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Carbon Footprinting: An Investor Toolkit

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Measuring, monitoring and reporting on carbon emissions can appear very confusing.

The recommendations from the European Commission's Technical Expert Group (TEG) on sustainable finance and the Task Force on Climate-related Financial Disclosures (TCFD) have led to several approaches which are currently used in the market place to assess carbon emissions and calculate company and portfolio-level carbon footprint.

This educational guide aims to help investors and asset owners understand carbon pricing and help them build and design portfolios that are aligned with the Paris Agreement goals. In doing so, investors and asset owners can report to their constituents on generally accepted standards, including those of the TCFD.

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Measuring Carbon Footprints

Carbon emissions generally refer to the total greenhouse gas (GHG) emissions caused directly and indirectly by an individual, organisation, event or product. GHGs are atmospheric gases that absorb and emit radiation within the thermal infrared range and that contribute to the greenhouse effect and global climate change.

GHG emissions can be expressed as a carbon dioxide equivalent (CO_2e). Using CO_2e as a unit of measurement allows different GHGs to be compared on a like-for-like basis, relative to one unit of carbon dioxide.

Emissions of CO_2e are based on the seven GHGs identified by the Kyoto Protocol:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulphur hexafluoride (SF_6)
- Nitrogen trifluoride (NF_3)

Each GHG has a different global warming potential (GWP) and persists for a different length of time in the atmosphere. Aside from carbon dioxide, the two main GHGs and their 100-year global warming potential (GWP) are:

- Methane (CH_4) — 25 x CO_2 Releasing 1kg of methane into the atmosphere is about equivalent to releasing 25kg of CO_2.
- Nitrous oxide (N_2O) — 298 x CO_2 Releasing 1kg of nitrous oxide into the atmosphere is about equivalent to releasing 298kg of CO_2.[1]

To give an idea of scale, a typical internal combustion engine vehicle emits about 4.6 metric tonnes of carbon dioxide per year, along with much smaller amounts of methane and nitrous oxide.[2] The US is estimated to have emitted 6.5 billion metric tonnes of CO_2e in 2017.[3]

Carbon dioxide accounted for the largest percentage of GHGs (82%), followed by methane (10%), nitrous oxide (6%) and other gases (3%). So, while methane and particularly nitrous oxide are much more potent GHGs, the sheer volume of carbon dioxide means it has the greatest impact on warming.

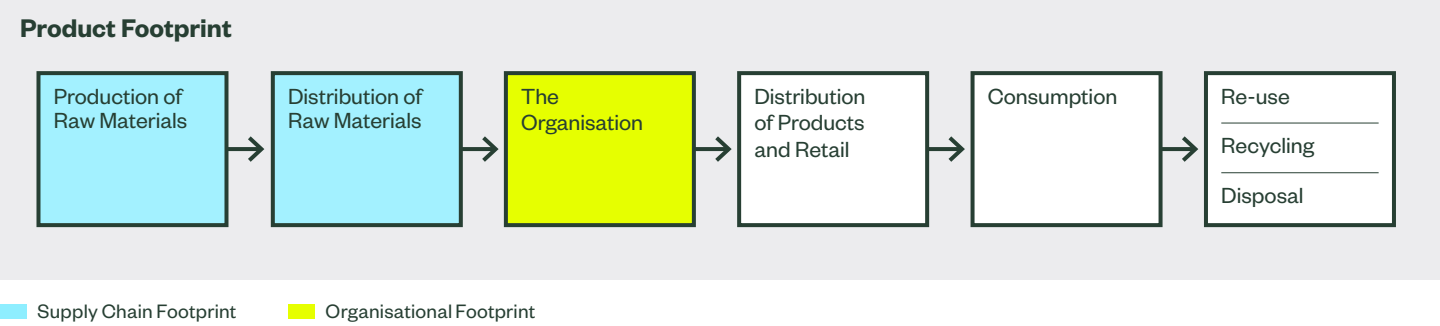
For a company, quantifying GHG emissions allows an understanding of where the largest emissions arise and how its carbon footprint can be reduced.

