Understanding carbon exposure metrics

An evaluation of current standards in a rapidly evolving landscape

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Incorporating climate change risk analysis into the investment process is essential for long-term investors. Greenhouse gas (GHG) accounting is a core component of this process. However, the evaluation and attribution of emissions is not trivial and a range of metrics can be used to assess efficiency, each potentially providing complementary information. Given the relative novelty of the field and the fragmented nature of the current regulatory environment, great attention must be given to the use of consistent emissions metrics.

This document aims to review the current state of GHG accounting and clarify the main types of exposure metrics and how each should be used.

CLIMATE CHANGE AND THE ROLE OF GREENHOUSE GASES

Greenhouse gases are defined as atmospheric compounds that have the ability to absorb and re-emit the heat (infrared radiation) coming from the Earth's surface. As this atmospheric re-emission occurs in all directions, some of the energy is radiated back towards the Earth's surface and warms it, effectively slowing down the cooling rate of the planet. The amplitude of this phenomenon, called the greenhouse effect, is controlled by the concentration of those gases in the atmosphere. Although the process is natural in itself, and critical to the emergence and support of life on the planet, recent emissions of GHGs as a result of human activity have upended the balance and amplified the phenomenon. This has resulted, so far, in an increase in global average surface temperature of over 1.1°C relative to the pre-industrial period,[1] which has an unambiguous human cause. This increase in temperature has induced significant changes to the climate system, including (but not limited to) a rapid melting of mountain glaciers and large ice sheets, a rise in sea levels (from this melting and from the thermal expansion of warming oceans) and emerging changes in the frequency and severity of extreme events. Although attributing any specific event to climate change alone is extremely challenging, trends can be assessed, and clear climate change signals have already been observed for events such as temperature extremes (hot and cold), extreme precipitation events and drought. For example, it was found that the record Siberian heatwave of 2020 would have been extremely unlikely to happen without the contribution of human-induced climate change.[2]

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[1] Defined as the 1850-1900 period by the Intergovernmental Panel on Climate Change (IPCC), in its latest series of reports (Fifth and Sixth Assessment Reports (AR5, AR6) and the Special Report on 1.5°C).

[2] World Weather Attribution initiative, https://www.worldweatherattribution.org/siberian-heatwave-of-2020-almost-impossible-without-climate-change/

Economic impacts from such changes to the climate system are also starting to be felt. Over the past few decades, economic losses from weather-related natural catastrophes have been trending up. In 2020, the world experienced the second-highest number of billion-dollar natural disaster events in history,[3] with economic losses reaching USD 210 billion, of which only about 40% was insured.[4] Recent research suggests that expected global GDP losses could reach 18% by 2050 (compared to a world without climate change) if no mitigation action is taken, whereas meeting the Paris Agreement targets could limit these losses to 4%.[5] Furthermore, limiting global temperature rise to 1.5°C rather than 2°C results in a significant reduction in climate-related risks and therefore reduced impact on human and natural systems. By mid-century, estimates suggest this could result in avoided damages of USD 8.1-11.6 trillion and could lead to co-benefits of 0.5-0.6% of world GDP due to reduction in air pollution,[6] highlighting some of the key advantages of aggressive emission reductions.

A constant temperature can only be achieved when the rate of removal of GHGs from the atmosphere is equal to the rate of their emission or, in other words, when there is a balance between the sources and sinks of each GHG.[7] Reaching this equilibrium, or "net zero emissions", does not result in an instantaneous stabilization of global temperature. Furthermore, some impacts of climate change, such as sea-level rise, have a delayed response, meaning that the final impact will not be realized until decades after temperatures are stabilized. Reaching net-zero emissions by a certain date could also lead to different temperature outcomes, since global temperature depends on the total "carbon budget", or the net cumulative emissions up to the point of stabilization. Thus, achieving a given temperature target requires both reaching net zero emissions and keeping within the carbon budget. This is particularly important in the context of efforts to limit temperature changes to 1.5°C, as we have already used up around 90% of the carbon budget to have a good chance of achieving this goal, and are on track to use the rest of the budget within the next decade.[8]

