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Forward-looking Climate Metrics

An introduction to the current global landscape

Rodolphe Bouquet, Managing Director, Sustainable Investment
Anna Georgieva, Associate Principal, Sustainable Investment
Saumya Mehrotra, Associate Principal, Sustainable Investment

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Table of Contents

1. Overview

This paper:
> Reviews some of the most prominent forward-looking climate metrics (FLCMs) that are currently available to investors, including proprietary methodologies developed by dedicated providers;
> Discusses the challenges that still remain with respect to the coverage, standardization, and reliability of the data underpinning FLCMs;
> Demonstrates the effect of such challenges by showing the divergence in estimated performance for the same companies using different data providers;
> Concludes with a look at key implications for index design and climate transition at large.

2. Forward-looking climate metrics and why we need them

Financial reporting data and greenhouse gas (GHG) emissions footprints[1] are both examples of **lagging** indicators – in other words, they are backward-looking and static. While useful for decision making, such past performance indicators usually provide limited insights for the future. This is especially true in a context in which companies are increasingly changing their products and strategies in light of their climate commitments.

By contrast, **leading** (or **forward-looking**) business indicators such as customer engagement, and climate indicators such as the existence of robust climate targets, provide insights on where company performance is heading before this shows up in static reported data.

Investors are now widely demanding that companies set ambitious climate commitments, and are embedding these in an unprecedented manner in portfolio construction right across the active-to-passive spectrum.[2] A suite of leading climate indicators has emerged that can be used to identify whether entities are performing favorably on their climate commitments. These are referred to in this paper as **forward-looking climate metrics**, or **FLCMs** (see Figure 1).

Figure 1. Sample lagging versus forward-looking business and climate metrics

	Traditional financial analysis	Climate analysis
Lagging indicators – Are observable and measurable – Reflect output, past management decisions, and business strategy	– Revenue – Number of units produced – Customer engagement	– GHG footprint – Emissions covered by existing carbon pricing schemes
Forward-looking indicators – Predict future conditions – Change before lagging indicators change	– Percentage of customers signing up for two-year agreements – Estee Lauder Lipstick Index[3]	– Commitment to science-based climate targets (SBTs) – Task Force on Climate-related Financial Disclosures (TCFD) score

Source: Qontigo.

[1] See the discussion on the "State of the art on carbon footprint" on p. 39 of the EU's 2019 TEG Final Report on Climate Benchmarks and Benchmarks' ESG Disclosures and the UN-convened Net-Zero Asst Owner Alliance's Inaugural 2025 Target Setting Protocol for the role of carbon footprints in portfolio target setting.

[2] See the TCFD 2020 Status Report for a synthesis of climate reporting by approximately 1,700 large companies in multiple sectors and regions over a three-year period.

[3] Bloomberg 2020. Estee Lauder Says 'Lipstick Index' Is Out, Moisturizer Is In

Figure 2. The rationale for the emergence of FLCMs

Source: Qontigo.

Just as multiple traditional financial valuation metrics are used in mainstream financial decision-making, no single climate-related metric can fully describe the position of a product, company, fund, or investment strategy in relation to the climate. For example, while it is possible to have an estimated "1.5 degree aligned" portfolio in technology or green infrastructure, the portfolio's performance could still be impacted by systemic climate change risks (for example due to the failure of coordinated government policy to ensure a transition to a manageable level of warming).[4] As such, a broader dashboard of performance indicators and forward-looking metrics is needed.

Qontigo has identified four FLCM use cases for financial institutions (see Figure 3).

Figure 3. FLCMs for financial institutions can be classified into four use cases

Use case	Overview	Examples
1. Trends	Helps investors assess the real-world climate pathway companies have already adopted	> GHG reduction momentum > Exposure to emissions-intensive assets and business models
2. Targets	Helps investors assess companies' intentions and accountability on continued progress	> Long-, medium-, and short-term emissions reductions targets > Implied temperature rise
3. Quality of climate risk management	Helps investors assess how strategically a company is integrating climate risks and opportunities	> Corporate policies and business strategy > TCFD alignment
4. Climate-related financial risk exposure	Helps investors assess companies' exposure to at-risk business activities and resources	> Transition risk exposure > Physical risk exposure

Source: Qontigo.

[4] PRI 2021. Forward looking climate metrics

2.1. Investor demand for climate action is growing

Since the landmark Paris Agreement was adopted in 2015, there has been a significant increase in global attention paid to both setting and meeting credible emissions reduction targets. In April 2021, over 160 financial firms across the world with more than USD 70 trillion in assets under management (AUM) committed to accelerate the transition to a net zero economy as part of the Glasgow Financial Alliance for Net Zero (GFANZ).[5] This sector-wide strategic forum brings together existing and emerging net zero finance initiatives, including the Net-Zero Asset Owner Alliance, the Net Zero Asset Managers Initiative, the Net-Zero Banking Alliance, and the Net-Zero Insurance Alliance. GFANZ members are required to use science-based guidelines to reach net zero Scope 1, 2, and 3 emissions by 2050, set interim 2030 targets, and commit to transparent reporting and accounting.

Now supported by investors representing over USD 54 trillion in AUM, Climate Action 100+ is the world's largest collaborative investor engagement initiative, and is focused on the 160+ largest corporate GHG emitters in the world.[6] In March 2021, it introduced a new assessment framework called the Net-Zero Company Benchmark, which evaluates companies' performance against the initiative's priorities. These include asking companies to commit to net zero emissions by 2050 or sooner.[7] One of the Benchmark's headline findings was that, while 83 (52%) of the focus companies assessed have announced an ambition to achieve net zero, none has yet fully disclosed how it will achieve this goal.

2.2. The enabling environment is becoming more established

31 countries, accounting for 73% of global GHG emissions, have now either adopted or are considering net zero targets according to the Climate Action Tracker, a scientific analysis organization tracking government climate action against the Paris Agreement.[8] However, even in the optimistic scenario that all these countries actually establish targets and fully implement them, it is estimated that the implied warming level is still well above the 1.5 degree Paris agreement target. Similarly, the 2021 edition of the Climate Change Performance Index (CCPI)[9] – another long-standing tool for identifying leaders and laggards in climate action – also showed that no countries make it to the "very high" rating, based on a range of climate indicators. Since September 2020 several major economies have pledged to increase their climate ambitions, and this is expected to lead to a ripple effect.

One tangible measure of progress is that governments across the world are moving to introduce legislation and regulation requiring climate disclosures, with countries such as the United Kingdom, Switzerland, and New Zealand looking to mandate disclosure on TCFD – the most widely recognized framework for organizations to effectively disclose and manage climate-related risks and opportunities (see Figure 4).[10, 11, 12]

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[5] UNFCCC 2021. New Financial Alliance for Net Zero Emissions Launches

[6] Climate Action 100+

[7] Climate Action 100+ 2021. Net Zero Company Benchmark

[8] Climate Action Tracker 2021. Global Update: Climate Summit Momentum

[9] Climate Change Performance Index 2021

[10] UK HM Treasury2020. UK joint regulator and government TCFD Taskforce: Interim Report and Roadmap

[11] Swiss Federal Department of Finance 2021. Switzerland promotes transparency on climate-related financial risks

[12] New Zealand Ministry for the Environment 2021. Mandatory climate-related disclosures

Figure 4. Core elements of recommended climate-related financial disclosures

Governance
The organization's governance around climate-related risks and opportunities

Strategy
The actual and potential impacts of climate-related risks and opportunities on the organization's business, strategy, and financial planning

Risk Management
The processes used by the organization to identify, assess, and manage climate-related risks

Metrics and Targets
The metrics and targets used to assess and manage relevant climate-related risks and opportunities

Source: TCFD 2021.