Broadly, there are three types of carbon footprint for companies:[4]

- An **organisational carbon footprint** measures the GHG emissions from all the activities across an organisation, including energy used in buildings, industrial processes and company vehicles.
- A **supply chain carbon footprint** measures the carbon impacts of the raw materials and services that are purchased by an organisation to deliver its services and/or products.
- A **product carbon footprint** measures the GHG emissions over the whole life of a product from the extraction of raw materials and manufacturing through to its use, recycling or disposal.

Companies generate emissions from their supply chains to their operations and finally the products/services they produce and distribute.

Figure 1
Carbon Footprint for a Typical Company



Source: The Carbon Trust.

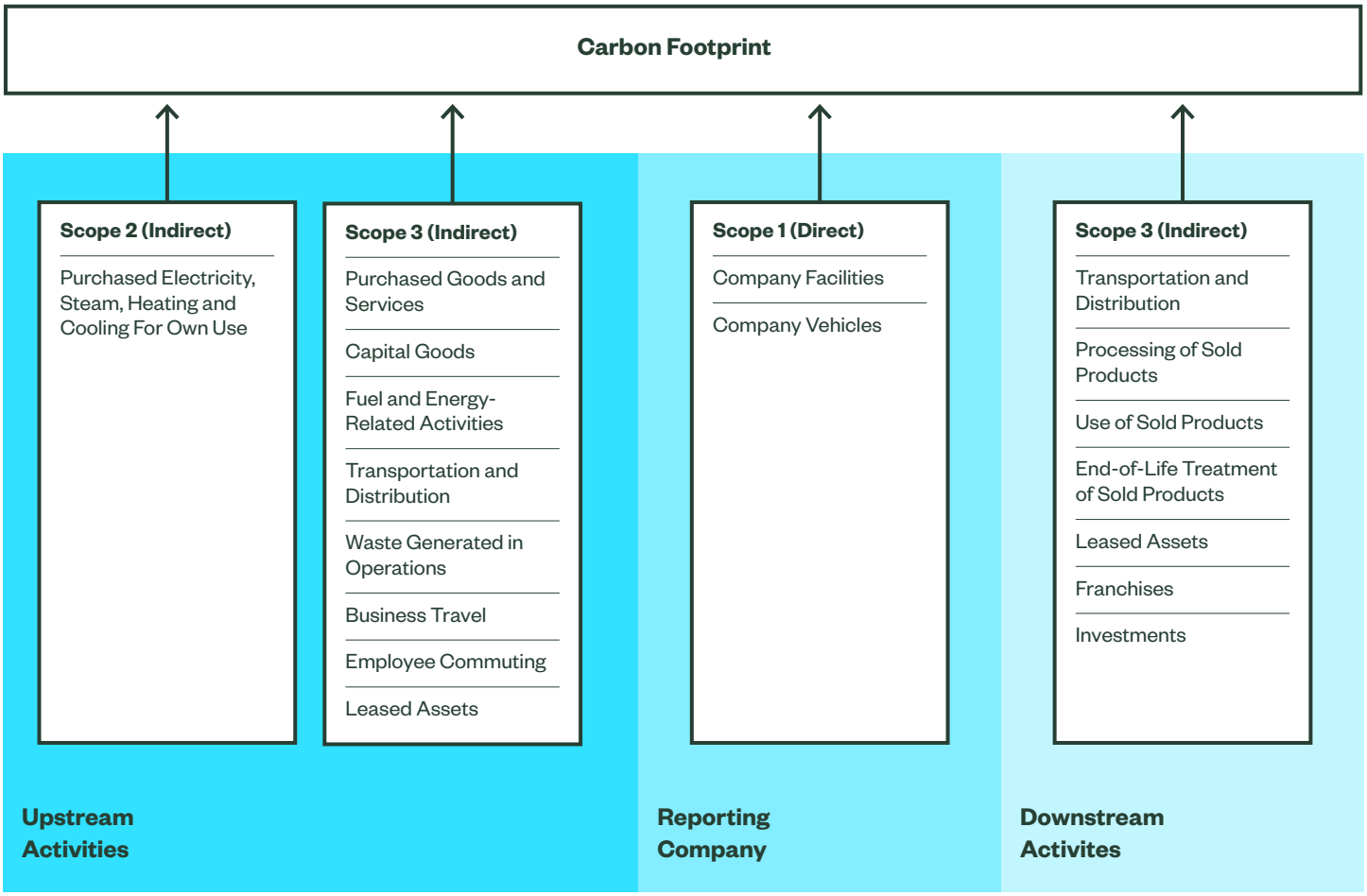
Greenhouse Gas Protocol

The Greenhouse Gas (GHG) Protocol Standard is the most widely used greenhouse gas accounting and reporting standard. The GHG Protocol categorises emissions into three 'scopes':