The most widely used standards for GHG accounting come from the Greenhouse Gas Protocol.[9] This corporate standard for accounting and reporting on GHG emissions was developed to provide a framework for businesses to measure and manage emissions data in a complete, transparent and consistent manner. The protocol identifies seven main greenhouse gases significantly impacted by human activity: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and four types/families of fluorinated gases (nitrogen trifluoride (NF_3), sulphur hexafluoride (SF_6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs)). The overall contribution of each gas to the energy balance of the climate system depends on its concentration, its ability to absorb/emit thermal energy and its lifetime in the atmosphere. To facilitate any comparison between emissions of those various gases, their overall warming impact is usually presented with respect to that of an equivalent mass of CO_2 over a specified time period (100 years), using a conversion factor called the Global Warming Potential (GWP). Using those conversion factors, total GHG emissions are combined and presented in terms of CO_2 equivalent (CO_2e). Although carbon dioxide has the lowest global warming potential among monitored GHGs, it has the greatest impact on the radiative balance of the planet due to its long atmospheric lifetime and the large volumes emitted by human activity.

3 There were 53 billion-dollar loss events in 2020, second only to 2010, which had 54. (Source: Aon. https://www.aon.com/global-weather-catastrophe-natural-disasters-costs-climate-change-2020-annual-report/index.html).

4 Munich Re, https://www.munichre.com/en/company/media-relations/media-information-and-corporate-news/media-information/2021/2020-natural-disasters-balance.html

5 Swiss Re, https://www.swissre.com/dam/jcr:e73ee7c3-7f83-4c17-a2b8-8ef23a8d3312/swiss-re-institute-expertise-publication-economics-of-climate-change.pdf

6 Intergovernmental Panel on Climate Change (special report 'Global Warming of 1.5°C'), https://www.ipcc.ch/sr15/

7 The Paris Agreement calls for a balance between sources and sinks of anthropogenic GHGs "by the second half of this century" in order to limit global temperature rise to "well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C" (Source: United Nations Framework Convention on Climate Change, https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement).

8 United Nations Framework Convention on Climate Change, https://unfccc.int/news/full-ndc-synthesis-report-some-progress-but-still-a-big-concern

9 GHG Protocol, https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf

Global warming potential estimates and lifetime for the greenhouse gases covered by the GHG Protocol

GAS	ATMOSPHERIC CONCENTRATION (2019)[10]	GLOBAL WARMING POTENTIAL[11]	LIFETIME (YEARS)
Carbon dioxide (CO_2)	410 ppm	1	#[12]
Methane (CH_4)	1866 ppb	27.9	11.8
Nitrous oxide (N_2O)	332 ppb	273	109
Hydrofluorocarbons (HFCs)	237 ppt	1,260 – 5,810	>50[13]
Perfluorocarbons (PFCs)	109 ppt	7,380 – 12,400	2,600 – 50,000[14]
Nitrogen trifluoride (NF_3)	2 ppt	16,100	569
Sulphur hexafluoride (SF_6)	10 ppt	25,200	3,200

Source: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report (AR6) of the Intergovernmental Panel on Climate Change (IPCC).

The complex role of short-lived gases is increasingly being recognized as a core component of efforts to establish credible emission reduction plans. In particular, as methane has a relatively short atmospheric lifetime (around 12 years), determining its overall impact based on a 100-year reference frame can underestimate its impacts on shorter timescales. The immediate gains obtainable from tackling emissions can thus be underestimated. However, understanding of the benefits of reducing methane emissions early has grown in recent years, resulting in a new focus on tackling methane emissions from gas flaring[15] as well as in the agriculture and waste sectors.[16] In September 2021, the United States and the European Union announced the Global Methane Pledge, an initiative with the aim of reducing global methane emissions by 30% by 2030 (from 2020 levels).[17]

EMISSION CATEGORIES

The GHG Protocol divides emissions into three main categories:

- **SCOPE 1**: Direct emissions from owned and controlled assets such as company facilities and vehicles, as well as fugitive emissions.[18]
- **SCOPE 2**: Indirect emissions from purchased electricity, steam, heat or cooling.
- **SCOPE 3**: Indirect emissions from the rest of a company's value chain, occurring either before (upstream) or after (downstream) its activities. The GHG Protocol separates those emissions into 15 separate sub-categories.