While the primary responsibility for tackling climate change remains with governments, since about 2016 central banks and supervisors have become increasingly involved in responding to the climate threat to the financial system. Central banks can help ensure the resilience of the financial system during the transition to a low-carbon economy by providing more and better information to market participants on climate change risks, including via stress testing. "Markets respond to signals from central banks, and the seriousness of intent with which they consider net-zero targets is likely to have a profound bearing on financial market decisions that will ultimately determine capital formation and, thus, the carbon trajectory of the economy." according to a report by the London School of Economics' Grantham Research Institute and the SOAS University of London's Centre for Sustainable Finance.[13] The most notable initiatives include:

> The Network for Greening the Financial System (NGFS), the global green central banking group, is stepping up its work across global jurisdictions. In 2020, the NGFS published several reports, including a number of operational guides and the NGFS scenarios.[14] Looking ahead, it expects to continue expanding its efforts on climate scenarios, supervisory practices, monetary policy, and sustainable and responsible investment practices, and to take the first steps to bridge data gaps in its work.[15]

> In Europe, the European Central Bank (ECB) and Bank of England have confirmed that banks in their jurisdictions will be stress-tested on climate change.[16,17] The ECB – which has already published the results of its own first economy-wide climate stress test – also released a set of guidelines on how banks should

[13] Robins, Dikau and Volz 2021. Net-zero central banking: A new phase in greening the financial system. London: Grantham Research Institute on Climate Change and the Environment and Centre for Climate Change Economics and Policy, London School of Economics and Political Science, and Centre for Sustainable Finance, SOAS, University of London

[14] NGFS 2020. NGFS Climate Scenarios for central banks and supervisors

[15] NGFS 2020. Annual report

[16] ECB 2020. ECB publishes final guide on climate-related and environmental risks for banks

[17] Bank of England 2021. Climate change

manage and disclose climate risks.[18] In addition, it announced that it and the 19 national central banks making up the Eurosystem would start providing annual reports on the climate performance of their investment portfolios using the TCFD framework.[19]

> In Asia, the Joint Committee on Climate Change (JC3) set up by Bank Negara Malaysia and the Securities Commission Malaysia announced in February 2021 the priorities for strengthening the financial industry's capacity to manage climate-related risks and enhancing its role in scaling up green finance through climate scenario analysis, TCFD alignment, engagement, and technical capacity building.[20]

> In North America, the Bank of Canada is working on improving country-specific climate scenario modelling, with results planned for the end of 2021[21]. The US Federal Reserve Board (the Fed) is also building its "capacity to understand the potential implications of climate change for financial institutions, infrastructure, and markets"[22]. The Fed has created an organization-wide Supervision Climate Committee that will develop its approach towards climate risk analysis.

This recent progress made by the global sustainable investment movement despite varying ambition levels across countries has made it clear that overall momentum is unstoppable.

2.3. A new generation of transition roadmaps is emerging

A wide range of both freely and commercially available climate scenario analysis[23] tools exist to help investors implement scenario planning – a key recommendation of the TCFD. The Principles for Responsible Investment (PRI) maintains a directory of climate scenario tools[24] and requires its 3,000+ signatories (which represent USD 100+ trillion in assets) to select the climate reference scenarios they use from a list (see Figure 5). Notably, in mid-2021 the International Energy Agency (IEA) published a long-awaited comprehensive roadmap for the global energy system to reach net zero by 2050.[25]

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[18] ECB Blog 2021. Shining a light on climate risks: the ECB's economy-wide climate stress test – Blog post by Luis de Guindos, Vice-President of the ECB

[19] Change to ECB 2021. Eurosystem agrees on common stance for climate change-related sustainable investments in non-monetary policy portfolios

[20] Bank Negara Malaysia 2021. Joint Statement by Bank Negara Malaysia and Securities Commission Malaysia: Towards Greening the Financial Sector

[21] Bank of Canada 2020. Bank of Canada and OSFI launch pilot project on climate risk scenarios

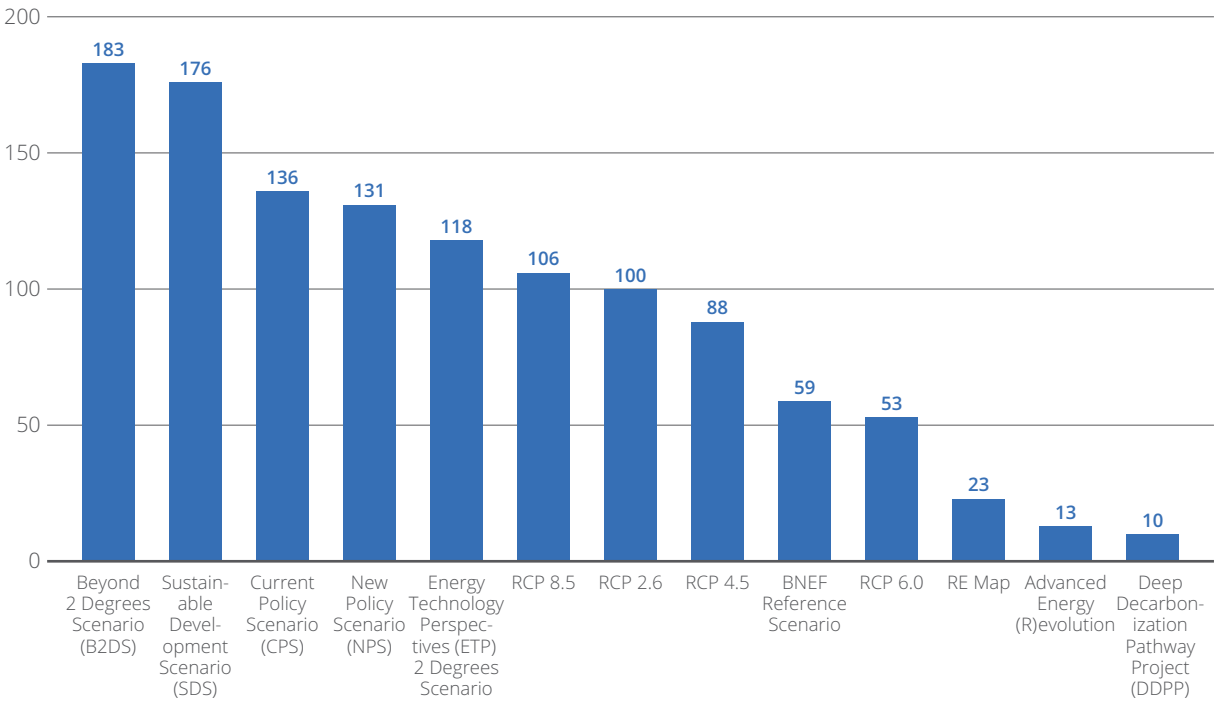
[22] KPMG 2021. ESG: An immediate priority of the new administration

[23] "Scenario analysis is a well-established method for developing input to strategic plans in order to enhance plan flexibility or resiliency to a range of future states. The use of scenario analysis for assessing climate-related risks and opportunities and their potential business implications, however, is relatively recent. Given the importance of forward-looking assessments of climate-related risk, the Task Force believes that scenario analysis is an important and useful tool for an organization to use, both for understanding strategic implications of climate-related risks and opportunities and for informing stakeholders about how the organization is positioning itself in light of these risks and opportunities. It also can provide useful forward-looking information to investors, lenders, and insurance underwriters."
As defined in TCFD 2017. Technical Supplement

[24] PRI 2021. Climate Scenario Analysis

[25] IEA 2021. Net Zero by 2050 – a Roadmap for the Global Energy Sector

Figure 5. Number of PRI signatories using different climate scenarios in 2020



No comparison with 2019 is possible because this question became mandatory in the PRI reporting framework.