- **Scope 1:** Direct emissions from owned or controlled sources.
  Examples: Fuel combustion and company vehicles.
- **Scope 2:** Indirect emissions from purchased electricity, steam, heating and cooling consumed by the reporting company.
  Examples: Purchased electricity and heating.
- **Scope 3:** All other indirect emissions that occur in a company's value chain.
  Examples: Purchased goods and services, business travel, and employee commuting and investments.

The schematic below shows the three scopes across a typical company's value chain.

Figure 2
Greenhouse Gas Protocol Scopes and Emissions



Source: Greenhouse Gas Protocol.

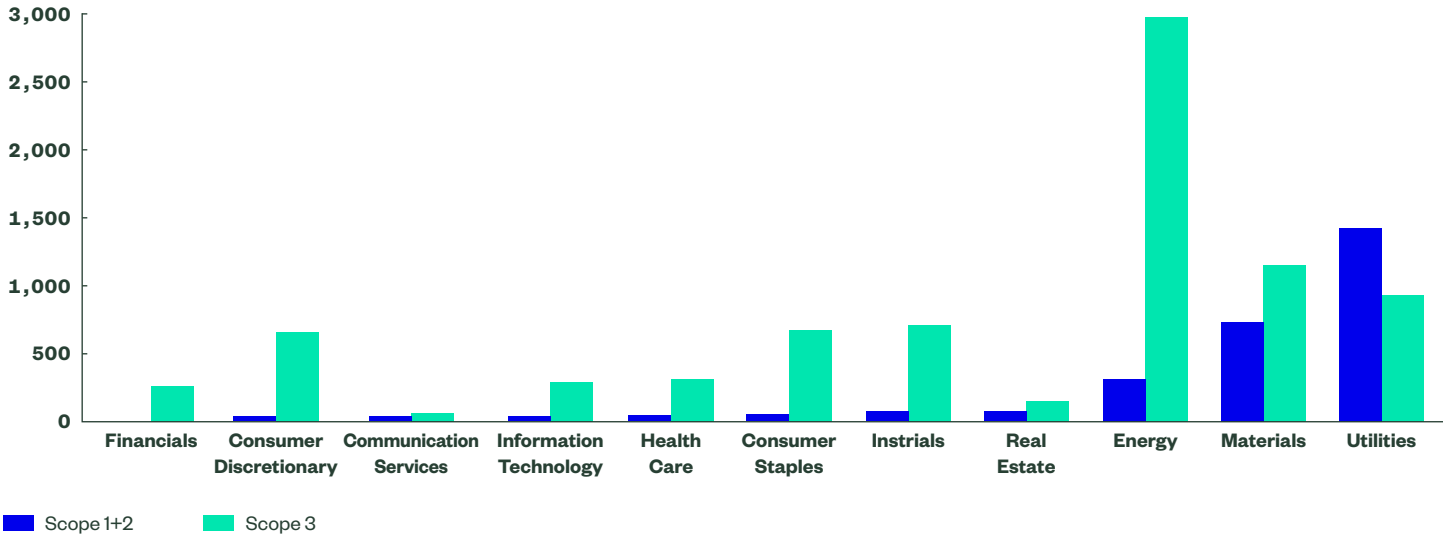
Scope 3 Complexities

Take a US steel company with global operations and a long value chain. How should we measure this company's carbon footprint? In an ideal world, we would simply add up a company's scope 1, 2 and 3 emissions and divide by the company's revenue (in $million). In reality, it's not so simple.