10 ppm = parts per million, ppb = parts per billion, ppt = parts per trillion. HFC concentration given in HFC-134a equivalent, PFC concentration given in CF4 equivalent.

11 100-year global warming potential.

12 CO_2 has multiple lifetimes owing to the variety of removal processes. Around 25% of emitted CO_2 remains in the atmosphere for more than 1,000 years.

13 There are many types of HFCs. The most prominent, HFC-134a, has a lifetime of 14 years.

14 Range based on the most prominent types of PFCs: PFC-14, PFC-116 and PFC-218.

15 Environmental Defence Fund, https://business.edf.org/insights/tackling-flaring-learnings-from-leading-permian-operators/

16 The European Commission noted an increased focus on reducing methane emissions as part of its 2030 Climate Target Plan (European Commission, https://ec.europa.eu/commission/presscorner/detail/en/IP_20_1833).

17 European Commission, https://ec.europa.eu/commission/presscorner/detail/en/IP_21_4785

18 Fugitive emissions typically result from leaks – for example, from air-conditioning or refrigeration equipment, gas transport, gas processing, coal mines, coal piles, waste and waste water.

Categories of GHG emissions

Upstream activities (indirect emissions)	**SCOPE 3** • Purchased goods and services • Capital goods • Fuel and energy-related activities not in Scope 1 or 2 • Upstream transportation/distribution • Waste from operations • Business travel • Employee commuting • Leased assets (upstream) **SCOPE 2** • Purchased energy (electricity, steam, heating, cooling)
Reporting company (direct emissions)	**SCOPE 1** • Company assets (facilities, vehicles, etc.)
Downstream activities (indirect emissions)	**SCOPE 3** • Downstream transportation/distribution • Processing of sold products • Use of sold products • End-of-life treatment of sold products • Leased assets (downstream) • Franchises • Investments

Source: GHG Protocol Corporate Accounting and Reporting Standard (https://ghgprotocol.org/corporate-standard).

The separation of emissions into these scopes avoids double counting emissions within a company, and facilitates the year-on-year tracking of emission evolution. Double counting will, however, be a feature of aggregated emissions (for example, the scope 1 emissions of a utility company will be the scope 2 or 3 emissions for another). For the purposes of portfolio carbon accounting, this is not necessarily of significant concern, as it simply extends the responsibility for a particular emission across multiple parties.

Most companies will have negligible scope 1 emissions, as these tend to be concentrated in the power, materials, heavy industry and transport sectors. Scope 2 emissions, however, are distributed across all sectors, with a particular concentration in the industry sector. Scope 3 emissions will often represent the majority of emissions of a given company, but with significant variance in the specific origin of those emissions. For example, the “use of sold products” is estimated to comprise up to 90% of emissions for oil and gas companies[19], while emissions from “investments” are most material for financial institutions.[20]

Measuring and validating scope 3 emissions is particularly challenging. As emissions must be considered and apportioned across a wide range of economic activities, reported values and estimates are particularly sensitive to methodological assumptions and broader emission data availability. For those reasons, regulators are more flexible in their approach to scope 3 integration and have focused their immediate attention on scope 1 and 2 emissions. However, as the largest share of company emissions are typically scope 3, there is an increasing demand for the measurement and reporting of this data.[21] To address the computation challenges, scope 3 emissions can be split by category and considered in a hierarchical fashion, focusing first on categories that are both material and close in the economic chain. Sources of uncertainties and potential biases can then be addressed separately.