Source: Principles for Responsible Investment, 2020.

Efforts to develop climate transition roadmaps for financial analysis face many challenges, including the following:

> A lack of granularity in understanding net zero pathways on the part of the sector;
> A need for research and development on economic and financial models that translate climate scenarios into risk metrics at security and portfolio levels across different time horizons; and
> A lack of diversified understanding of the paradigm shift needed in terms of economic growth within planetary boundaries.

One major source of friction has been that even the most progressive climate scenarios today assume unabated global economic growth and rely solely on technological solutions such as nuclear energy and "negative emissions" technologies, while neglecting the huge potential of reducing emissions through societal and economic change. While "decoupling" economic growth and resource use is often presented as a solution, scientific debates on its feasibility have been ongoing since the 19th century and a consensus still does not exist, as stated in a recent "Narratives for change" series published by the European Environment Agency.[26]

The 2020 Societal Transition Scenario (STS) published by the Berlin-based Heinrich Böll Foundation takes a different approach, being based instead on the way society organizes production and consumption, including changes in governance, culture, and individual behavior. This is one concrete follow-up to Professor

[26] European Environment Agency 2021. Growth without economic growth

Tim Jackson's critically acclaimed 2009 work, "Prosperity Without Growth".[27, 28] The STS says it is the first draft of a climate mitigation scenario depicting an alternative future of a democratically planned structural transformation that leads to greater well-being for all. It calls for this outline to be "underpinned by further scientific research, and for a spirit of confidence that reshaping society for the benefit of all people and the environment is possible".

3. Overview of existing metrics by use case

A growing number of proprietary FLCM methodologies are being developed by a wide range of providers to evaluate companies on various aspects of their climate positioning. They draw on a common set of underlying company-level indicators, which can be used on a standalone basis as "raw data" in the investment process as well as alongside proprietary methodologies.

Since usefulness often lies in the comparative, rather than the absolute, significance of the metrics, it cannot be emphasized enough how important it is for users to consider **multiple** FLCMs, rather than single metrics in isolation. Moreover, given the strong differences in the *scope*, *measurement*, and *weighting* of individual indicators, different providers' assessments vary widely even when they are expressed in similar units, as in the case of temperature alignment.[29]

Examples of both standalone indicators and prominent proprietary methodologies are reviewed at a metalevel in the sections that follow.

3.1. Trends

Trends	
Purpose: Helps investors assess the real-world climate pathway companies have already adopted	
GHG reduction momentum	Calculable using reported company data such as historic GHG emissions, current expenditures (opex), and new investments (capex or R&D). Can also be taken from e.g., Carbon4 Finance (C4F), ISS ESG, Sustainalytics, Sustainable Development Investments Asset Owner Platform (SDI AOP).
Exposure to emissions-intensive assets and business models	

3.1.1. GHG reduction momentum

Historic year-on-year GHG emissions intensity trends are often extrapolated to derive basic momentum trends, and are sometimes also combined with a company's climate targets. Downsides of this approach are that the past is not necessarily a predictor of the future when it comes to climate impact reduction, and that assessments are best combined with other metrics such as green operational expenditures (opex) and new investments (capex).

[27] Kuhnhenn, Costa et al. 2020. A Societal Transformation Scenario for Staying Below 1.5°C. Volume 23 of the Economic & Social Issues Series.

[28] Tim Jackson 2009. Prosperity without Growth. Economics for a Finite Planet (1st edition)

[29] Berg, Kölbel, and Rigobon, 2020. Aggregate Confusion: The Divergence of ESG Ratings

3.1.2. Exposure to emissions-intensive assets and business models

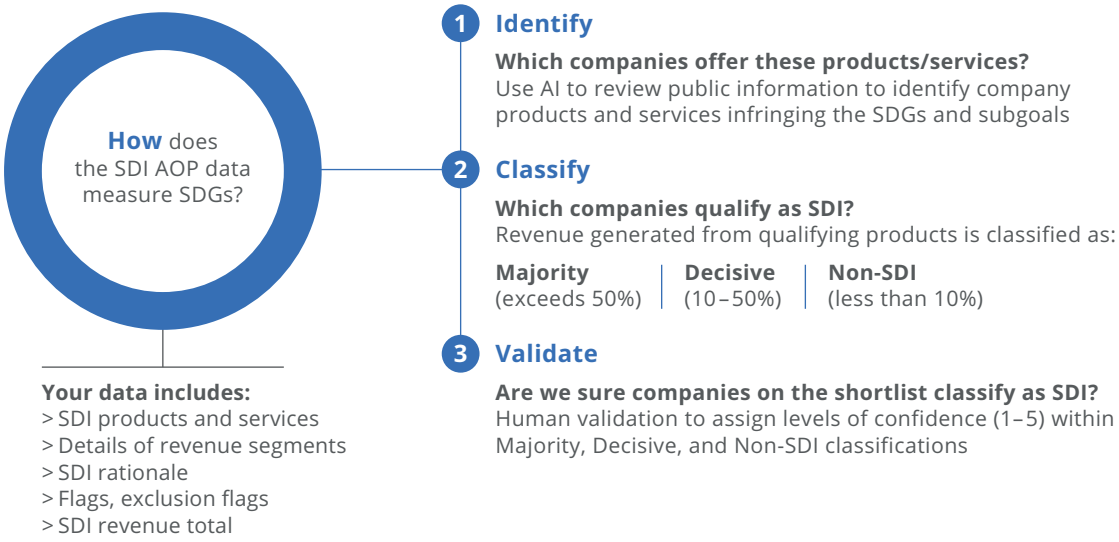
Companies' investments in opex and capex provide real-world metrics for investors to assess the pathway they are adopting towards their commitments, since these expenditures are based on business decisions that will directly feed into their climate performance.

For example, Urgewald's well-known and publicly available Coal Exit List[30] sets out forward-looking exclusion criteria across the coal value chain that go beyond simple revenue thresholds to include companies expanding thermal coal mines, power plants, and infrastructure projects. Beyond coal, French think tank Reclaim Finance[31] calls for the exclusion of oil and gas companies that, among other criteria, are not planning a rapid reduction to zero of all capital expenditures on oil and gas production and transportation projects, and for increased investment in non-GHG-emitting technologies.

Similarly, Carbon Tracker's work highlights that higher capex exposure outside low-carbon scenarios leads to higher stranded asset risk.[32] One finding suggested that, under the IEA's Sustainable Development Scenario (SDS)[33], two-thirds of potential capex on new oil fields is at risk of becoming stranded.