Measuring scope 3 emissions is an inexact science with limited data and varying methodologies generating sometimes widely varying results. While reporting on Scope 1 and 2 emissions is becoming the norm in most jurisdictions, reporting on scope 3 emissions is largely voluntary.

Sector-specific categorisation of companies can help to reveal the true sources of emissions. The chart below illustrates transition risk for various sectors, split by the scope of emissions in those sectors. It's clear that the impact of the uncertainties around measuring scope 3 emissions is greatest in the energy sector.

Figure 3
Transition Risk: Sector Breakdown emissionsof Scope 1+2 and Scope 3



Source: Trucost. Chart is provided for illustrative purposes.

Another problem is double counting of emissions. One company's scope 3 emissions can overlap with another's scope 1 emissions. Categories can also be double counted within Scope 3, for example, if two companies account for third-party transportation of goods between them.[5]

The scale of the problem is compounded because scope 3 emissions can constitute the largest portion of companies' carbon footprint. It has been estimated that on average, more than 75% of an industry sector's carbon footprint is attributed to Scope 3 sources.[6] Yet, a focus on scope 3 emissions has been criticised for drowning valuable information on scopes 1 and 2 emissions in a sea of noise.

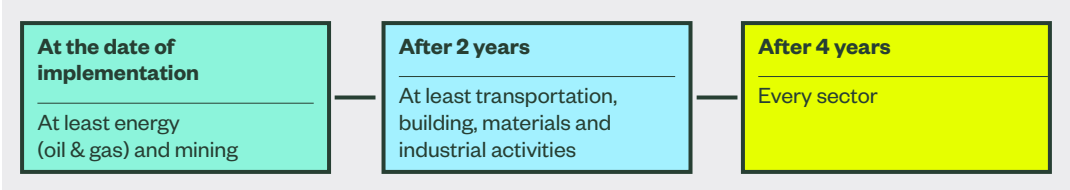
Accounting for Scope 3 GHG Emissions

Because of these challenges, the TCFD currently recommends calculating carbon intensity using scope 1 and 2 emissions and, if appropriate, scope 3 GHG emissions.

The new European Union climate benchmark regulations encourage the use of Scope 3 emissions, based on the Technical Expert Group's (TEG's) recommendations.

Below is the TEG's guidance on when companies should account for their scope 3 GHG emissions by sector.

Figure 4
TEG Guidance on Scope 3 Emissions Reporting



Source: European Commission Technical Expert Group on Sustainable Finance (2020).

> **“ The TCFD recommends calculating carbon intensity using scope 1 and 2 emissions and, if appropriate, scope 3 GHG emissions.”**

Given the current state of corporate Scope 3 GHG reporting, the TEG recognises that Scope 3 data will likely be estimated.

The effectiveness and efficiency of reduction targets will largely depend on how firms will substantially increase the volume and quality of its Scope 3 GHG emissions reporting or the quality of the Scope 3 estimations. We can expect the Scope 3 phase-in to help improve the quality and reliability of data (in particular for oil & gas and mining).

The list of high-impact sectors should be reviewed once scope 3 emissions are implemented for every sector. The financial sector for example, considered as low impact by the TEG, has a very limited impact when considering scope 1 & 2 emissions but has relatively significant scope 3 emissions, notably through the financing of carbon-intensive projects and infrastructure.

Scope 3 emissions are also more important for companies in the services industries (7%–30% of emissions) where employee commuting and air transportation are common, compared to companies in the manufacturing industries (<1% of total analysed emissions).[7]

As progress is made to more accurately account for scope 3 emissions, a nuanced and prudent approach is advised. Key for investors is to ensure companies are clearly reporting their carbon emissions and the data and assumptions used in their calculations. If companies are reporting scope 1 and 2 emissions only, they should be able to explain why they have excluded their scope 3 footprint. Companies that do not disclose such information and cannot adequately explain it should be a red flag.