[19] Climate Accountability Institute, https://climateaccountability.org/carbonmajors.html

[20] CDP, https://www.cdp.net/en/articles/media/finance-sectors-funded-emissions-over-700-times-greater-than-its-own

[21] For example, the EU Climate Transition and Paris-aligned benchmarks will require scope 3 emissions to be included across all sectors by 2026, and it is thus expected that companies will increase reporting to meet this demand.

CARBON ACCOUNTING METRICS

Carbon accounting metrics are used to apportion company emissions to the lending and investing activities of financial institutions. Carbon emissions can be assessed based on ownership or efficiency perspectives, with these two families of metrics providing complementary information on the emission characteristics of portfolios or individual issuers.

The definitions in this section are based on the two leading standards on carbon accounting metrics: the Partnership for Carbon Accounting Financials (PCAF)[22] and the Task Force on Climate-related Financial Discloses (TCFD). The PCAF standards, based on the GHG Protocol, are quickly becoming the reference for the calculation of scope 3 emissions of investments (category 15). The TCFD, on the other hand, provides a broader range of carbon footprinting and exposure metrics for a variety of different use cases.[23]

1. Total financed emissions

The total financed emissions metric is a measure of the total emissions (tonnes[24] of CO_2e) attributed to a portfolio, where in-scope company emissions[25] are apportioned based on a relevant ownership ratio (here, financing share):

$$\boldsymbol{Total\ financed\ emissions\ (tonnes\ CO_2e) = \sum_{i=1}^{N}\left[I_i \times Emissions_i \times \frac{Investment_i}{EVIC_i}\right]},$$

where:

$\boldsymbol{I_i}$ is a scope marker, equal to 1 for assets in scope ***and*** with available (reported or estimated) data (0 otherwise)
$\boldsymbol{Emissions_i}$ are the in scope* greenhouse gas emissions of company ***i***, in tonnes of CO_2 equivalent
$\boldsymbol{Investment_i}$ is the total value invested in company ***i***
$\boldsymbol{EVIC_i}$ is the enterprise value (including cash) of company ***i***, defined as the sum of the market capitalization of ordinary shares at fiscal year-end, the market capitalization of preferred shares at fiscal year-end, and the book values of total debt and minorities' interest (PCAF)

This simple metric is the starting point of any carbon analysis process, and should be the ultimate check to ensure that strategies based on other intensity-based or footprint-based metrics result in overall carbon emission reductions. It is also additive, allowing portfolio decomposition and attribution analysis. However, as it is an absolute measure (scaling with portfolio size), portfolios cannot be compared on a like-for-like basis; differences in total financed emissions may simply reflect differences in portfolio size. Thus, great care should be taken in interpreting any observed trends, as the metric will respond to changes in emissions and portfolio size. It is also important to bear in mind that, since this metric aggregates the emissions of all portfolio companies, double counting of emissions is likely to occur. Double counting can be minimized by following the attribution methods provided by PCAF and, if a consistent methodology is followed and data transparently reported, should not be considered a significant issue, given that the overall aim of these calculations is to track progress against decarbonization targets. As double counting spreads the responsibility for an emission across multiple companies, it simply increases the gain (or loss) resulting from an emission reduction (or rise).

A note on enterprise value

The apportioning metric for ownership ratio can be based on either equity ownership (market capitalization) or financing share (enterprise value). Whereas early equity-focused iterations tended to focus on market capitalization, the use of enterprise value has become more widespread, as it provides a harmonized way of attributing emissions across a broader range of financial actors. Crucially, it means that total financed emissions can also be calculated for fixed income portfolios.

In 2019, the EU Technical Expert Group (TEG) on Sustainable Finance recommended the exclusion of cash and cash equivalent deductions from the computation of enterprise value to avoid rare cases of negative enterprise values, leading to the concept of "enterprise value including cash" (EVIC).

[22] Partnership for Carbon Accounting Financials, https://carbonaccountingfinancials.com/files/downloads/PCAF-Global-GHG-Standard.pdf

[23] Task Force on Climate-Related Financial Disclosures, https://assets.bbhub.io/company/sites/60/2021/07/2021-TCFD-Implementing_Guidance.pdf (Table 2).