A number of proprietary methodologies can identify the extent to which corporate business activities are distributed across the brown-to-green spectrum. For example, the Sustainable Development Investment Asset Owner Platform (SDI AOP) – an asset owner-led platform committed to accelerating the market adoption of Sustainable Development Investments – focuses on identifying companies' contributions through their products or operations to the United Nations' Sustainable Development Goals (SDGs), including SDG 13 Climate Action (see Figure 6). Other examples include C4F's "green and brown shares", "energy consumption/production mix", "fossil fuel reserves", and other sector-specific indicators; and Sustainalytics' EU Taxonomy alignment dataset.

Figure 6. The SDI AOP approach to SDG measurement



Source: SDI Asset Owners Platform.

[30] Urgewald 2020. Global Coal Exit List

[31] Reclaim Finance 2021. Our Demands

[32] Carbon Tracker 2020. Fault Lines – How diverging oil & gas company strategies link to stranded asset risk

[33] IEA Sustainable Development Scenario

3.2. Targets

Targets	
Purpose: Helps investors assess companies' intentions and accountability on continued progress	
Long-, medium- and short-term emissions reduction targets	Can be taken from e.g., the Science Based Targets initiative (SBTi)
Implied temperature rise	Can be taken from e.g., ISS ESG, CDP

3.2.1. Long-, medium-, and short-term emissions reduction targets

Ambitious long-term targets are a strong indicator of a company's intentions. However, only 33 percent of the net zero targets set by subnational governments and 8 percent of those set by companies include interim targets that chart a decarbonization pathway.[34] Medium- and short-term targets are necessary to ensure accountability and prevent "time-washing"[35], an issue increasingly discussed in mainstream finance circles.[36] Nuances in the specific details of implementation approaches determine whether net zero targets really contribute to deep decarbonization or produce any impact at all.

Unsurprisingly, the best, most direct, and most unambiguous strategy is to adopt real emissions reduction targets. But these are meaningless end points unless they specify a pathway. In addition, to inform actual business decisions that lead to the desired climate outcome pathways (scenarios) constraining production and capex and linked to asset levels are needed. Figure 7 highlights a list of variables developed by the Energy Transition Advisors as part of PRI's Inevitable Policy Response (IPR) initiative, that investors should keep in mind when assessing the strength of any net zero pathways stated.

[34] New Climate Institute 2020. Navigating the nuances of net-zero targets

[35] The practice of setting long-term goals or targets without defining accountabilities, or providing opportunities for verification, in the shorter term.

[36] FT 2020. The problem with zero carbon pledges

Figure 7. Selected aspects associated with the climate pathway architecture

Metrics	Description
Target temperature over pre-industrial levels	The temperature above pre-industrial levels with which the scenario is consistent
Probability of achieving temperature target	The probability of achieving a particular temperature outcome – a critical datapoint, as the uncertainties within climate science lead to wide ranges of outcomes meaning that a probabilistic presentation is useful
Carbon emissions budgets	To stabilize global temperature at any level vs pre-industrial, a "carbon budget" is the finite amount of emissions that can be released before net emissions need to reach zero
Scenario start year	The year the analysis of the particular scenario model starts
Emissions peak	The year at which emissions peak
Net zero year	The year where there are zero net emissions which means any residual direct emissions are offset by GHG removal technologies
Scenario transition modelled end year	The last year of the detailed modelling in the scenario
Emissions reduction on base year %	The percentage reduction of emissions highlighted in the scenario at its end year measured against its base year (which is not always the first year of the scenario model)
Geography and sector	Countries, regions and sectors in scope of analysis
Carbon pricing assumptions	Carbon pricing is the most cited policy method to optimise the shift of capital from high to low carbon assets and, because it can be added to the asset level, represents a favourite method for modellers
Technology trajectories/ demand profiles	Not a single data point but are a series of often complex signposts and datapoints that define how various technologies are developing e.g. volume of electric cars, GW of renewable capacity
Asset level data	Granular real asset data and financial data linked to technology/demand profiles is needed for investors and companies to apply economic results to portfolios
Associated capex	The amount of capital required to achieve the various demand/production/ emissions targets
Potential stranded assets	Now generally accepted to be those assets that at some point prior to the end of their economic life are no longer able to earn an economic return due to changes with the transition to a low-carbon economy
Commodity demand and pricing assumptions	The broad commodity level analysis in terms of demand/supply and price
Other key technology assumptions	Clearly outlined assumptions with respect to the availability and use of GHG removal technologies

Source: Based on PRI, 2020. Pathways to net zero: scenario architecture for strategic resilience testing and planning.

One way to monitor corporate targets is via the Science Based Targets initiative (SBTi), which aims to "mobilize companies to set science-based emissions reduction targets and boost their competitive advantage in the transition to the low-carbon economy. Targets adopted by companies to reduce GHG emissions"[37] are considered to be "science-based" if they are in line with the latest climate science assessment of what is needed to meet the goals of the Paris Agreement. These are to limit global warming to well below 2 degrees above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees. To ensure that targets remain aligned, companies are required to review and, if necessary, revalidate their targets every five years from the date on which the original targets were approved, starting in 2025.

[37] SBTI 2020. About us

Figure 8. Companies in the STOXX Global 1800 universe and climate benchmark universes with SBTs, as of April 2021

	Global 1800		Global 1800 PAB		Global 1800 CTB	
	%	#	%	#	%	#
Targets Set	21.56%	250	30.50%	221	30.73%	239
Committed	10.01%	107	10.35%	97	10.36%	104
SBT Total	31.57%	357	40.84%	318	41.09%	343

Source: Qontigo, based on ISS ESG data.

3.2.2. Implied temperature rise

Implied temperature rise metrics aim to provide a forward-looking view of carbon exposure that can be applied to a wide range of industries, companies, and asset classes.[38] The 2020 Alignment Cookbook commissioned by the French Ministry for Ecological and Inclusive Transition and WWF France is a particularly useful in-depth technical resource to help navigate the often complex landscape of proprietary transition risk assessment methodologies that are focused on portfolio alignment with low-carbon trajectories and temperature goals.[39] A prior publication dating from 2018 reviewed the physical climate risk approaches by eight service providers.[40]

To give one specific example, ISS ESG's temperature score examines whether an issuer's/a portfolio's emissions over- or undershoot the IEA's SDS scenario by 2050. The relationship between an increase in emissions and an increase in temperature for the scenarios is included in such a way that a company aligned with the SDS in 2050 is also expected to have a temperature score of 1.5 degrees. By contrast, a company with a temperature score of 6 degrees has estimated emissions that are significantly above the allocated carbon budget in 2050. As the data provider rightfully cautions in its methodology, the temperature score should be used with caution, since data and modelling availability is currently limited and a single metric cannot explain the full dynamics of the contribution made by an issuer or portfolio to the global rise in temperature.

3.3. Quality of climate risk management

Quality of climate risk management	
Purpose: Helps investors assess how strategically a company is integrating climate risks and opportunities	
Corporate policies and business strategy	Can be taken from e.g., ISS ESG, C4F, ACT methodology, TPI
TCFD alignment	Can be taken from e.g., Clarity AI

[38] TCFD, 2020. Forward-Looking Financial Sector Metrics Consultation

[39] Institut Louis Bachelier 2020. The Alignment Cookbook – A Technical Review of Methodologies Assessing a Portfolio's Alignment with Low-Carbon Trajectories or Temperature Goal

[40] ClimINVEST 2018. Getting started on Physical climate risk analysis in finance

3.3.1. Corporate policies and business strategy

The strategy and governance of individual portfolio constituents are of crucial importance in achieving stated climate-related targets. To assess if a portfolio company has the potential to manage climate risks effectively, investors need to examine how climate considerations are integrated with its corporate policies, processes, and business strategy. For example, at a minimum governance has to be provided at board level, with structures in place to implement issues across the organization.