Below is a summary of the key characteristics of scope 1, 2 and 3 emissions.

Figure 5
Overview of Scope 1, 2 and 3 GHG Protocol Characteristics

	Scope 1 + 2 GHG Protocol	**Direct + First Tier Indirect S&P Trucost GHG Protocol + 4 Gases**	**Scope 1 + 2 + 3 GHG Protocol**
Data Robustness and Reliability	Most robust and reliable Most commonly reported	Good	Least robust and reliable Challenges to measuring scope 3 Significant estimations
Comprehensiveness of Emissions Measure	Least	Moderate	Most comprehensive (Food companies/Oil & Gas)
Ease of Portfolio Implementation	Lowest impact on TE	Low impact on TE	Most challenging to implement with large potential tracking error impact
Regulatory Trends	TCFD recommended	N/A	EU requirement for all sectors within 4 years

Source: Trucost (2020).

Carbon Intensity

With total emissions over a given period in CO_2e, carbon intensity can then be calculated by dividing emissions by a relevant measure of activity. For a typical company, this is usually revenues (in $M):

Company (Issuer) Emission Intensity = **Tonnes of CO_2e/Company (Issuer) Revenues**

As an example, between 2013 and 2018, Google's carbon intensity fell from 23.2 to 5.7 tonnes of CO_2 equivalent per million dollars of revenues.[8] Google has stated that it has been carbon neutral since 2007 through investment in renewables and use of carbon offsets.

The revenues approach offer a good indication of output efficiency as revenues are a good proxy for production and indicate how operationally efficient portfolio companies are in terms of carbon emitted per unit of output.

Using revenue (instead of physical or other metrics) to normalise the data tends to favour companies with higher pricing levels relative to their peers.[9]

Other denominators can be used in the calculation of company carbon intensity. For example, the new EU climate benchmarks use a measure of carbon intensity that divides a company's emissions by its enterprise value.[10]

However, significant changes in underlying companies' market capitalisation can be misinterpreted. It is sensitive to swings in market capitalisation and can therefore be difficult to compare year-on-year performance.

Carbon intensity for a product or service can be calculated in a similar way to that for companies — emissions divided by a unit of product or activity. Some examples from everyday life are below:

Figure 6
Emissions Intensity for Common Consumer Products

Product	Emissions Intensity Metric
Can of cola	kg CO_2e per 330ml can
Washing machine	kg CO_2e per wash
Television	kg CO_2e per hour of viewing
Car	kg CO_2e per kilometre driven

Source: Greenhouse Gas Protocol.

The Financial Stability Board's Task Force on Climate-related Financial Disclosures (TCFD) recommends that companies disclose and report on emission intensity and several other climate-related metrics:

Figure 7
Categories of Climate-Related Metrics and Associated Risk Types

Category	Subcategory	Risk Type	Description of Metric
Greenhouse Gas (GHG) Emissions	Emission Level	Transition	Total emissions (by type of GHG, by source, by scope)
	Emission Intensity	Transition	Emissions per output scaling factor (e.g. revenues, sales, units produced)
	Embedded Emissions	Transition	Emissions per unit of fossil fuel reserves
Energy/Fuel	Energy Usage	Transition	Total energy consumption (megawatt hour [MWh] or gigajoules [GJ] per year)
	Energy Intensity	Transition	Total energy consumed per output scaling factor (e.g. revenues, sales, units produced, floor area)
	Energy Mix	Transition	Percent of energy by type of energy source (e.g., renewable, hydro, coal, oil, natural gas) (MWh or GJ)

Source: Trucost.

Portfolio Carbon Footprint

Portfolio carbon footprinting captures an investor's exposure to carbon emissions by quantifying the GHG emissions associated with a portfolio's underlying holdings and allows investors to quickly appraise large numbers of holdings for carbon emission `hot spots' regardless of asset class, size, geography or portfolio style. As a result, it is often the first step investors take when beginning to address climate risk.