[24] According to the GHG Protocol, GHGs should be measured in units of "tonnes" (metric ton, equivalent to 1,000kg). The tonne or metric ton is often shortened to "ton" and is not to be confused with the "short ton" or "long ton", which are both imperial units.

[25] Scope 1 and 2 emissions, with a progressive phase-in of scope 3 emissions (following the PCAF standard and TCFD recommendations).

EVIC has been recommended by PCAF as the apportioning metric of choice, and the TCFD has also recommended its use for listed equities, corporate bonds and business loans in its latest guidance on carbon metrics.

2. Carbon footprint[26]

This version of the total financed emissions metric is normalized by the total value invested in a given portfolio and measures the emission impact of a portfolio per million invested. It allows for like-for-like comparisons across differently sized portfolios, and the contribution of individual issuers can be examined to identify large relative contributors to overall emissions. As it can be applied across asset classes and can be directly linked to company ownership, it acts as a first-level deep-dive into emission contributions.

$$\boldsymbol{Carbon\ footprint\ (tonnes\ CO_2e/million\ invested\ (USD))} = \frac{\sum_{i=1}^{N}\left[I_i \times \frac{Investment_i}{AUM} \times \frac{Emissions_i}{EVIC_i}\right]}{\sum_{i=1}^{N}\left[I_i \times \frac{Investment_i}{AUM}\right]},$$

where:

$\boldsymbol{I_i}$ is a scope marker, equal to 1 for assets in scope *and* with available (reported or estimated) data (0 otherwise)
$\boldsymbol{Emissions_i}$ are the greenhouse gas emissions of company *i*, in tonnes of CO_2 equivalent
$\boldsymbol{Investment_i}$ is the total value invested in company *i*
$\boldsymbol{AUM}$ is the total size of the portfolio
$\boldsymbol{EVIC_i}$ is the enterprise value (including cash) of company *i*, in million USD, defined as "the sum of the market capitalization of ordinary shares at fiscal year-end, the market capitalization of preferred shares at fiscal year-end, and the book values of total debt and minorities' interest" (PCAF)

3. Carbon intensity

While carbon footprint is ownership-driven, carbon intensity metrics focus on the carbon efficiency of companies relative to the products they sell and can establish the exposure of a portfolio to carbon-intensive companies or sectors. This efficiency can be computed in economic terms (using revenues as a common economic denominator), or in physical terms (using sector-specific physical units of production).

3a. WACI (revenue intensity)

Weighted average carbon intensity (WACI) is a measure of carbon emissions normalized by revenues. Since revenues are a relevant comparison point across all issuers, the metric can be used for portfolio decomposition and attribution analyses across sectors and asset classes. Moreover, since companies with high emissions and low revenues are likely to be more vulnerable to carbon pricing mechanisms, the metric is useful from a risk analysis perspective to indicate an issuer's potential exposure to transition risks. It also accounts for the fact that emitting one tonne of CO_2 to produce a high-value product may be more justifiable than emitting one tonne of CO_2 to produce a low-value product. As such, it is useful to compare the carbon efficiency of companies across different industries. However, revenues cannot just be influenced by the long-term value of the products a company produces, but also short-term price fluctuations and/or differences in the competitiveness of local markets. This means that the carbon intensity can be an imperfect way of comparing the carbon efficiency of different companies operating in the same industry.

$$\boldsymbol{WACI\ (tonnes\ CO_2e/million\ revenues\ (USD))} = \frac{\sum_{i=1}^{N}\left[I_i \times \frac{Investment_i}{AUM} \times \frac{Emissions_i}{Revenues_i}\right]}{\sum_{i=1}^{N}\left[I_i \times \frac{Investment_i}{AUM}\right]},$$

where:

$\boldsymbol{I_i}$ is a scope marker, equal to 1 for assets in scope *and* with available (reported or estimated) data (0 otherwise)
$\boldsymbol{Emissions_i}$ are the greenhouse gas emissions of company *i*, in tonnes of CO_2 equivalent
$\boldsymbol{Investment_i}$ is the total value invested in company *i*
$\boldsymbol{AUM}$ is the total size of the portfolio
$\boldsymbol{Revenues_i}$ are the total revenues of company *i*, in million USD

[26] This metric is also called "Financed Carbon Emissions" by certain data providers, such as MSCI.