To give one example, the ISS ESG Carbon Risk Rating (CRR), which rates companies on a scale of 1 (climate laggards) to 100 (climate leaders), assesses the carbon-related performance of companies based on a combination of:

> Quantitative indicators, such as the current intensity and trend of GHG emissions or the GHG impact of the product portfolio, including revenue shares of products or services associated with both positive and negative climate impacts;
> Forward-looking qualitative indicators such as corporate policies, ongoing shifts in the product and service portfolio, emissions reduction targets, and action plans; and
> A classification of the company's absolute climate risk exposure from its business activities.

As another example, C4F's Forward-looking Rating[41] (scale 1 – 4) is based on the assessment of four sub-criteria specific to each sub-sector:

> Company strategy on climate change;
> Weight of investments in low-carbon projects or R&D;
> Reduction target for Scope 1+2 intensity; and
> Reduction target for Scope 3 intensity.

3.3.2. TCFD alignment

The TCFD score developed by Clarity AI measures the alignment of organizations and portfolios with TCFD recommendations by leveraging the CDP climate change questionnaire. It helps investors understand how a company is integrating climate risks and opportunities with its strategy and forward planning (in contrast to just backward reporting). It also supports engagement strategies, identifying areas where companies can improve their practices and disclosures related to climate risks and opportunities.

3.4. Climate-related financial risk exposure

Climate-related financial risk exposure	
Purpose: Helps investors assess companies' exposure to at-risk business activities and resources	
Transition risk exposure	Can be taken from e.g., Climate Policy Initiative, Quant Foundry, Entelligent
Physical risk exposure	Can be taken from e.g., ISS ESG, 427

3.4.1. Transition risk exposure[42]

A company's climate transition risk profile is defined by the financial materiality of the impact on it of changes in policy or legal frameworks, technological change, and shifts in consumer and investor sentiment due to

[41] C4F, 2018. Carbon Impact Analytics

[42] While transition risks and physical risks are frequently distinguished, they are intertwined and can be seen as the two sides of the same coin. Greater policy action may increase the impact of transition risks, but at the same time reduce physical risks in later decades.

the transition to a low-carbon economy. For example, policies to limit GHG emissions, such as a carbon tax, may increase raw materials and energy costs, or require businesses to carry out a costly production process overhaul to minimize GHG emissions.

In 2019, the PRI commissioned a unique forecast of inevitable policy responses (IPRs) to climate change by governments around the world. The aim of the initiative is to prepare investors to align their portfolios with the forecast policy scenarios, which are predicted to be forceful, abrupt, and disorderly because of the delay in climate action. The program's publications also include modelled impacts of the forecast policies on the macroeconomy; key sectors, regions, and asset classes including equity markets; and implications for land use. Some of the world's largest institutional investors and financial institutions have committed to use the IPR forecast to inform their strategic asset allocation. An updated version of the forecast (IPR2021) is shown in Figure 9.

Investors measuring transition risk need to take into consideration transition scenarios such as those outlined earlier in this paper, and to assess the latter's impact on valuation and risk models. In addition, a number of banks, insurers, asset owners, and asset managers such as BlackRock[43] and Legal and General Investment Management[44] are developing proprietary climate modelling expertise.

Figure 9. IPR2021 forecasts most countries will implement a package of policies to deliver rapid emissions reductions across the main emitting sectors

Carbon pricing	Coal phase-out	100% clean power	Zero emission vehicles
> Carbon taxes > Emissions trading systems > Border carbon adjustments	> Prohibiting regulations > Emissions performance standards > Electricity market reforms	> 100% clean power targets > Renewables capacity auctions and other support policies	> 100% zero emission vehicle (ZEV) sales legislation > Manufacturer ZEV obligations > ZEV consumer subsidies
Low-carbon buildings	**Clean industry**	**Low-emissions agriculture**	**Forestry**
> Prohibiting regulations for fossil heating systems > Purchase subsidies for low-carbon heating systems > Thermal efficiency regulations for new builds and retrofits > Minimum energy performance standards for new appliances	> Emissions performance standards for industrial plant > Subsidies for new or retrofit clean industrial processes	> Methane or nitous oxide emissions tap or cap-and-trade system > Subsidies for low-emissions agricultural practices and technologies > Farmer education and technical assistance programmes	> Strong policy action against deforestation, such as monitoring and penalties, supported by consumer pressure > Incentives for reforestation and afforestation via domestic action and carbon markets
"Just transition" lens to ensure social and political feasibility.			

Source: PRI Inevitable Policy Response, 2021.

[43] Rhodium Group, 2019. Clear, Present and Underpriced: The Physical Risks of Climate Change

[44] LGIM, 2020. LGIM announces climate solutions capability powered by risk and alignment framework co-developed with Baringa Partners

Proprietary transition risk exposure metrics could focus on future valuations of specific assets, and applications of climate considerations within more traditional financial valuation metrics.[45] Metrics may also emerge as outputs from climate-related scenario analyses and stress tests that are integrated with financial stability monitoring and supervision.

For example, financial technology consultancy Quant Foundry provides a bottom-up scenario engine that can be applied to generate multiple scenarios from changes in GHG targets. The solution simulates the climate and industry sector outcomes and integrates these at a company level. It provides a causal link for each outcome that offers a motivation for any investment/divestment choice.[46]

Entelligent's E-score measures a company's sector exposure relative to climate change transition risk.[47] The company uses a range of climate scenarios, combining these with energy economics and security-level financial data to identify companies' individual vulnerability to climate transition risk. Its model predictions are structured as two-year forecasts of the expected active return under three climate scenarios: business as usual, low-carbon, and high-carbon.

3.4.2. Physical risk exposure

Although assessing physical climate risks is challenging, several commercial data providers and academics have started to develop risk scores. A recent University of Zurich paper comparing six physical risk scores found substantial divergence between them, even where they were based on similar methodologies, and leading to different rankings within and across sectors.[48] This implies that investors may not be able to adequately account for corporations' physical risk exposure at present using available risk scores. Meanwhile, the World Resources Institute (WRI)'s research on corporate reporting found wide divergence among physical climate risk reporting metrics, suggesting a lack of a common understanding and approach to identifying and assessing physical climate risks.[49] It is clear that further work is needed to help build a bridge between the science and the private sector on climate impact issues.

The ISS ESG physical risk solution is an example of currently available metrics, which it provides at both a corporate and a portfolio level. Its analysis includes impacts on physical assets and property, plant, and equipment (PPE); selling, general, and administrative expenses (SGA); the cost of goods sold (COGS); sales; and revenue. The five hazards expected to have the highest financial impact are tropical cyclones, river floods, droughts, wildfires, and heat waves. Key outputs include:

> **Physical risk score per hazard and scenario**: Expresses the change in risk between a historical scenario and a future scenario. Available in two future scenarios: the most likely and the worst case.

> **Value-at-risk (VaR) per hazard and scenario**: Especially relevant for investors, VaR is calculated based on a proprietary economic value added (EVA) model. Different parts of the company, e.g., sales or PPE, are affected depending on the company's structure and the hazards concerned, with the impact on the company being calculated and expressed as the VaR.

