Focus on absolute technology exposure for oil & gas, coal and utilities, thereby ensuring that the global emissions budget is respected, regardless of investment strategy (growth or value); • "Solutions"/ "Greening by" companies assessed based on their "green" technology exposure (for sectors covered in the assessment).
Asset classes	<p>Listed equity, corporate bonds, and corporate lending.</p>
Coverage	<p>Securities in PACTA Sectors : Bonds: 14 500 ISINs ; Equity: 3 500 ISINs. ~80% of the emissions linked to a typical financial portfolio.</p>
Sector-coverage	<p>PACTA: power utilities, oil & gas production and coal mining, automotive production (technology); steel, cement, aviation and shipping (SDA).</p> <p>More Impact: aggregation at portfolio-level into a single, cross-sector metric: power utilities, oil & gas, automotive and coal mining.</p> <p>Influence Map: aggregation at portfolio-level into a single, cross-sector metric: power utilities, automotive, oil & gas, steel, cement, aviation and coal mining.</p>
Usability	
Output	<ul style="list-style-type: none"> • Current and future (T+5) technology exposure based on revealed plans and capex; • Portfolio-level misalignment indicator at technology-level that measures the extent to which current and planned assets, production profiles, investments, and GHG emissions are aligned with a 2°C trajectory (two methods: Influence Map and MoreImpact).
Updates	<p>Raw data is updated on an on-going to a annually frequency depending on the sector; frequency aligns with the frequency of changes in the sector company plans. On the platform the real economy data is updated approximately twice per year but at least annually; temperature benchmarks (scenarios) are updated annually and also integrated in the same frequency.</p>
Accessibility	<p>Online tool (free)</p>
Methodology development	
Data sources	<p>IEA ETP, additional scenarios where relevant (user choice); asset-level datasets, financial data.</p>

Data checks & quality assurance; Management of uncertainty	Frequent updates of the benchmarks and CAPEX data; Guiding people to use indicators that reflect the uncertainty (e.g. Implied Temperature Rise range instead of an ambiguous distinct temperature); Focus on sector level rather than aggregated results; Educate users/people (e.g. banks) on scenarios and their uncertainties; Focus on a reasonable timescale (5 years) which reflects company “most likely” CAPEX plans; Communicate that the results of the analysis are a scenario and not a forecast of future company plans; Rely units (i.e. capacity and production) which are standardized units and not subject to modeling uncertainties (i.e. emissions).
Temperature alignment assessment recipe	
Step 1. Bottom-up calculation of the current and forward-looking climate performance of each company	
<ul style="list-style-type: none"> Based on physical asset-level databases that aggregate revealed company plans and CAPEX, mapped to companies and end-owners; Portfolio’s current technology exposure is compared to a market portfolio, based on the exposure of the global universe of assets in the relevant asset class to the sectors, as well as to the peers participating in the tests. Results are expressed in absolute terms, investee ownership, or weighted by market value of issuers exposed to technology. 	
Step 2. Choice of scenario and temperature trajectories	
<ul style="list-style-type: none"> ETP 2017 (oil & gas, coal and power, automotive, steel, cement, aviation) & WEO (oil & gas, coal and power) scenario; Where available user of the online tool can choose its scenario. 	
Step 3. Deriving temperature alignment benchmarks	
<ul style="list-style-type: none"> Market’s trajectory benchmark: the combination of the current investment plans of all companies in the respective asset class for the same time period. Scenario-aligned trajectories: Oil & gas, power, coal: Technology-level trajectories that would be expected if the companies in the portfolio were to develop according to the scenarios. Calculated by applying the rates of change as defined by alignment and temperature trajectories to the portfolio companies (contraction/expansion approach). Current company’s performance is taken into account by adjusting the expansion/ contraction rate as given by the scenario based on company-specific market share and technology share. A range of sectors (steel, cement, aviation and shipping) are covered using an SDA-like approach. These are not aggregated at portfolio-level with the More Impact methodologies (see below). 	
Step 4. Temperature alignment assessment	
<p><u>PACTA approach:</u> portfolio-level misalignment indicator at technology-level that measures the extent to which current and planned assets, production profiles, investments, and GHG emissions are aligned with a climate scenario;</p> <p><u>Influence Map</u> has devised an aggregation methodology, to aggregate technology misalignment to sector misalignment and sector misalignment to portfolio-level overall misalignment.</p> <ul style="list-style-type: none"> The overall score is between -100 and +100, with 0 “Paris Agreement aligned” based on B2DS scenario, derived based on the weighted deviation relative to a single baseline (B2DS). Technology exposure deviation is calculated based on the extent to which each technology’s emissions contributions must change between 2019 and 2050 as outlined by the B2DS scenario. Sectors’ alignment are aggregated at portfolio-level based on each sectors’ importance to the B2DS scenario. <p><u>More Impact</u> uses the same premise as the Influence Map aggregation methodology but uses multiple benchmark scenarios in order to account for non-linearity, and express the results in an temperature range in reference the portfolio’s relative alignment with the set of benchmark scenarios (e.g. the portfolio alignment is less ambitious than a 1.75 °C scenario and more ambitious than a 2.0 °C scenario).</p>	



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