3b. Physical intensity

Sector-specific intensity analyses can also be performed using physical production units. This approach ties emissions to industrial output, independent of revenue, business strategy or market positioning. It replaces revenues in the above equation with a production metric relevant to the sector under study.[27] As such, this metric compares the carbon efficiency of companies producing a given product and removes the dependence on any fluctuations in the prices those products are sold for.

Comparisons among product types and across sectors are difficult and potentially misleading, limiting the scope of this approach for portfolio analysis. This approach is also best suited to sectors with a simple, relatively uniform product mix.

Examples of physical intensity metrics

SECTOR	PHYSICAL INTENSITY METRIC
Automotive	kg CO_2e/km driven
Energy	kg CO_2e/MJ (megajoule) of energy extracted
Manufacturing	kg CO_2e/unit of production output
Materials	kg CO_2e/tonne of production output
Mining	kg CO_2e/tonne of mineral extracted
Utilities	kg CO_2e/MWh (megawatt-hour) of electricity produced

Source: J.P. Morgan Asset Management, as of 3 November 2021.

[27] This method is used in sector specific analysis such as the Transition Pathway Initiative (TPI) (Source: TPI, https://www.transitionpathwayinitiative.org/publications/65.pdf?type=Publication).

APPLICATION APPROACH

While the use of carbon metrics should be ultimately dictated by specific decarbonization goals, a hierarchical approach will leverage the complementary nature of the insights all metrics provide.