> **Management score for overall physical climate risk management**: The management score shows whether a company has taken physical climate risk into consideration in its risk management strategies. For a company to receive a management score, it must report to the CDP how it is affected by physical risks, the strategies it has put in place, and how it expects the costs will affect the balance sheet.

[45] TCFD 2020. Forward-Looking Financial Sector Metrics Consultation

[46] Quant Foundry, 2021. Climate Change Offerings

[47] Change to Entelligent 2021. Solutions.

[48] Hain, Kölbel, and Leippold 2021. Let's Get Physical: Comparing Metrics of Physical Climate Risk.

[49] WRI 2021. With Patchy Guidance, Companies May Have Climate Risk Blind Spots

4. Challenges with FLCMs

Investor demand for climate data integration has boosted the development of more robust climate science and modelling in recent years. However, challenges remain with respect to the coverage, standardization, and reliability of the data underpinning these climate models.

In more detail, the challenges associated with using FLCMs include, but are not limited to, the following:

> **Coverage** – Many FLCMs rely on past GHG emissions data to estimate future trends, and the lack of historical data can exacerbate uncertainty in future assumptions. Standardized emissions reporting methodologies – like the GHG Protocol Scope 3 Standard[50] – are a recent development and only now beginning to be widely adopted by corporations across the world. As such, there is currently little possibility for investors to verify and have confidence in their portfolio companies' reported progress on climate commitments, given the lack of emission baselines and track records. To give one illustration of this: The CDP – one of the most widely used climate disclosure frameworks across the world – has reported that it currently has to estimate data for around one-third of Scope 1 emissions and slightly more than half of Scope 2 emissions from the over 5,000 companies it covers.[51] In particular, few companies report Scope 3 GHG emissions, although these could account for more than 50% of their total emissions. Additionally, Scope 3 emissions can hide important stranded asset risk potential. An example of this is Airbus, whose landmark Scope 3 emissions disclosures, first made for 2019 and 2020, revealed that the 1,429 planes sold would generate 1.2 bn tonnes of CO2e between them over their average lifespan of 22 years.[52]

Figure 10 shows findings from a study conducted by the University of Hamburg and WWF Hamburg to highlight the stark inconsistencies in corporate Scope 3 emissions data – for both reported as well as estimated data – reported by various data providers.[53] Most Scope 3 data providers demonstrated very low levels of correlation with others in the group, owing to differences in their estimation methods, and to gaps in and the complexity of the data reported. This is in contrast to Scope 1 emissions data, which the authors describe as "relatively homogenous," and Scope 2 data, which was found to be "more consistent" than Scope 3 data. These findings point to the need for greater engagement between investors and issuers to ensure that the accounting and disclosure of Scope 3 emissions are robust and reflect all upstream and downstream categories.

Figure 10. Scope 3 emissions are often estimated and can vary greatly between different data providers[54]

Scope 3	Bloomberg	CDP	ISS ESG	MSCI	Thomson Reuters	Trucost
Bloomberg	1					
CDP	0.4137	1				
ISS ESG	0.2444	0.1100	1			
MSCI	0.8963	0.4045	0.1650	1		
Thomson Reuters	0.9864	0.3956	0.2380	0.8907	1	
Trucost	0.5924	0.2203	0.1888	0.3813	0.5771	1

Source: University of Hamburg / WWF Deutschland 2018. Consistency of Corporate Carbon Emission Data.

[50] GHG Protocol Corporate Value Chain (Scope 3) Standard

[51] CDP Full GHG Emissions Dataset 2019 Summary

[52] The Guardian 2021. Airbus reveals planes sold in last two years will emit over 1bn tonnes of CO2

[53] University of Hamburg / WWF Deutschland 2018. Consistency of Corporate Carbon Emission Data.

[54] Adjusted correlations Scope 3, a conservative approach that removes only the most extreme outliers and leaves 99.9% of the sample intact.

> **Uncertainties and lack of standardization around climate science** – The scenarios and transition pathways that underpin FLCMs can create confusion and affect the comparability of data. For example, in a recent paper[55] climate scientists themselves argue that the integration of climate science with risk disclosure and decision-making has outstripped the current capabilities of climate science and climate models by at least a decade. It is important that all stakeholders understand that any template-based approach, while useful for comparisons between assets and entities, is unlikely to reflect actual risks.

> **Data assurance and liability** – The lack of standards for climate data assurance and verifiability, and the current inability to demonstrate tangibly that FLCMs are indeed leading indicators, means that investors are reluctant to use potentially inaccurate data so as to avoid any liability associated with mis-calculating FLCMs. In its response to a recent TCFD consultation on forward-looking metrics, the Institute of International Finance (IIF) noted that "In the absence of clear and robust verification practices to enable market discipline, it is possible for metrics to be manipulated, potentially resulting in greenwashing or mis-selling".[56]

> **Lack of transparency and consistency in data providers' methodologies** – In their responses to the TCFD consultation on forward-looking metrics, many investors and investor networks highlighted that the current methodologies and disclosure frameworks developed by different data providers are "black boxes" that offer little scope and few insights for them to compare their holdings across sectors. Even where publicly available descriptions of the methodologies exist, differences across data providers can still make the resulting disclosures difficult to compare for investors and others evaluating climate exposure across their holdings. Some respondents suggested that the adoption of FLCMs should be phased in, thus ensuring the metrics are more useful in financial decision-making. In addition, given the uncertainty around climate science and sources of data, the scope of error associated with the metrics can be quite significant. However, data providers rarely provide any margin of uncertainty when using the data in their methodologies.

5. Practical insights

The Final Report by the European Union Technical Expert Group (EU TEG)[57] defines nine (out of a total of 21) NACE sections[58] as having both a high climate impact and being key to the transition to a low-carbon economy.

To illustrate the usage and some of the challenges facing FLCMs that were mentioned earlier, we compared methodologically similar FLCMs from three different data providers for companies in the nine NACE sections that also form part of the STOXX® Europe 600 Paris-Aligned Benchmark.

The initial data sample consisted of 259 companies spanning these nine NACE sections. However, only 135 companies in the sample had FLCMs spanning all three providers (see Figure 11). Therefore, 124 companies were excluded from further analysis. In addition, in order to compare the data, the scores had to be transformed and normalized. For example, some providers use a descending order, with low scores being the best and high ones the worst.

[55] Fiedler, Pitman, et al. 2021. Business risk and the emergence of climate analytics. Nature Climate Change volume 11, pp. 87–94.

[56] IIF 2021. Response letter to TCFD consultation on forward-looking Financial Sector Metrics

[57] EU TEG 2019. Final Report on Climate Benchmarks and Benchmarks' ESG disclosures

[58] NACE stands for "Nomenclature statistique des activités économiques dans la Communauté européenne". The 21 sections making up Level 1 of this statistical classification of economic activities are the first and most aggregated of the four different hierarchical levels (the most granular Level 4 comprises 615 different classes).

Figure 11. Companies in the STOXX 600 PAB index in high climate impact NACE sections, and companies analyzed

High climate impact NACE sections	STOXX 600 PAB companies	Companies with FLCMs across the three providers
A. Agriculture, forestry, and fishing	1	0
B. Mining and quarrying	3	1
C. Manufacturing	162	75
D. Electricity, gas, steam, and air conditioning supply	5	4
E. Water supply, sewerage, waste management, and remediation activities	4	3
F. Construction	11	10
G. Wholesale and retail trade, repair of motor vehicles and motorcycles	30	4
H. Transportation and storage	13	12
L. Real estate activities	30	26

Source: Qontigo.