Initiatives such as the Montreal Pledge and advisory groups such as the High Level Commission on Carbon Pricing, the High-Level Expert Group on Sustainable Finance and the Financial Stability Board's Task Force on Climate Related Financial Disclosures (TCFD) are all pushing for greater transparency and strongly support carbon footprinting.

The increased demand for portfolio carbon footprinting and the lack of clear established standards have led to the emergence of several methodologies, sometimes with the same name but using different methodologies.

The four metrics highlighted below are the most widely adopted and well-defined by the TCFD:

1. Weighted Average Carbon Intensity
2. Total Carbon Emissions
3. Carbon Emissions to Value Invested
4. Carbon Emissions to Revenue Intensity

The most appropriate methodology to calculate a portfolio's carbon footprint depends on the particular question an investor wants to answer. The following descriptions can help investors discern the specific intent of each carbon footprinting approach.

Carbon Metrics

Weighted Average Carbon Intensity Weighted Average Carbon Intensity shows a portfolio's exposure to carbon-intensive companies. As carbon-intensive companies are likely to be more exposed to carbon pricing mechanisms or other carbon regulatory risks, this metric is regarded as a useful indicator of a portfolio's potential exposure to transition risks (such as policy intervention or changing consumer behaviour) relative to other portfolios or benchmarks.

This is the most popular metric since the TCFD endorsed it in its final recommendations report in 2017. Unlike other approaches, the calculation does not require market capitalisation or enterprise value as inputs and can therefore be applied more easily to asset classes beyond equity and listed fixed income.

Investors can calculate weighted average portfolio carbon intensity by combining Scope 1 and Scope 2 GHG emissions then allocating based on portfolio weights (current value of the investment relative to current portfolio value).

Weighted Average Carbon Intensity =

$$\sum_{n}^{i} * \left(\frac{\text{current value of investment}_i}{\text{current portfolio value}_i} \times \frac{\text{issuer's Scope 1 and Scope 2 GHG emissions}_i}{\text{issuer's \$M revenue}_i} \right)$$

* The sum of.

The advantages of this approach are that it is more easily applied across asset classes and the calculation is simple and easy to communicate. This metric also allows for portfolio decomposition and attribution analysis.[11]

Total Carbon Emissions The Total Carbon Emissions metric measures a portfolio's carbon emissions allocated to the portfolio in absolute terms and is the starting point for carbon footprinting.

The methodology recommended by the TCFD adopts the equity ownership approach, consistent with the GHG Protocol accounting standard, allocating emissions to an investor based on levels of capital invested in a company and quantifies a market participant's responsibility for the carbon emissions of each holding. The higher the percentage holding in a company, the more of its emissions you own. This metric also allows for portfolio decomposition and attribution analysis and is a useful tool for investors managing their portfolio to a specific carbon budget. However, portfolios cannot be compared on a like for like basis because the data are not normalised and size can skew the results.

Total Carbon Emissions =

$$\sum_{n}^{i} \left(\frac{\text{current value of investment}_i}{\text{issuer's market captalisation}_i} * \text{issuer's Scope 1 and Scope 2 GHG emissions}_i \right)$$

Most often, absolute carbon emissions are apportioned from a company to a portfolio based on equity ownership (market capitalisation) or share of financing (enterprise value).

For an equity portfolio, market capitalisation is the most appropriate apportioning metric when calculating an investor's 'ownership' of emissions. However, as investors have started to look beyond their equity portfolios, the apportioning metric used has begun to vary.

For a fixed income portfolio, balanced fund or even an aggregated footprint across asset classes, enterprise value, net debt, gross debt or total invested capital might all be considered. However, significant changes in underlying companies' market capitalisation can be misinterpreted. It is sensitive to swings in market capitalisation and can therefore be difficult to compare year-on-year performance.