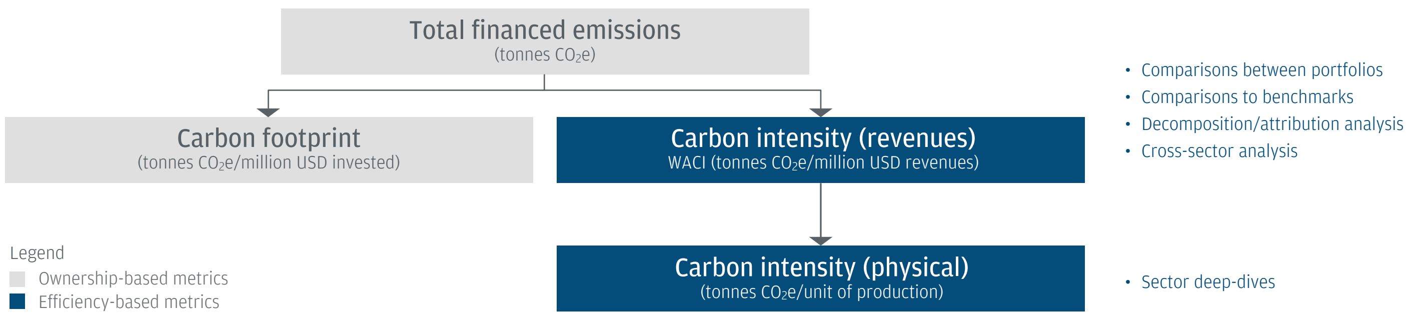
Comparison of carbon metrics

METRIC	USE CASE(S)	PROS/CONS
Total financed emissions (tonnes CO_2e)	To set baselines and to track emission evolution.	+ Easily applied to portfolio analysis (decomposition and attribution). + Tracks absolute emission changes of a portfolio over time. - Portfolio comparisons are difficult, since the data is not normalized by portfolio size. - Variations in enterprise value can impact emission trends.
Carbon footprint (tonnes CO_2e/million invested)	To compare portfolios and perform company attribution based on ownership.	+ Easily applied to portfolio analysis (decomposition and attribution). + Comparisons between portfolios can be easily performed. + Link between ownership and emission responsibility is intuitive. - Does not consider the carbon efficiency (relative to the products sold) of individual companies. - Variations in enterprise value can impact emission trends.
Carbon intensity (revenue (WACI)) (tonnes CO_2e/million revenues)	To evaluate exposure to carbon-intensive companies.	+ Easily applied to portfolio analysis (decomposition and attribution). + Reflects the size and carbon efficiency of individual companies. - Normalization using revenues can make this metric sensitive to short-term fluctuations in product prices. - Sensitive to outliers, as extreme values with large portfolio weights can skew the output.
Carbon intensity (physical) (tonnes CO_2e/unit of production)	To perform sector-specific deep-dive analyses.	+ Direct, fundamental link to physical production. + Independent of pricing practices and market positioning. + Considers the size and carbon efficiency of individual companies. - Normalizing factors are sector-specific. - Does not allow for portfolio analysis (decomposition and attribution) across sectors. - Not suitable for sectors with a wide product mix.

Source: J.P. Morgan Asset Management, as of 3 November 2021.

In the context of portfolio analysis, a hierarchical approach would involve looking first at the emissions attributed to a portfolio or set of portfolios (ownership approach), both in terms of total emissions (to assess progress against decarbonization targets) and carbon footprint. The more granular approach provided by carbon footprint analysis can then be used to 1) identify individual issuers/sectors contributing to the overall emissions of a portfolio; 2) perform comparisons to relevant benchmarks; and 3) prioritize action items. This information can be complemented with revenue-based carbon intensity (WACI), which will provide insight on carbon efficiency across and within sectors. For specific sectors where high emissions (absolute or with respect to a relevant benchmark) are identified, deep dives can be conducted based on physical units of production.

Application of carbon metrics



Source: J.P. Morgan Asset Management, as of 3 November 2021.

EMISSIONS REPORTING

In order to calculate any of the available carbon metrics, financial institutions must rely on accurate, comparable and timely company level emissions data. However, data quality is mixed and reporting rates vary across countries and sectors, resulting in a fragmented data landscape. Third-party data providers[28] supply estimates to fill these gaps, and even sometimes evaluate and replace potentially erroneous data. While estimates allow for a more complete emissions calculation universe, estimation methodologies vary widely and company or portfolio assessments will have a strong dependency on the data provider used. Differences between providers can become especially acute when scope 3 emissions are considered.

Within individual portfolios, the proportion of estimated emissions will depend on several factors, including country, sector and whether the company is listed. Publicly listed companies in high emitting sectors such as oil & gas, coal and heavy industry are required to report their scope 1 emissions under national regulations in many countries, and requirements are much more extensive in several jurisdictions.[29] In emerging markets, reporting levels are currently lower, and the degree of reliance on estimates tends to be higher. Similarly, as private companies do not typically fall under mandatory regulations, the majority of these emissions are estimated. It is also important to note that each data provider has a different coverage universe, so the proportion of estimated data within a portfolio will vary across data providers, both in terms of reporting companies covered and companies that have their emissions estimated.

CURRENT LANDSCAPE

The use of carbon metrics in the regulatory landscape is evolving rapidly. The table below shows the carbon accounting metrics that are recommended or required by different standards and regulators as of October 2021. Total financed emissions and carbon footprint metrics are most commonly required, while WACI and other carbon intensity metrics, which have previously been popular, are now not typically a core requirement. This shift occurred following the release of the PCAF GHG Accounting and Reporting Standards at the end of 2020, which led to updates in the TCFD guidance that underpins many of the regulatory standards. The TCFD now recommends reporting total financed emissions following the PCAF standard (except for insurance underwriting), in addition to the WACI metric it initially chose in 2017.

Overview of carbon metric reporting standards and requirements

	TOTAL EMISSIONS	CARBON FOOTPRINT	WACI (INTENSITY)
Task Force on Climate-Related Financial Disclosures (TCFD)	✓	✓[30]	✓
Partnership for Carbon Accounting Financials (PCAF)	✓	✓	
Sustainable Finance Disclosure Regulation (SFDR, EU)	✓	✓	
Securities and Futures Commission (SFC, HK)	✓	✓	
Financial Conduct Authority (FCA, UK)[31]	✓	✓	✓
Department for Work and Pensions (DWP, UK)[32]	✓	✓	
Securities and Exchange Commission (SEC, USA)[33]	TBD	TBD	TBD

Source: J.P. Morgan Asset Management, as of 3 November 2021.