Our approach:

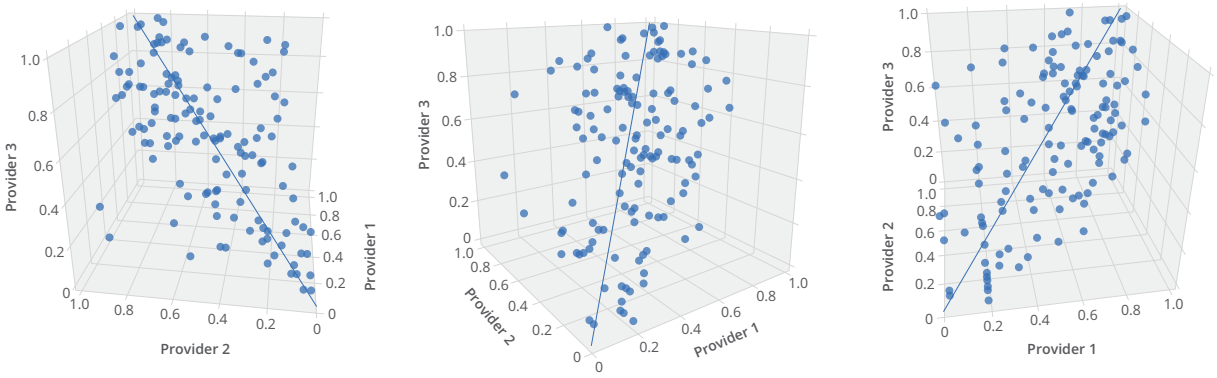
> Firstly, we ensured all scores followed the same system, by inverting the scores that exhibited a descending scale in which low was best.

> Secondly, we normalized them with the help of rank percentiles derived for the series in question. Consequently, all the score values were transformed into [0, 1] intervals, while keeping the correct ordering.

This transformation allows us to compare all data points on an apples-to-apples basis and ensures the initial ordering within each ranking provider. Given the already relatively small data sample of 129 points representing nine sectors, the analysis does not permit further industry-specific granularity. At an average of 16, the number of observations per industry-specific grouping is too small to reveal systemic patterns and prone to outliers/noise.

Figure 12 depicts the transformed and normalized scores from the three different data providers. For simplicity of representation, an identity curve was added to show the deviations from perfectly aligned scores in a three-dimensional space (in which all three scores after transformations would be perfectly aligned). The deviation across different providers is further quantified with the help of Spearman's correlation coefficient, which is applied to each possible pair (see Figure 13).

Figure12. Transformed and normalized scores for 135 companies plotted in 3D



Source: Qontigo.

Figure 13. Correlation across three providers on a sample of methodologically similar proprietary FLCM

	Provider 1	Provider 2	Provider 3
Provider 1	1.000		
Provider 2	0.643	1.000	
Provider 3	0.431	0.445	1.000

Source: Qontigo, own analysis.

As is also evident from our analysis, the divergence amongst different climate data providers goes beyond Scope 3 emissions reporting and estimation highlighted in Figure 10 in the previous section. The correlations derived range between 0.4 and 0.65, revealing a relatively modest positive dependence between the providers. In layman's terms, the scores are related, meaning that a good score for Provider 1 is likely to be followed by a good score for Providers 2 and 3. At the same time, however, this relationship is not particularly strong and, for example, a very high score for Provider 2 does not imply high scores across the board. To ensure a complete analysis, we also calculated the p-values for the correlation coefficient that proved significant at the 5% significance level. The same approach was repeated with other correlation measures (Kandel, Pearson); these confirmed our findings but are not shown in this paper for simplicity of representation.

6. Implications for index design

There is a bright future in store for climate benchmarks that combine financial and climate objectives and that can serve as:
> The underlying for passive investment strategies;
> An investment performance benchmark for active strategies;
> An engagement tool; and
> A policy benchmark to help guide strategic asset allocation (SAA).

Although a lot remains to be done, including continuous iteration of what a best-practice methodology looks like, the foundations have already been laid. While climate metric-adjusted versions of existing benchmarks have existed for more than a decade, they have historically been designed to focus on backward-looking data and were intended to help investors hedge against climate transition risks. In a step change for climate index design, the EU amended its Benchmark Regulation in November 2019 to introduce minimum criteria for two types of climate benchmarks: EU Climate Transition Benchmarks (EU CTBs) and EU Paris-aligned Benchmarks (EU PABs) (see Figure 14 below). In contrast to existing approaches, these go beyond climate risk to also incorporate a forward-looking goal of directing investments towards energy transition opportunities ("opportunity objective"). By doing so, they pave the way for mainstreaming the use of FLCMs in index design.

Figure 14. Summary of minimum standards for EU CTBs and EU PABs[59]

Minimum standards	EU CTB	EU PAB
Risk-oriented minimum standards:		
Minimum Scope 1+2 (+3)[14] carbon intensity reduction compared to investible universe	30%	50%
Scope 3 phase-in	2–4 years	2–4 years
"Do no significant harm" principle	Yes	Yes
Opportunity-oriented minimum standards:		
Minimum green share/brown share ration compared to investible universe	At least equivalent	Significantly larger (factor 4)
Exposure contraints	Minimum exposure to sectors highly exposed to climate change issues is at least equal to market benchmark value	
Year-on-year self-decarbonization of the benchmark	At least 7%: in line with or beyond decarbonization trajectory from the IPCC's 1.5°C scenario (with no or limited overshoot)	
Disqualification from label if two consecutive years of misalignments with trajetory	Immediate	Immediate

Source: EU TEG 2019. Interim Report on Climate Benchmarks and Benchmarks' ESG Disclosures.

[59] The two types of climate benchmarks pursue a similar objective but differ in terms of their level of restrictiveness and ambition. EU PABs are designed for more ambitious climate-related investment strategies and are characterized by stricter minimum requirements, while EU CTBs permit greater diversification and serve the needs of institutional investors in their core allocation activities. Note that only transition risks and opportunities are considered part of the minimum standards for the two types of indices.

As evidenced in this paper, FLCMs are imperfect and measurements from different providers, though related, are different. The devil is in the detail and clearly metrics ought to be used in combination rather than in isolation. For example, although SBTs are a useful indicator of a company's intentions with respect to climate alignment, investors should consider them as just one of many forward-looking climate-related measures needed to develop a robust model.

To future-proof our indices and optimize the impact for our clients, Qontigo created the STOXX Paris-Aligned Benchmark (PAB) and Carbon Transition Benchmark (CTB) Indices in 2020.[60] These comply with and exceed the minimum requirements under the EU-recommended methodologies alongside ensuring that the benchmark is well diversified and comparable with underlying universes.[61] Figure 15 summarizes how the STOXX EU climate indices use various FLCMs (drawn from ISS ESG) to assess a company's or portfolio's trends, targets, quality of climate risk management, and climate-related financial risk exposure.