Carbon Emissions to Value Invested By normalising Total Carbon Emissions, market participants can compare portfolios of different sizes and still use a metric that is consistent with the GHG protocol. The Carbon Footprint metric offers one approach for doing this, showing carbon emission for a portfolio normalised by the market value of the portfolio or fund and expressed in metric tons Co_2e/$million invested. This approach tells an investor which portfolios are the most carbon intensive, and therefore, where attention should be focused first when it comes to managing carbon risk.

Carbon Emissions to Value Invested =

$$\frac{\sum_{n}^{i}\left(\frac{\text{current value of investment}_i}{\text{issuer's market captalisation}_i} * \text{issuer's Scope 1 and Scope 2 GHG emissions}_i\right)}{\text{current portfolio value (\$M)}}$$

Carbon Emissions to Revenue Intensity The Carbon to Revenue Intensity performs a similar function to the Carbon Emissions to Value Invested metric but, in addition, it normalises the Total Carbon Emissions by the issuer's revenues to enable comparison across portfolios of different sizes.

The revenues approach allows for a better indication of output efficiency as revenues are a good proxy for production. For example, if an investor owns 1% of a company, they also own 1% of its emissions and 1% of its revenues.

Carbon Emissions to Revenue Intensity =

$$\frac{\sum_{n}^{i}\left(\frac{\text{current value of investment}_i}{\text{issue's market captalisation}_i} * \text{issuer's Scope 1 and Scope 2 GHG emissions}_i\right)}{\sum_{n}^{i}\left(\frac{\text{current value of investment}_i}{\text{issuer's market captalisation}_i} * \text{issuer's \$M revenue}_i\right)}$$

The method is consistent with GHG Protocol and is comparable across portfolios of all sizes. Finally, it normalises for carbon emission efficiency with currency exchange rates being equal.

Below is a summary of the key carbon metrics.

Figure 8
TCFD Carbon Metrics

Metric	Weighted Average Carbon Intensity	Total Carbon Emissions	Carbon Emissions to Value Invested	Carbon Emissions to Revenue Intensity
Units	Metric tons CO_2e/million revenues	Metric tons CO_2e	Metric tons CO_2e/million revenues	Metric tons CO_2e/million revenues
Ownership approach used	No	Yes	Yes	Yes
Methodology	The weighted average of individual company carbon intensities	The aggregated apportioned carbon emissions of the portfolio constituents	The aggregation of apportioned carbon emissions of constituents per $1 million invested	The aggregation of apportioned carbon emissions of constituents per $1 million generated in apportioned revenues

Source: Trucost.

The End Goal

Before undertaking any analysis of portfolio carbon footprinting or the impact of carbon pricing on your portfolio, it's important to first determine your end goal.

Does your portfolio or fund aim to manage climate-related risks? Do you adopt an exclusionary approach to companies with high carbon emissions and brown revenues? Do you want to understand how carbon price risk can be modelled under different scenarios? Or do you simply want to know your portfolio or fund's exposure relative to the broader market?

> **"Before undertaking any analysis, determine your end goal"**

Carbon metrics can be used alongside portfolio footprinting to provide investors with a more holistic understanding of their exposure to climate risks and opportunities. This is particularly useful for institutional investors, who have hundreds or thousands of holdings across portfolios, with different benchmarks, geographic exposure and investment styles, often run by different asset managers.

Endnotes

1 United Nations Framework Convention on Climate Change.

2 US Environment Protection Agency (2020).

3 United States Center for Climate and Energy Solutions (2018).

4 The Carbon Trust.

5 Carbon Disclosure Project (2020).

6 'The Growing Importance of Scope 3 Greenhouse Gas Emissions From Industry', Hertwich and Wood (2018).

7 TCFD (2020).

8 Statista (2018).

9 Enterprise value is the total value of a company's market capitalisation and market value of debt, less cash and equivalents.

10 'Categorization of Scope 3 Emissions for Streamlined Enterprise Carbon Footprinting', Huang et al (2009).

11 Nationally Determined Contributions (NDCs) are the efforts each country in the Paris Agreement is taking to reduce their emissions and adapt to the impacts of climate change.

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- Build from breadth
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