[28] Such as Bloomberg, ISS, Moody's (Vigeo Eiris), MSCI, Sustainalytics and Trucost.

[29] Emissions reporting is mandatory for publicly listed big emitters (at a minimum) in the UK, EU, Japan, US and Canada (Source: Carbone4, https://www.carbone4.com/wp-content/uploads/2016/09/CARBONE4-carbon-reporting-by-companies-around-the-world-EN.pdf).

[30] In its latest proposed guidance on carbon metrics, the Task Force now recommends following the PCAF framework (carbon footprint) for financed emissions (Source: TCFD, https://assets.bbhub.io/company/sites/60/2021/07/2021-TCFD-Implementing_Guidance.pdf).

[31] In the consultation phase.

[32] In the consultation phase. In July 2021, the DWP replaced in its draft statutory guidance the use of WACI as the key recommended metric with the use of carbon footprint. (Source: Department for Works and Pensions, https://www.gov.uk/government/consultations/taking-action-on-climate-risk-improving-governance-and-reporting-by-occupational-pension-schemes-response-and-consultation-on-regulations/taking-action-on-climate-risk-improving-governance-and-reporting-by-occupational-pension-schemes)

[33] The SEC is expected to propose emissions-related disclosure requirements by early 2022 (Source: SEC, https://www.sec.gov/sec-response-climate-and-esg-risks-and-opportunities).

SUMMARY

Climate change is already having a measurable impact on human and natural systems. Minimising future impacts and limiting the rise in global temperature to well below 2°C (in line with the requirements of the Paris Agreement) is only feasible if total emissions stay within the carbon budget compatible with this target. As this budget is rapidly being used up, rapid and aggressive emission reductions are necessary if the target is to remain achievable.

In response to a growing need for climate action, investors are increasingly required and expected to measure, report and manage the GHG emissions for which they are responsible. Based on the best practice from the TCFD guidelines and the PCAF standard, this would include using a suite of complementary carbon accounting metrics to characterize portfolio emissions:

1. **TOTAL FINANCED EMISSIONS** to set baselines and track emissions evolution
2. **CARBON FOOTPRINT** to compare portfolios and perform attribution analyses
3. **CARBON INTENSITY** (revenue-based) to perform cross-sector comparisons and evaluate exposure to carbon-intensive companies
4. **CARBON INTENSITY** (physical activity-based) to perform sector-specific deep dives

However, approaches to carbon accounting are likely to continue evolving, especially given the changing regulatory landscape. In this context, it is important to keep monitoring the evolution of emissions standards and metrics to minimize risk and develop further insights on the emissions characteristics of investments.

DISCLAIMER

These materials have been prepared solely for informational purposes and are entirely based on information available to the public and from sources believed to be reliable, are not necessarily all-inclusive and are not guaranteed as to accuracy. As such, no warranty of accuracy or reliability is given and no responsibility arising in any other way for errors and omissions is accepted by J.P. Morgan Asset Management, its officers, employees or agents. Carbon exposure metrics may include information self-reported by companies and third-party providers that may be based on criteria that differs significantly from the criteria used by asset managers such as J.P. Morgan Asset Management or investors. In addition, the criteria used by third-party providers can differ significantly, and data can vary across providers and within the same industry for the same provider.

The use and propagation of the metrics mentioned in this document within global industries and services is rapidly evolving and is subject to change, and this will also impact any use of such metrics.

The carbon metrics references in this paper are not exhaustive and investors should also consider other greenhouse gas emissions data points to review and consider the analysis on climate impact in any portfolios. It is important to note that these metrics may not appropriately capture emissions from certain asset classes.

The information is provided as is at the date of the document with no commitment to update or revise any information, including forward-looking information.

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