Figure 15. How STOXX PAB and CTB indices use FLCMs

Use case	Index feature	FLCMs used
Trend	Align portfolio with five-year 7% year-on-year self-decarbonization requirement	Emissions data
Trend	Measure green/brown energy ratio	Green/brown sources classification
Target	Assess corporate target setting	Monitored SBTi-approved targets
Target	Assess alignment with the IEA's 2 degree scenario	Carbon budget
Quality of climate risk management	Align with UN SDG 13	SDG Solutions Assessment
Climate-related financial risk exposure	Overweight climate leaders and underweight climate laggards	Carbon Risk Rating and carbon budget data

Source: Qontigo.

In late 2020, Andra AP-fonden – one of Northern Europe's largest pension funds and better known as AP2 – announced that it had, over the year, gradually adjusted approximately SEK 200 billion of its over SEK 360 billion of AUM (global corporate bonds and foreign equities). This was done to ensure investments are consistent with the PAB, but without compromising the return and risk characteristics of the index.[62] Speaking about its move, AP2 – which plans to run all its equity portfolios against Paris-aligned benchmarks in the coming years – highlighted the fact that its decision to have a Paris-aligned portfolio was taken in 2016, but that it was only the introduction of the PAB framework in 2019 that provided the right framework to do so. This is because they considered greenwashing concerns have been minimized, since it is an external framework by a credible institution (the EU); in addition, it will evolve over time, allowing investors to commit to a process of change rather than outright implementation.[63]

[60] Full methodology available at: https://www.stoxx.com/document/Indices/Common/Indexguide/stoxx_index_guide.pdf

[61] Qontigo 2020. Qontigo Launches First EU-Compliant Climate Benchmark Indices

[62] AP2 2020. Applying EU rules, Andra AP-fonden ceases investment in fossil fuel companies

[63] Responsible Investor 2021. The great index exodus: why asset owners are choosing ESG benchmarks.

While this may be the boldest index move from a fiduciary investor so far, it is not the first and it certainly won't be the last. For example, also in 2020, the Church of England's Pension Board invested GBP 800m of passive assets in an index based on the TPI methodology, which tracks whether companies align to 2 degrees or below 2 degrees/net zero.[64] And in 2017, Swiss Re pioneered the switch to ESG benchmarks, after previously considering ESG as an "add-on" approach only. The Swiss re/insurer and co-founder of the Net Zero Asset Owners Alliance has continued on its journey since then: it now applies ESG criteria to close to 100% of its investment portfolio, after confirming that the move made greater economic sense, too.[65]

Climate benchmark methodologies themselves are bound to evolve too. In its 2019 report (cited above) the EU TEG itself strongly recommended a review of all minimum standards after three years to ensure the highest level of ambition for climate benchmarks, reflecting future enhancements in the state of the research and best practices in scenario analysis applied to investment strategies. For example, given the limitations associated with using GHG intensity data (which range from the quality of emissions data itself to the volatility of commonly used financial metrics such as Enterprise Value), the future could have a greater focus on using instead real economic outputs, absolute emissions reduction pathways, and sector specificity across a minimum number of climate-relevant sectors to which the index is exposed, in line with leading initiatives such as the SBTs and the Paris Agreement Capital Transition Assessment (PACTA).[66]

Initiatives such as the Net Zero Asset Owners Alliance and the Net Zero Asset Managers Initiative give legitimacy to institutional investor net zero commitments, and switching entire holdings to climate benchmarks such as the EU PAB is possible without putting financial objectives at risk.[67] Measuring external active managers against climate benchmarks will also improve incentives to integrate climate transition with mainstream portfolios. As everybody does this, the influence on the cost of capital for companies could finally result in major real-world outcomes – the ultimate reason why FLCMs exist.

[64] The Church of England, 2020. Church of England Pension Board invests £600 million in global new stock index backing the Paris Climate Agreement

[65] Swiss Re 2018. Swiss Re analysis confirms ESG benchmarks make economic sense – new publication on responsible investments launched today

[66] 2 Degrees Investing Initiative 2020. EU Climate Benchmarks Factsheet

[67] Qontigo 2020. Climate Impact Investing Is Coming On Fast... What Portfolio Managers Need to Know – and Do – to Successfully Adapt. details what portfolio managers need to know when switching to a fully Paris Aligned Benchmark (PAB) portfolio from a current market-cap weighted (CWB) portfolio.

7. Acronym list

C4F	Carbon4 Finance
CCPI	Climate Change Performance Index
COP26	The 26th UN Climate Change Conference of the Parties
ECB	European Central Bank
EU CTB	EU Climate Transition Benchmark
EU PAB	EU Paris-aligned Benchmark
EU TEG	The European Union's Technical Expert Group on Sustainable Finance
FLCMs	Forward-looking climate metrics
GFANZ	Glasgow Financial Alliance for Net Zero
GHG	Greenhouse gas emissions
IEA	International Energy Agency
IPR	Inevitable Policy Response
ISS	Institutional Shareholder Services
JC3	Joint Committee on Climate Change
NACE	Nomenclature statistique des activités économiques dans la Communauté européenne
NGFS	Network of Central Banks and Supervisors for Greening the Financial System
PACTA	Paris Agreement Capital Transition Assessment tool
PRI	Principles for Responsible Investment
SBTs	Science-based targets
SBTi	Science-based Targets initiative
SDGs	Sustainable Development Goals
SDI AOP	Sustainable Development Investments Asset Owner Platform
SDS	Sustainable Development Scenario
STS	Societal Transformation Scenario
TCFD	Task Force on Climate-related Financial Disclosures
WRI	World Resources Institute

8. Contacts & Information

Learn more about how Qontigo can help you better manage risk and enhance your investment process.
Qontigo.com

Europe

Frankfurt
Mergenthalerallee 61
65760 Eschborn, Germany
+49 69 2 11 0

Geneva
Rue du Rhone 69, 2nd Floor
1207 Geneva, Switzerland
+41 22 700 83 00

London
No. 1 Poultry
London EC2R 8EJ, United Kingdom
+44 20 7856 2424

Paris
19 Boulevard Malesherbes
75008, Paris, France
+33 1 55 27 38 38

7 Rue Léo Delibes
75116, Paris, France
+33 1 55 27 67 76

Prague
Futurama Business Park Building F
Sokolovska 662/136b
186 00 Prague 8, Czech Republic

Zug
Theilerstrasse 1A
6300 Zug, Switzerland
+41 43 430 71 60

Americas

Atlanta
400 Northridge Road, Suite 550
Atlanta, GA 30350
+1 678 672 5400

Buenos Aires
Corrientes Avenue 800, 33rd Floor
Office 101
Buenos Aires C1043AAU, Argentina
+54 11 5983 0320

Chicago
1 South Wacker Drive, Suite 200
Chicago, IL 60606
+1 224 324 4279

New York
17 State Street, Suite 2700
New York, NY 10004 USA
+1 212 991 4500

San Francisco
201 Mission Street, Suite #2150
San Francisco, CA 94105
+1 415 614 4170

Asia Pacific

Hong Kong
28/F LHT Tower
31 Queen's Road Central
Hong Kong
+852 8203 2790

Singapore
80 Robinson Road, #02-00
Singapore 068898, Singapore
+852 8203 2790

Sydney
9 Castlereagh Street, Level 17
Sydney, NSW 2000, Australia
+61 2 8074 3104

Tokyo
27F Marunouchi Kitaguchi Building,
1-6-5 Marunouchi Chiyoda-ku
Tokyo 100-0005, Japan
+81 3 4578 6688

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